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Historic tuff masonry in Naples: different approaches to its conservation

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Topic: T4.2 Materials and intervention techniques for vernacular architecture.

Abstract
Tuff, a sedimentary rock made of volcanic ash, is a traditional building material in the Campania region. Since its foundation Naples' architecture, whether monumental or vernacular, has been erected in tuff masonry and only the arrival of concrete and steel has meant its downfall. Due to the soft nature of tuff, traditionally the building material was designed to be covered by plaster and very few and monumental architectures, by selecting and sculpting to the purpose the rock, were designed to be fair-faced. In years the exposition to natural and artificial degradation agents has brought a wide variety of deterioration phenomena both on the fair-faced tuff masonry and the ones that had lost plaster. In approaching the restoration of these architectures, the conservator is faced with a challenging task. This is due to the difficulty of balancing the pursue of minimum intervention and authenticity respect, the conservation of the historic consolidated image of the architecture and the necessity of using the best restoration techniques that guarantee the highest conservation of the material in future years, with particular regard to bio-compatible and sustainable materials both for operators and the environment. By analyzing the restoration of various architectures, both archaeological and modern, the paper address this difficult task and the different decisions made by the conservators in relation to the monuments' nature, identity, history and status of conservation. The paper is based on a multidisciplinary approach due to the contribution of the expertise of an architect, a restorer and an archaeologist.

Keywords: *tuff; conservation; architectural heritage; traditional building techniques.*

1.Introduction: tuff and its traditional use in Naples

Since its first settlement, the use of Neapolitan yellow tuff as a building material has been a constant of Neapolitan architecture. Among the many volcanic stones characteristic of the area, both its large diffusion and the ease of its manufacturing has made yellow tuff the most used building material throughout the millennial history of Naples. The characteristics related to its use may be summarised in the following points. The widespread availability of the material in the Bay of Naples. It originates from the large volcanic eruption that more than 15000 years ago interested the whole area defined today as Campi Flegrei. The debris traveled a great distance from the eruptive centre up to the city of Naples and to the *Piana Campana* (Deino, 2004). The consequent affordability of processing. The economy of manufacturing is in fact due to its direct availability. In several contributions it is underlined that the stone was often quarried directly from the subsoil of the building area, so that the costs connected to transport were reduced

and the "emptied" space was then reused as a deposit or cistern (Fiengo, 1998; Fiengo, 2008). This practice was so rooted and common and the dense network of caves under the city was so widespread that in 1781, aware of the potential danger, King Ferdinand IV issued an edict to forbid digging within inhabited areas and along public roads (Sottosuolo di Napoli, 1967). Its good petrophysical and mechanical characteristics. This is the reason of its easy workability, closely related to the heterogeneous composition, for the description of which we refer to specific scientific contributions (De Gennaro, 2013). This feature determines its lightness, malleability to cutting tools and chisels, but also its porosity and volumetric response to thermal changes. Over the centuries tuff has been mostly used as a structural material, plastered on both sides, but sometimes, in buildings of particular significance, the stone was selected and cut with special care in order to be left exposed. The cases like these are few and mostly date back to the Angevin period which have left us majestic architectures both religious and civil (Santa Chiara Church, San Giovanni a Carbonara Church, the Castle of Sant'Elmo, Castle Nuovo, to name a few). The diffusion of piperno in the Aragonese period, a gray volcanic stone much more resistant than tuff, has led to the progressive abandonment of the exposed tuff in monumental architecture in favour of piperno facades, like Palazzo Gravina, Palazzo Sanseverino or the Church of Monteoliveto, and later on to plaster, used to create neat surfaces or painted in order to imitate other building materials like marble or clay (Fiengo, Guerriero, 1998).

1.1. Forms of degradation and intervention issues

Because of its heterogeneous composition, tuff stone is exposed to various forms of degradation, both natural and anthropogenic. Most of them have been indexed through a standardised lexicon (first NorMaL 1/88, now UNI 11182/2006) that has thus provided a shared nomenclature of the most common forms of deterioration. In the case of historical buildings and especially for the stones preserved *facciavista* (fair-faced), most degradation phenomena are caused by the decohesion of the composing elements (the separation of cements, of single crystals, of pumice) due to the deposit of acid substances in the atmosphere resulting from pollution, often associated with complex thermohygrometric conditions, and by the formation of efflorescence and biodeterogenic phenomena.

The study is based on the work of the authors on numerous Neapolitan conservation works on historical buildings dating back to a very long period of time, from the Greek age until the nineteenth century, characterised by the use of tuff both as a building stone and as a finishing and decorative element. It has provided the authors the opportunity to monitorate and compare the most common forms of degradation and, considering the issues of architectural conservation, to choose the most appropriate conservative practices and methodologies in each case. Of course, the types of degradation change radically depending firstly on the quality of the stone, and secondly on whether tuff is protected or not by *arriccio*, plaster or fine stuff. With regard to conservation status, the challenges that often arise for the operators are basically related to these fundamental themes: sustainability of the removal operations and the delay of the biodeterogenic processes; cortical and depth consolidation of the stone; integration of small and large gaps; final protection of the surfaces, especially in relation to the masonry and the building aesthetic. For this reason the age and the use of the buildings are fundamental.

2. Case studies

2.1 Case 1: the remains of a Roman villa in Marianella. Tuff as *reticulatum*

2.1.1 The site and conservation issues

The remains known as the "villa of Marianella" originally belonged to a farm dating from the I century A.D. and frequented until the early Middle Ages (*L'insediamento agricolo* 1987).

The ancient structures were discovered accidentally, during public works for the building of a road, in the mid-eighties. The archaeological excavations were carried out in 1986 and 1987 by the Centre Jean Bérard, with the scientific direction of the Neapolitan Superintendency. The ancient walls were partially restored. The farm had a squared plan, with sides of about 30 m. The rooms were disposed on the three sides of a central courtyard, probably columned. The fourth side of the courtyard was closed by a wall. The walls show a core in *opus coementicium*, a mixture of irregular pieces of tuff and cement mortar made with pozzolan and sand. The external facings are in *opus reticulatum*, made with pyramidal blocks with a squared base (*cubilia*) left *facciavista*, that formed a kind of lattice ("*reticulum"*) with a 45° inclination. This technique, as widely known, is typical of Roman architecture between the I century B.C. and the I century A.D. in Central and South-Central Italy (Adam, 1998).

Facings in *opus reticulatum* were very often covered by plaster, but sometimes they were probably left to the sight: it is proved by some walls with blocks made of stones of different color – tuff, limestone, basalt – that gave life to decorative patterns, sometimes even letters (Adam 1988). Due to the rural function of the Marianella "*villa*", the facings in *opus reticulatum* are quite rough; the blocks are of large size, measuring about 10 cm, and the joints are very irregular. The archaeological site has been left for many years with little or no maintenance: in the last year the Superintendency has begun a project, in order to re-discover the ancient walls, covered by thick vegetation; in some points the ancient *cubilia* had collapsed. The aim of the project is to create a green area in the disadvantaged neighborhood of Marianella, in which the presence of a historical testimony could play an important social role.

Fig. 1. Roman villa in Marianella (Bosso, 2022).

2.1.2 Intervention techniques

Opus coementicium is a natural place for the growth of plants with deep roots and also for bio deterioration. The walls therefore presented widespread forms of degradation, typical of outdoor masonries, in contact with the ground, not covered and with a very high relative humidity. In summary, the following were found: biodeterogenic attacks, decohesion of the bedding layers, disintegration of the joints between tuff blocks, differential degradation. The forms of degradation have posed some typical problems of tuff conservation: the techniques for the inhibition of the processes of biodeterioration, the problem of the aggregation of decohesion, the great dilemma regarding the integration of big gaps and the wall ridges. For conservation purposes, the interventions focused on identifying the best materials to slow down the bio-deterioration processes and consolidate the bedded layers, therefore restoring the original texture of the walls, conserving them and facilitating the comprehension of the site. The results of other restoration actions carried out on the territory prove that the use of compatible and biocompatible materials is the right path for the technical and economic sustainability of the restoring intervention. However, comparative experiences at other sites suggested the use of traditional materials for chemical weeding, in reason of the proximity to the ground and due to thermo-hygrometric conditions, and the

reconstitution of joints between the *cubilia* to inhibit plant growth. As for the mortars, they must be as close as possible to the original materials in order to accompany the movements of tuff to the thermo-hygrometric variations, a mechanical property mentioned above. In this regard the properties to be checked are the mechanical ones: adherence to the support; transpirability to prevent the crystallization of soluble salts that, as previously mentioned, are an important part of the damage; permeability to vapour to counteract the poor drainage of water of the original stone. Numerous tests have shown that hydraulic mortars without cements and slaked lime are suitable materials for interventions: in this case, the mixture of the mortar was made from the earth of Terzigno, a town in Campania whose proximity to Mount Vesuvius determines the heterogeneity of the earthy sediments, compatible for mechanical and aesthetic properties. As for the very important issue of the integration of large gaps resulting from the collapse of the wall due to the deep rooting of weeds, the choice was suggested by the type of degradation. The collapsed parts, in fact, threatened the stability of the entire walls and all the collapsed tuff stones were found on site and therefore could be re-collocated. It was therefore decided in this case to adopt a sort of anastylosis by moving back the integration carried out with the original stones by 0.50 cm. In modern conservation methods tuff facing in *opus reticulatum* is obviously left to the sight when it isn't covered by the original ancient plaster. This obligates the conservator to preserve the surface with a protection layer: in this case a protective fluorinated copolymer was chosen.

2.2. Case 2: the Church of San Giovanni a Carbonara. Conservation of XIV Century facciavista tuff

2.2.1 Conservative issues

The church of San Giovanni a Carbonara is one of the most relevant basilica of the city. Built outside of the fortified city starting from 1343, it still represents the Angevin and renaissance Neapolitan art at its best (Filangieri di Candida, A. 1924; Pane, R. 1975-77). In its long history the religious complex underwent numerous transformations and additions which progressively enriched the monumental architecture. Sadly the last century deeply affected its conservation, firstly by the violent bombing of the church in 1943, during World War II, which affected both the roof and the facades, the first shuttered beyond recovery, the others deeply compromised (ACS, ACC, MFAA, Campania). It was therefore necessary to carry out important works of restoration, rebuilding parts of the monumental tuff and piperno masonry characteristic of the architecture. Despite other important conservation works carried out in the late sixties and in the nineties in consequence of the terrible earthquake of 1980 (ASN, SGC), the lack of maintenance, the obsolescence of some of the intervention and the exposure to aggressive deterioration factors (heavy air pollution, strong winds, direct sun, rising dump) deeply affected its state of conservation, demanding a new and vast restoration project. The works, directed by the local Provveditorato, were closely followed by the Superintendency, which acknowledged the difficult issue of conserving the characteristic and massive *facciavista* walls, by now punctuated with numerous replaced blocks and altered by a great variety of degradation phenomena, such as biodeterioration, efflorescence and exfoliation of cortical layers. It was therefore decided to carry out numerous samples in order to identify the best ones.

2.2.2 Intervention techniques

The *facciavista* tuff was affected by biodeterioration process caused by the proliferation of molds and lichens due to the insistence on the bare stone of wastewater and the consequent growth of soluble salts, with severe decohesion of the constituent elements visible in the advanced exfoliation of the stone. In this case also, taking into account bio-restoration (Orial, 1993) and its development (Tiano, 2005) that technically accompanies the

choice of minimum intervention, we have tried to operate with the utmost respect for material compatibility by first testing sustainable materials, such as essential oils, for the removal of biodegrade (Kakhael, 2019).

Fig. 2. San Giovanni a Carbonara (Russo Krauss, 2021).

Specifically, thyme oil was tested. The feasibility test gave good results, however due to the vastness and penetration of the infestation it was decided to work with quaternary ammonium salts to ensure a longer duration over time. The consolidation phase, on the other hand, was faced with the sustainable and compatible method of limewater, which gave optimal results by managing to reaggregate the surface and compact the exfoliation even in an advanced state (Fig. 2). As regards the integration phase, in this case, with existing rectangular ashlars, but strongly compromised, it was decided to integrate only the missing cortical parts with sub-level grouting, performed with slaked lime, tuff aggregates and very fine-grained brick (eco-mortar) avoiding the replacement of whole stones. The long experience in the consolidation of silicate stones has led, in the Italian and Neapolitan territory, to an increasingly conscious use of structured materials with a greater penetration capacity (Albini, 2012; Hosseini, 2018). For this reason and to ensure the longest possible life for the consolidation and integration operations, over the years numerous materials have been tested on exposed stones to replace ethyl silicate. This material has in fact been used for a long time to consolidate and protect, but gives the stone an unnatural refraction as it is vaguely saturated. In general, the monitoring of the use of other types of inorganic consolidants has shown that solvent-based polymeric re-aggregants causes serious complications on porous stones as well (Delgado, 2022). In this case, the stone was protected with an aqueous dispersion of nanometer-sized colloidal silica.

Fig. 3. San Giovanni a Carbonara (Russo Krauss, 2021).

2.2.3 Architectural choices

The beauty of the facades of the church of San Giovanni in Carbonara lay in the massive facciavista walls, mainly in tuff, but also in piperno. Conceived to be left exposed, the blocks are way larger than in traditional local architecture. They are neatly carved and with very little mortar in the joints. Except for the marble portals there are no decorations and everything is left to the texture of the masonry. It is therefore with particular care that the issue of stone conservation had to be addressed. Almost every block, both original or of replacement, presented a deterioration phenomenon in a more or less advanced stage (Fig. 3). Consolidating and protecting the stones, filling the biggest gaps, which represented both an aesthetic issue and a conservation issue, maintaining the distinction of the intervention while restoring the homogeneity of the wall surface was a difficult task. The choice has been that of the minimum intervention, accepting the aesthetic differences of the blocks, both in their colour and in their texture, consolidating the material and filling the biggest gaps with sub-level grouting. Instead of matching the colour of the mortar in each *lacuna* to the colour of the nearby stone a much less mimetic intervention was chosen. All the *lacune*

were treated as one and a single colour was selected to accompany and define this new historic phase of the monument (Fig. 4).

Fig. 4. San Giovanni a Carbonara after the work of conservation (Russo Krauss, 2022).

2.3 Case 3: archeological site of Pausilypon. Tuff as a preparatory layer for frescoes

2.3.1 Conservative issues

On the top of the promontory of Posillipo, in a natural landscape of absolute beauty there are the archeological remains of the Roman villa of Publio Vedio Pollione, one of the richest men of the Republic, who chose this magnificent scenario for its *otium* Villa. Upon his death the estate was given to Augustus, becoming an imperial villa. It was therefore transformed and expanded according to the needs of the later emperors. Due to collapses and instabilities both in its acces by land and sea (the 700m long Grotta di Seiano under the Posillipo hill and the berths of Gaiola) in the Early Medieval Period the site was abandoned. Starting from the XIII century the area was repopulated and mainly used as farms and orchards while the archeological remains were sacked by local noblemen to enrich their villas (Varriale, 2015). The first excavations were carried out in 1820 by the architect Guglielmo Bechi. Twenty years later the access to the Grotta di Seiano was rediscovered and king Ferdinand II ordered its recovery. From now on the site was both excavated with continuity, although with no method or regard, and inhabited by local rich men (Günther, 1913). In the XX century no excavation was executed and the site was abandoned until in 1988 the Archeological Superintendency progressively acquired and excavated the site creating the Parco archeologico del Pausilypon. In its many hectares lay visible numerous parts of the Villa, while others still await to be excavated. As the owner of the site the Superintendency is in charge of its conservation, which constitutes a challenge due to the scale of the archeological remains and to the constant exposure to strong external agents.

2.3.2 Intervention techniques

The archaeological site of Pausilypon is an excellent site for the monitoring of the outcomeson tuff of the conservation techniques, which continued for years and have had several processes of deterioration. This evidence proved conclusively that the policy of adopting materials in mechanical and chemical-physical contrast with natural stones has not achieved results suitable for proper conservation of the surfaces over time. The site presents, in fact, some types of interventions carried out previously with more invasive materials. These include cortical consolidation, with the use of synthetic no-film-forming resins; the integration of gaps with the use of cement mortars. Taking into account the peculiar conditions of the site, heavily exposed to weathering, especially direct sunlight, marine aerosol and strong winds, the conservation project, currently under study, will be strongly oriented to the search of sustainable practices that ensure maintainability and durability through the use of biocompatible materials. The conservation project will be informed by an approach of environmental and economic sustainability: all practices will be made from biocompatible and recycled materials through the extensive use of waste from other processes. To verify this approach a first phase of feasibility testing was done for the consolidation, integration and protection interventions. With regard to consolidation, the challenge is the defense against the stress to which tuff is subjected mainly because of the strong winds and the insistence of the marine aerosol. This is because

part of the walls are exposed to the sea and in any case the entire site is located on a high promontory. In this case also the feasibility tests had nanostructured materials (i.e. nanolimes) that penetrating in depth were able to saturate the material more effectively re-aggregating the stone and leaving intact the porous aspect typical of tuff. In the peculiar case of the Pausilypon's tuff facings, a great majority of them receive the layers that form the fresco. For this reason it will be necessary to make some decisive choices that are related to the protection of the ancient walls too exposed to sun and wind through structures completely different from those used in the past. In fact, the current heavy archeological coverings rest upon the archeological remains, with rods deep in the masonry and, although the wall ridges were increased by great portions, they anchor both in ancient and restoration masonries. To this end the project aims to replace the outdated coverings and install new ones in the area that have proved more sensitive to weathering.

Fig. 5. Pausilypon archeological park (Russo Krauss, 2021).

The slowing down of biodeterogenic degradation in the case of an archaeological park like Pausilypon, characterised by great biodiversity thanks to the extension of the luxuriant Mediterranean macchia, is a great challenge that imposes a choice of materials that take into account the interactions of biocides with the vegetation that surrounds and sometimes encloses the site. Therefore, the choices will be oriented to medicinal plants or to enzymatic cleaning, which, in any case, constitutes an interesting alternative to traditional chemical products, which, besides involving treatments often aggressive for the substrate, are poorly selective. Moreover, according to some studies on the control of biological degradation, enzymes are a valid alternative to traditional biocidal products, reducing completely the toxicological risk resulting from the use of such substances (Goldin, 2017). The issue of stone integration with tuff masonry is complicated by the fact that since masonry houses most frescoes, it is necessary to study the solutions of continuity between it and the painted plaster when the space is lacunose. The choices of modern conservation impose not to reconstitute the fragmented plaster on the tuff left exposed. The edges of these "painted islands" are often treated with cement mortars and it is obvious that because of their absolute inconsistency with the movements and the natural porosity of tuff, over time they will come off. In this case also it is necessary to apply a “homeopathic” principle using materials as similar as possible to the original, in order to accompany its physical and mechanical characteristics.

3. Conclusions

Due to its traditional use in every century and in every type of architecture, the challenges related to the conservation of tuff masonry are intrinsic in the work of architectural conservation in Naples. Despite its apparent constant features, however, every building raises a different conservation issue. Different approaches must be taken into account in order to identify the right intervention. Firstly the question of the original design of the architecture must be considered. Is it a vernacular or a monumental architecture? Is the masonry of prestige or not? Was it covered in plaster or not? Then the story of the architecture must be studied in order to individuate its different phases, alterations, changes, all up to the more recent history of restorations, understanding which approaches and which techniques were used over different years (for examples in presence of big gaps: sometimes they were filled with tuff and sometimes with bricks). Then the conservator must acknowledge the historicised image of the monument and set the goals of its intervention. Only at this point is it possible to ponder the different techniques, identify

the feasibility tests to carry out and then, by comparing the results, select the right one. For instance in the case of the XVI century convent of Santa Caterina a Formiello (Furnari 1996), which was converted in a wool factory in XIX century and nowadays is a condominium that has long lost most of its plaster from the walls, the issue of the conservation of its facades is particularly challenging and the instance of the conservation of the historicised image of the facciavista walls collides with the needs of the material. In fact the little tuff ashlars, the wide and irregular joints, the little wall thickness, the wide variety of alteration phenomena, mostly erosion, all demand the application of a protective layer.

It can be concluded that no easy and codified solution can be given to the conservation operators in the case of tuff masonry, which must be approached case by case, considering and balancing different instances with the most different conservation techniques available today.

References

Archivio Centrale dello Stato, Allied Control Commission, Monument Fine Arts & Archives, Campania series (ACS, ACC, MFAA, Campania), scaff. 80, bob. 148D/1D.

Archive of Soprintendenza Archeologia Belle Arti e Paesaggio di Napoli, church of San Giovanni a Carbonara (ASN, SGC).

Adam, J.-P. (1998), *La construction romaine. Materiaux et techniques,* Paris 1984 = *L'arte di costruire presso i romani. Materiali e tecniche*.

Albini, R., Bettucci, O., Borrelli, E., Macchia, A., Campanella, L., & Mazzei, B (2012). *Il consolidamento con idrossido di calce nano strutturata in ambiente ipogeo*. In Lo stato dell'arte 10, X Nazional IGIIC Congress.

Bosso, R., (2020). *"Al mesto orror profondo". Le tombe a camera ellenistiche della Sanità, scoperte e ricerche nei secoli XVIII e XIX*, in Bosso R., Di Franco L., Di Martino G., Foresta S., Perrella R. (eds), Archeologie borboniche. La ricerca sull'antico a Capri e nelle province di Napoli e Terra di Lavoro, Conference proceedings (Capri, 11-12 ottobre 2019).

De Gennaro, M., Calcaterra, D., Langella, A. (2013). *Le pietre storiche della Campania. Dall'oblio alla riscoperta*. (Ed.) Luciano Editore.

Deino, A.L., Orsi, G., Piochi, M., de Vita, S., (2004). *The age of the Neapolitan Yellow Tuff caldera-forming eruption (Campi Flegrei caldera – Italy) assessed by 40Ar/39 Ardating method*. J Volcanol Geoth Res 133, 157–170.

Delgado Rodrigues, J. (2022). *Stone Consolidation. Between Science and Practice*. In Conserving Stone Heritage (pp. 101-135). Springer.

Fiengo, G., Guerriero, L. (1998). *Murature tradizionali napoletane. Cronologie dei paramenti tra il XVI ed il XIX secolo*. (Ed.) Arte Tipografica.

Fiengo, G., Guerriero, L. (2008). *Atlante delle tecniche costruttive tradizionali. Napoli, Terra di Lavoro (XVI-XIX). Vol I.* (Ed.) Arte Tipografica.

Filangieri di Candida, A., (1924). *La chiesa e il monastero di San Giovanni a Carbonara,* Lubrano.

Furnari M. (1996) (ed). *Santa Caterina a Formello. Vicende di un'insula napoletana*, Electa.

Goldin, E. (2017). *Confronto tra Nasier ei Biocidi tradizionali per la biopulitura di opere contemporanee e moderne*.

Günther, R. T. (1913) *Pausilypon: the imperial villa near Naples*.

Hosseini, M., &Karapanagiotis, I. (Eds.). (2018). *Advanced materials for the conservation of stone*. Cham, Switzerland: Springer.

Il sottosuolo di Napoli. Relazione della Commissione di Studio. Comune di Napoli. 1967.

Istituto Centrale del Restauro (1988), *Raccomandazioni Normal n. 1/88. Alterazioni macroscopiche dei materiali lapidei*. Lessico, Roma 1988

M. A. Kakahel, F. Wu, J. D. Gu, H. Feng, K. Shah, and W. Wang (2019). *Controlling biodeterioration of cultural heritage objects with biocides: A review*. Int. Biodeterior. Biodegrad., vol. 143, no. July, p. 104721 doi: 10.1016/j.ibiod.2019.104721.

L'insediamento agricolo di Marianella (1987). In *Archeologia e trasformazione urbana. Notiziario 12,* Catalogo della mostra a cura dell'Ufficio tecnico del Sindaco di Napoli.

Orial, G. Castanier, S. Le Metayer, G., Loubiere, J.-F. (1993). *The biomineralization: a new process to protect calcareous stone; applied to historic monuments.* In Biodeterioration of cultural property 2: proceedings of the 2nd International Conference on Biodeterioration of Cultural Property: October 5-8, 1992, held at Pacifico Yokohama (Pacific Convention Plaza Yokohama).

Pane, R. (1975-77). *Il Rinascimento nell'Italia meridionale,* Edizioni di Comunità.

Tiano, P., Cantisani, E., Sutherland, I., & Paget, J. M. (2005). *Biomediated reinforcement of weathered calcareous stones*. Journal of Cultural Heritage, 7(1).

Varriale, I. (2015), *Pausilypon tra otium e potere imperiale*. In Bollettino dell'Istituto Archeologico Germanico, Sezione Romana, n. 121.