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The paving of ancient paths, testimony of an ancient culture: recovery of a traditional route in Genoa (Liguria, Italy)

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
One of the characteristic features of villages and towns is the paths that run through them. These often bear the traces of an ancient culture, which is manifested both in the materials used and in the construction and maintenance practices implemented in different territories. Rediscovering these traces is essential to understanding and safeguarding this significant component of the material history, which is often distorted or obliterated during urban interventions, owing to lack of knowledge. This paper presents a project for the enhancement and recovery of one of the traditional routes that run through Genoa from the coast to the mountains. These so-called "crêuze" are frequently made up of a central strip of bricks flanked by cobble-stones. In rainy weather, these bricks facilitate the passage of people, while proper drainage is ensured by the cambered profile and the cobble-stone side channels, which slow down the flow of water. To maximise the durability of these paths, both the construction techniques and the wise choice of materials and their processing were fundamental. Thus, this research also aims to ascertain the durability of the different materials used through their compositional and physical analysis. Awareness of the material culture that enabled such a high level of expertise to be achieved in the construction of these particular paths constitutes a valuable resource for correct interventions. The project involves private and public partners and also provides an opportunity to protect the territory through the proper management of water. In the past, water management was well organized. However, the various urban stratifications have given rise to evident problems.

Keywords: *paving, crêuze, brick, cobble-stones, material culture.*

1. Introduction

The image of villages and towns is characterized not only by their architecture, but also by their paved footpaths. These have long been neglected, as they are often regarded as being of little relevance to the local building culture. In reality, however, they constitute an important element in the perception of the architectural quality of the urban landscape, as was recognised by the European Landscape Convention, signed in Florence on October 20, 2000. Streets and paths bear the traces of an ancient culture, which is manifested by the materials used and the practices of construction and maintenance, which are different in each territory (Fig.1 and Fig. 2) (Musso, 1999; Bosia et al., 2006; Conforti et al., 2006; Decri & Volpato, 2006; Fatta et al., 2006; Gabbaria Mistrangelo, 2006; Galli et al., 2006; Laviscio, 2006; Mannoni et al., 2006). Unfortunately, this significant component of our

material culture is often distorted or obliterated during urban interventions, owing to lack of knowledge, high maintenance costs and the needs of vehicular traffic (Ambrogio et al., 2006; Branduini, 2006; Cazzani & Sangiorgio, 2006; Giambruno & Simonelli, 2006)

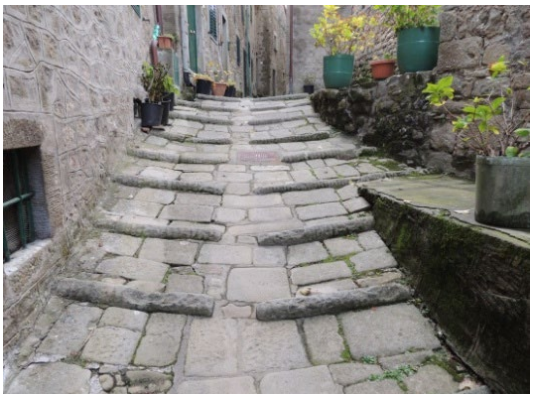

Fig. 1. Traditional sandstone paving in the village of Stiappa (Pistoia Apennines-Tuscany) (credits Fabio Fratini).

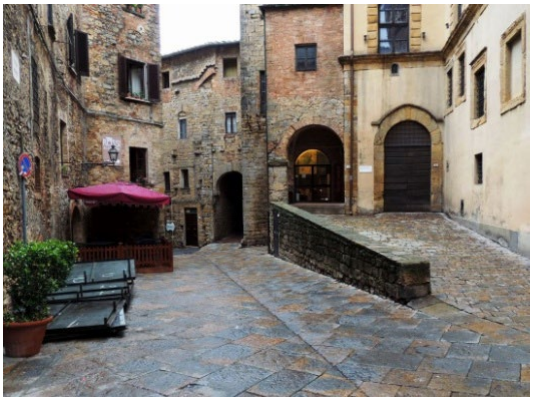

Fig. 2. Traditional paving made of Pietra Panchina in Volterra (Tuscany) (Source: Fabio Fratini).

This paper deals with a project for the study, enhancement and recovery of one of the traditional paths that run through Genoa and its territory, from the coast to the mountains. These so-called "*crêuze*" are made up of cobble-stones and a central or lateral strip of bricks laid by side (Fig. 3). The brick strip (called *pagliolo*), which is about one meter wide, facilitates the passage of people in rainy weather, while the cobble-stones made it safe for pack animals to walk. Drainage is facilitated by the cambered surface, while the cobble-stone side channels slow down the flow of water (Fig. 4).

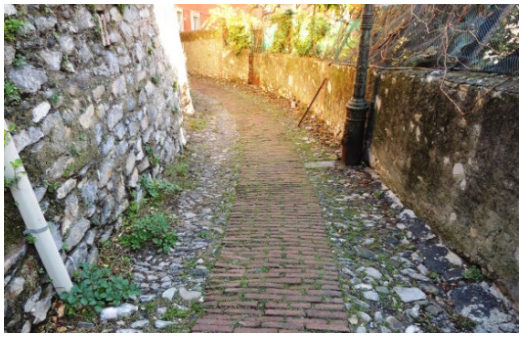

Fig.3. Genoa, *crêuza* with lateral cobble-stones and central brick strip (Source: Fratini)

The water flows into appropriately positioned sandstone storm drains; these have rectangular apertures (from three to five) or are made up of several elements called “cords” (from two to six) (Fig. 5).

Fig. 4. Cambered profile of the central brick strip and lateral cobble-stone channel (Source: Fratini).

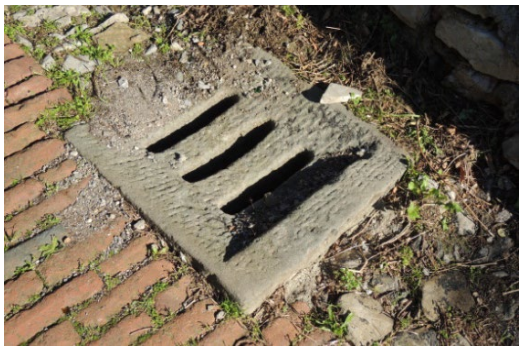

Fig.5. Sandstone storm drain (Source: Fabio Fratini).

To maximise the durability of these paths, the wise choice of materials and their processing, in addition to the construction techniques used, were fundamental. For example, the ancient bricks have proved to be much more resistant than more recent bricks, which sometimes favour the formation of a biological patina and often display little resistance to freeze-thaw

phenomena. Through the analysis of materials, this research also aims to determine the reasons for this different behaviour. Indeed, knowing how past builders were able to construct impressive works so skilfully can constitute a valuable resource for correct intervention. This project involves various partners, such as local associations, universities, municipalities etc. It also provides an opportunity to address the protection of the territory through the correct management of water. Indeed, in the past, water management was better organized than in later periods of urbanisation, which has given rise to evident problems.

2. The project "*Ultima crêuza*" (the last *crêuza*)

The project "*Ultima creuza*" was launched in 2015 by the Faculty of Architecture of the University of Genoa, the municipality of Genoa, the ISCUM (Institute of History of Material Culture) and some associations active in the territory, the aim being to promote and preserve a particular historical path in Genoa. Interest in this path was aroused by an epigraph in the square in front of the Convent of Santa Barnaba, which recounts the fate of the inmates who were locked up in the Prisons of the Doge's Palace. Having been sentenced to death, these prisoners were led along the *crêuze* up to the Convent of the Capuchin Friars, where they underwent "last rites" before being taken for execution to the Castellaccio Fort, on the heights of Genoa. Apart from this dramatic implication, the path provides a panorama over the city and encounters various sites of historical interest. Indeed, the intention was to raise awareness of the city and its history, not only in the area of the city's historical centre, but also outside the medieval walls, on the hills and towards the hinterland.

2.1 Objectives of the first part of the project

This project has several objectives. The first part of the project aims to: a) reveal the scenic beauty of this part of Genoa; b) observe the historical stratification of the city from the Middle Ages to its 19th century expansion and subsequent development in the 1960s; c) promote "mobile", "ecological" and "low-cost" tourism. Moreover, from the upper stretch of the path, it will be possible to observe endemic species of fauna and flora. Indeed, the idea is to promote an active type of tourism. Moreover, given that the path will be exclusively pedestrian and that transport to the starting point situated in the upper part will be by a public electric bus, this will be ecological tourism. The sustainability of the proposal is also considered important by minimizing the affixing of indications and panels but at the same time seeking effective communication.

2.1.1 Elements of intervention in part 1 of the project

Although the path is largely practicable and well defined, the following interventions will be necessary: a) signs will be affixed (involvement of urban design experts) in order to strengthen the user's perception of the entire path; b) along the way, the landscape, environmental and historical-artistic beauties will be explained. This information may be of a traditional type (signs) and innovative ("QR codes" applied at strategic points). In this part of the project, it is essential to involve the following partners: local associations, local administrations, designers and IT experts in communication.

2.2 Objectives of part 2 of the project

The second part of the project has the following objectives: a) to recognize the aspects of the material culture that allowed the creation of the *crêuze* (installation of paving, specific work on surfaces) and in the subsoil (canalizations.); b) according to the data obtained in the previous point, to draw up guidelines for conservation/recovery interventions; c) to restore the correct flow and drainage of water at the sides of the path. This second part of the project must also identify the areas of intervention by carefully designing the construction sites and, if necessary, implementing "micro-construction sites". This second part of the project will involve

local associations, ISCUM (Institute of the History of Material Culture), the University of Genoa, SSBAP (School of Specialization in Architectural and Landscape Heritage) of the University of Genoa, and Geomorfolab, ISCP-CNR (Institute of Heritage Sciences) of Florence. The objectives of this second part of the project are to highlight problems and propose solutions that can also be replicated in the other paths (*crêuze*) in the city.

2.3 Problems and opportunities of the project

"*Ultima Crêuza*" also offers an opportunity to address a much wider context that concerns the monitoring and protection of the territory by implementing correct water management, which takes into account the conformation of the land. This aspect was clearly borne in mind by those who constructed the ancient paths, but in the urban stratifications that have ensued in the last two centuries, problems have arisen. Indeed,

the inadequate regulation of water has been implicated in the environmental disasters of recent years (in the catchment area where the *crêuza* is located there have been six cases of major hydrogeological instability in the last 15 years). Specifically, it will be necessary to distinguish: a) the upper portion of the path (from Castellaccio Fort to the district of Santa Barnaba) from b) the lower portion, from the district of Santa Barnaba to *Porto Antico.* Indeed, the problems are different: a) in the upper part, disruptions have been caused by abandonment, the growth of weed vegetation, and localized collapses of the side walls due to the activities of wild boar; b) in the lower part, the progressive expansion of the city has intercepted and channelled streams, interrupted historical communication routes without controlling surface waters, and created retaining walls of considerable height without adequate water regulation. Many smaller interventions have also been carried out, partly to install utility systems (telecommunication cables, gas pipelines, water conduits, etc.) and partly in unsuccessful attempts to repair disconnected parts of the paving (Fig. 6). All too often, these interventions change the slopes of the path, impairing the correct flow of surface water.

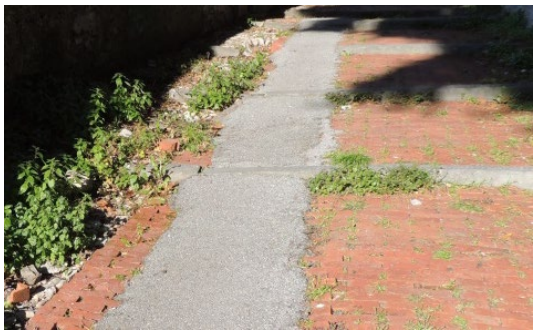

Fig.6 The installation of water systems has damaged the paving (Source: Fratini).

In some sections of the path, it is therefore necessary to carefully redesign the water disposal system; in most sections, however, the most pressing need is to implement constant maintenance. If performed constantly, this maintenance can even be carried out by volunteers working under the guidance of only a few specific instructions (e.g. constant cleaning of drainage channels, repositioning of unstable elements) (Mannoni, 2006). This type of maintenance could be carried out by the inhabitants of the buildings adjacent to the lower portion of the *crêuza.*

3. An opportunity to know, a chance to preserve

Beyond the specific case, the importance of this study is that it will highlight the most common problems facing paths of this type: i.e., the relationships between the materials used, the know-how required for their installation, the wise insertion of these paths in the territory, the correct disposal of water and the need for constant observation and maintenance. Elements of innovation of the project "***Ultima Crêuza***" are therefore: a) involvement of the population; b) continuous monitoring at low cost; c) small-scale action, restoration workshops; d) interaction with the users of the path; e) knowledge and monitoring for preventive maintenance.

3.1 The bricks of the *crêuze*

As mentioned above, one of the particular aspects of the *crêuze* is the bricks, which are most frequently placed in the centre of the path. In the past, the bricks used for such purposes were often called "paving bricks" and had specific prices (Pittaluga, 2001); very detailed descriptions can be found in the manuals (Maura, 1998). In the documents, specific categories of bricks have different denominations, each with a different price (Pittaluga, 2001). This suggests that many aspects of the ancient construction skills still elude us today. In the previous interventions that these paths have undergone, the bricks have sometimes been replaced, with unsatisfactory results in terms of aesthetics, functionality and durability. With regard to aesthetics, new bricks, which sometimes have an extremely smooth surface, tend to look out of place. With regard to functionality, when it rains or humidity is high, new smooth and fine-grained bricks tend to maintain a liquid film on the surface; over time, this favours the growth of a slippery biological patina (Fig. 7).

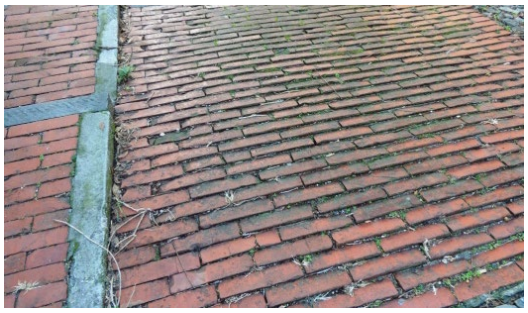

Fig.7. New, smooth bricks on which a thin biological patina is forming (Source: Fratini).

Sample	technology	Grain size	P%	γs gr/cm^3	decay	Age* century	laying
C1 - Salita di S.Barnaba	new, extruded	fine	23	1.95	flaking	20th	correct slopes
C2- Salita di S. Barnaba	new, extruded	fine	30	1.83	biological patina	20th.	correct slopes
C3 - Salita di Porta Chiappe superiore	old, handmade,	coarse	25	1.93	unweathered	19th	correct slopes.
C4 - Salita di Porta Chiappe superiore	new, extruded	fine	20	2.01	unweathered:	20th	correct slopes
C5- salita di Porta Chiappe superiore	new, extruded	fine	21	2.00	unweathered	20th	incorrect slopes
C6 - salita di Porta Chiappe superiore	new, extruded	fine	31	1.84	biological patina	20th	incorrect slopes
C7- salita diPporta Chiappe superiore	new, extruded	fine	26	1.90	unweathered.	20th	correct slopes
C8 - salita di Porta Chiappe inferiore	old, handmade	coarse	14	2.18	slight decohesion	19th	correct slopes
C9 - Salita di Porta Chiappe inferiore	old, handmade, variegated	coarse	32	1.62	slight decohesion	17th	correct slopes
C10- Salita di Porta Chiappe inferiore	old, handmade, variegated	coarse	42	1,42	unweathered	17th	correct slopes
C11-Salita di Porta Chiappe inferiore	old, handmade	medium	20	1.92	unweathered	19th	correct slopes
C12- salita di Porta Chiappe inferiore	new, extruded, sand on surface	fine	32	1.73	biological patina	20th	correct slopes
C13 - salita di Porta Chiappe inferiore	old, handmade, variegated,	fine	27	1.72	unweathered	18-19th	correct slopes
C14 -salita di Porta Chiappe inferiore	new, handmade	medium	28	1.76	biological patina	20th	correct slopes

Table 1. Analysis of the samples according to technology, grain size, water accessible porosity (P%), bulk volume (γs), decay, mensiochronology dating (*) and laying.

Taking into account these considerations on the importance of the materials, their finish and

installation, an on-site check was conducted; this is briefly explained below (Table. 1). For each stretch of *crêuza* involved in the study, stratigraphic investigations were made in order to identify the different parts in their correct chronological sequence (Pittaluga, 2009a). In some cases, it was also possible to obtain information from indirect sources. Regarding the brick layer, mensiochronological analysis of the elements was also carried out (Pittaluga, 2009b). Macroscopic observations of the type of mix (colour, grain) and presence/absence of other surface features (incisions, scratches) were made. All this information was then related to the specific characteristics, such as porosity, of the material. These data were analysed with reference to macroscopic decay (chipping, cracks, disintegration, biological patinas, etc.). In order to obtain as many interpretative elements as possible, observations were also made on the laying of the paving (correct slope, cambered profile, good regulation and channelling of surface waters) and any "anti-slip" measures implemented. In selecting the pavement sections to be analysed, the environmental conditions (high humidity, low insolation) were also considered. Indeed, the purpose was to verify the durability of the materials in particularly extreme conditions. With regard to durability, new bricks sometimes have a greater tendency to splinter than old bricks, which, in some cases, tend to disintegrate (Fig. 8 and Fig. 9). Splintering is the consequence of the action of freeze/thaw cycles and particularly affects materials with a high number of capillary pores (0.1-1µm) in comparison with larger pores.

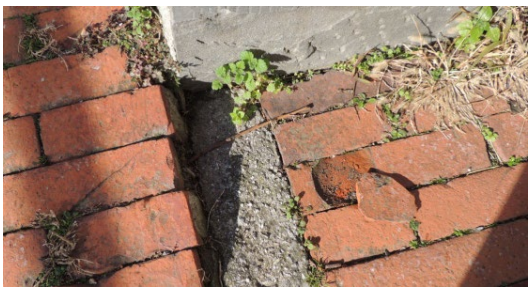

Fig.8. New bricks display chipping due to freeze-thaw phenomena (Source: Fratini).

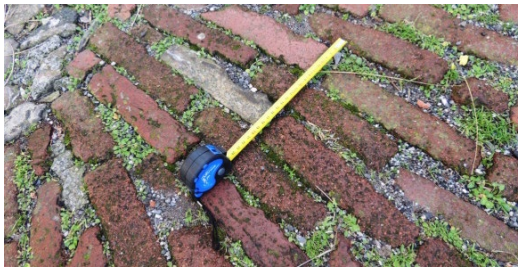

Fig.9. Old bricks with a rough appearance, with a slight tendency to disintegrate (Source: Fratini).

Thus, in this study, ancient bricks and bricks laid during various interventions carried out on the *crêuza* were sampled, in order to highlight the features of their composition that influence their behaviour. These materials were studied by means of the following methods: a) the mineralogical composition was determined through X-ray diffraction (X'Pert PRO diffractometer from PANalytical, equipped with an X'Celerator detector and HighScore software for the acquisition and interpretation of data according to the operative conditions: Cu Kα1= 1,545 Å radiation, 40 KV, 30 mA, 2Θ = 3-70°); b) determination of water-accessible porosity and bulk volume through the hydrostatic balance method; c) a petrographical study on thin sections, by means of optical microscopy under transmitted light to evaluate microstructural parameters, will be carried out in a further phase of the research.

With regard to the old bricks, all of which were hand-made, different types were observed: coarse-grained dark red with low porosity (14-20%) (C3, C8); coarse-grained, varicoloured with relatively high porosity (27-32%) (C9, C13); medium-grained, varicoloured with very high porosity (42%) (C10). This high porosity of the varicoloured bricks can be explained by the composition of the "clay" used to produce them. Indeed, it is a marly clay (with a high calcite content), as evidenced by the presence, in the fired material, of calcium silicates (gehlenite and diopside), as revealed by the diffractometric analysis. These minerals are formed above 800 °C, by reaction between the silica of the clay minerals and the calcium oxide resulting from the

dissociation of calcite. The dissociation of calcite occurs by loss of CO_2, with the formation of porosity (Fratini et al., 1993).

With regard to the new bricks, most of them are extruded (Table 1). Some are fine-grained with a smooth surface and medium porosity (20 to 26%) (C1, C3, C4, C5, C6, C7), some are fine-grained with sand on the surface (porosity of 30-35%) (C12), and some are medium-grained (porosity of 28-30%) (C2, C14). This first study on the bricks of this Genoese *crêuza* reveals the great variety present. Certainly, it is the ancient bricks, from the dark coarse-grained ones to the varicoloured ones, that arouse the greatest interest, as they really represent the territory. The petrographic study will also allow us to trace the origins of both types of brick, which differ markedly, just as the geology of the Genoese territory is extremely diverse. With regard to the replacement bricks used in recent interventions, we believe that the ones that yield the best results from the aesthetic, functional and durability points of view, are handmade bricks, which unfortunately are more expensive. Otherwise, bricks extruded with sand on the surface are also acceptable.

4. Conclusions

> Indeed, it is not too difficult to lay the sub-base by using only sand and gravel, without installing an electro-welded mesh to seal the support; nor is it difficult to obtain the bricks and stones. By contrast, it is no easy matter to acquire the optimum technique of juxtaposition of the various components, which must create such a force of cohesion that they cannot move (Mannoni et al., 2006, p. 252).

As seen in this research, traditional skills underpinned the choice of the most suitable bricks for the central strip, and of the particular laying technique to be adopted: cobbled, paved, bricks laid side-by-side etc. In the pre-industrial era, both urban paving and that of territorial roads required interventions over time. This was:

> not strictly maintenance which harmoniously updated the image of the city and territory as building techniques evolved. It was a dynamic of ordinary use and consumption that determined sedimentation processes of the various construction technologies connected to the progress of urban, architectural and economic evolution, and which, at the same time, guaranteed their current readability (Mannoni, 1994).

It is therefore increasingly necessary to recover this culture of construction. With respect to the problems of decay of historical itineraries, such as the ancient Genoese *crêuze*, two lines of action can be followed: 1) one that makes greater use of collaboration and participation (by associations, individual citizens, users of the itinerary) (Pittaluga, Fratini, 2019). This line of action is based more on the timely reporting of any decay phenomena, on the establishment of restoration teaching sites and on the preparation of guidelines that allow small, targeted and timely repairs to be carried out autonomously; 2) scientific investigations of the performance of the different materials, and their potential and compatibility according to their composition and structure, in order to carry out interventions of maintenance and restoration that do not upset the delicate balance of these extraordinary road constructions. The present study may be seen as a first contribution to this long journey of discovery.

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