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Even the details make a difference: problems and solutions regarding interventions on historic masonry cornices

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Abstract. The brick masonry envelope of a historic building may host several protruding elements creating graceful chiaroscuro effects. Windows frames and cornices made of fair-faced bricks protect façades and windows from rainwater and sunlight. They all have a very precise functional role and they have to face and manage natural agents during all their lifespan.
Rainwater, fog and snow can bring moisture inward in the wall and favour mould and biological growth. Large overhanging elements can cause problems of rotational stability, which are solved through the affixing of sturdy corbels. Brick masonry forming these elements can be affected by ageing and malfunction, but some design or construction inaccuracies can accelerate these phenomena.
The reduction, simplification or the disappearance of such decorated projecting elements in contemporary architecture certainly did not reduce these types of damage.
Since knowledge of construction technique and constant correct maintenance works are the natural methodology for the conservation of this architectural element, errors in diagnoses led to incorrect consolidation and maintenance procedures that may lead to unexpected consequences and be the cause of increased surface degradation of the architectural heritage.
The aim here is to report the consequences of inaccuracies in design or maintenance of projecting elements, with reference also to the brick facades of one of the most important Baroque buildings in Turin, part of the UNESCO site "*Residenze Sabaude*" and place of the first Parliament of the Kingdom of Italy.

Keywords: Masonry cornices, Palazzo Carignano, terracotta elements, planned conservation, decay.

1 *Palazzo Carignano* case study

1.1 *Palazzo Carignano* historical notes

The palace was designed as the residence of the Prince of Carignano by Guarino Guarini of Modena (1624-1683), a Theatine father, mathematician and architect to the Duke of Savoy. Under the direction of Guarini himself, the building site began on May 11, 1679, with the levelling of the area, and as early as January 10, 1682, the expense of the roof was settled: in two and half years the main sleeve (facing the square of the same name) was completed in the rough. With Guarini's death, work slowed down, and it was only in 1693 that the Carignano family settled permanently in the new residence. The C-shaped plan, open to the garden, included the main body facing west to the square and two short side sleeves facing the garden. In the Carignano palace, the facing brick is embodied in geometries and figures with vegetal and humanoid features, whose vibration seems to allude to tactile sensations of great warmth (Fig.1a,b). The curvilinear course of the main facades, echoes the curvilinear course of the ornamentation and corresponds to the oval that encloses the atrium on the ground floor and the ballroom (later parliament) on the second floor. In fact, all the facades have Baroque decorations in exposed *terracotta*, made by working in place the bricks that make up the wall apparatus, as if carving stone material: particularly interesting are the window frames celebrating the victory in 1667 of the French-Italian Carignan-Salières regiment against the native Iroquois during the colonisation of Canada, recalling the feathered headdresses of the American Indians, and the octagonal star decoration in the interior facades, a motif generated and treated through the rigorous study of geometry then reproduced in the craftsmanship of the brick, as Carlo Mollino would have perform in the reconstruction of the Teatro Regio, three centuries later.

The palace functioned as a residence for only a century. The French occupation at the end of the 18th century confiscated it and allocated the representative parts to the headquarters of the Prefecture of the Department of the Po (river), while splitting the rest of the building into rented lodgings. After the Restoration, the Carignanos regained possession of the palace (1818), which in 1831 was transferred to the state property, while the garden was sold to the city of Turin in 1833. The palace, divided in this way, became the seat of the Subalpine Parliament (1848), which took up residence in the ballroom, later consolidated by engineer Amedeo Peyron. With the birth of the Kingdom of Italy, the parliament hall was no longer sufficient to accomodate all the representatives of the new provinces, and it was decided to enlarge the palace by extending the side sleeves and building a vast building body to close the rear of the courtyard, but with a much greater depth of sleeve than the Baroque one.

The new parliament, however, never came into operation because in 1865 it was transferred to Florence and then to Rome. The design is due to Gaetano Ferri and Giuseppe Bollati, who continued the side sleeves of the old building by picking up the rhythm of the interior facades and on the side streets, while the rear facade is the result of an eclectic interpretation of neo-Renaissance stylistic features. Although the geometry of Guarini's decorative apparatus is reprised in the nineteenth-century

exposed brick facades, the stiffness and uniformity of the terracotta elements molded off-site differentiate the extension all too clearly from the softness and vibrancy of the brickwork by the seventeenth-century workers (Fig.1c).



a) b) c)

Fig. 1. Palazzo Carignano with its baroque facades, sinuous and preciously decorated in *terracotta*: a) and b) decorations of 17th century; c) the connection between the 17th and the 19th century portions (Pictures were taken on January 2024, by G. Cardani).

1.2 Notes on conservation events

The history of the conservation of the façades of *Palazzo Carignano* is marked by the recurrent detachment and falling of terracotta elements or fragments, which have affected almost all the façades facing the public road and those facing the courtyard, albeit to different degrees. This is partly due to the fact that for a long time there was no centralised and clear management of the building, which made it difficult to carry out continuous and coordinated maintenance [1].

Over time, the extended palace has been used for various public activities (offices, museums, universities), with a gradual loss of interior decoration, stucco and furnishings. The state of conservation has also deteriorated due to excessive use of the floors and sporadic and piecemeal maintenance, which has caused the roofs to deteriorate to the point of being unsafe and a source of constant infiltration into the vaults and cornices of the façade.

Although each manifestation of deterioration is almost always the result of numerous concomitant causes, it is equally often possible to identify a few main ones. In the case of the elements of the cornices and decorations of the façades of Palazzo Carignano, two main problems can be identified: the different characteristics of the materials used for the façades of the 17th century and those of the 19th century, with their consequent different behaviour in relation to environmental influences; the presence of localised infiltration phenomena, as a result of recent interventions.

2 The *terracotta* cornices of *Palazzo Carignano*

A programme of 'normalisation' of inspection and maintenance activities has recently been initiated, the first result of which has been the production of detailed systematic records of recurring criticalities.

2.1 Different consistency of 17th and 19th century facades.

The analysis of the results of this activity has shown, by comparison, a more diffuse and advanced degradation on the south and west-east façades (in relation to exposure factors and the resulting thermal expansion); with particular reference to the courtyard façades, a generally worse state of conservation of the 19th-century portions appears (Fig. 2a). The overall view of a module of the decorative apparatus of the crowning cornice of the 19th-century façade shows a diffuse lack of homogeneity in the chromatic characteristics of the individual elements, which can be attributed to sub-optimal production and firing processes. Also noteworthy is the design of the cornice above the corbels, which is no longer made with repeated courses of solid brick elements, but with the superimposition of two specially shaped elements made on a bench. The repeated and widespread phenomena of deterioration and detachment of significant parts are in this case due to the simultaneous presence of errors in the design and execution of the system and the persistent infiltration of rainwater from the upper part of the covering (Fig. 2b).

In fact, although the frames and decorative elements of the nineteenth-century installation interpreted the 17th century (Fig. 3) core in an attempt to achieve formal continuity, there are numerous aspects of discontinuity: not only different materials, sizes, production and firing techniques, but also different assembly and installation systems affected by design faults.

As early as the 1930s, the repeated and widespread loosening and falling off of significant sections of the summit cornices necessitated extensive replacement and reassembly of the elements. These additions are visible on close inspection, especially after cleaning the fronts.

2.2 Inadequate management of stormwater runoff.

The brief historical introduction mentioned the complex history of the building, not forgetting the resulting complex geometry of the roof system, which has been compromised and remodelled several times [2]. In particular, design errors in the correct management of rainwater run-off from the early 20th century interventions caused subsequent hidden infiltration phenomena, leading to flaking, cracking and detachment of material from the moulded terracotta elements, with dangerous falls of fragments, even of considerable size.

Recent studies and investigations into the necessary production of replacement elements have confirmed the conjectures expressed in the previous paragraph regarding the probable 'low temperature' of firing as the main cause of the qualities of the 19th century elements.



a) b)

Fig. 2. a) The overall view of a module of the decorative apparatus of the crowning cornice of the 19th century façade: noteworthy is the design of the cornice above the corbels, which is no longer made with repeated courses of solid brick elements, but with the superimposition of two specially shaped elements made on a bench; b) Detail of the upper cornice of the 19th century façade. Recent cleaning work has revealed earlier additions and consolidations to the hollow brick mouldings that complete the decorative system. The deterioration of these elements is closely linked to the presence of persistent infiltration from the rainwater collection system. (Pictures were taken on February 2024, by M. Zerbinatti).



Fig. 3. Upper cornice of the 17th century façade: replacement and partial consolidation of the closing courses and some decorated corbels can be appreciated. In this case, the moulded terracotta elements that make up the corbels, which are the most fragile part of the system, are adequately protected by the upper part of the cornice, which is made of solid bricks with a traditional masonry texture (Pictures were taken on February 2024, by M. Zerbinatti).

The case study of Palazzo Carignano, which is emblematic from the point of view of formal results, is at the same time significant in highlighting the need for coordinated action of complementary skills, for the interpretation of phenomena and manifestations, for the design of remedial interventions and for their realization.

Ongoing experiences reiterate the imperative of systematic and timely collection of historical, technical and detailed information, as any conservation intervention cannot disregard knowledge and must contribute to it.

2.3 Interpretation of recurring and specific issues

Thanks to the consultation of some of the drawings relating to the recent project for the conservative restoration and exceptional maintenance of the nineteenth-century interior façades, and in particular the photographic material, it is possible to supplement the critical reading with some specific observations [3].

In general, the brick façades of Palazzo Carignano offer a repertoire of recurrent problems for similar types of brick masonry, for which it is possible to identify possible concomitant causes and prepare appropriate corrective measures. [4].

The historical photographic repertoire, confirmed by the current conservation of certain parts of the façade (both from the 17th and 19th centuries), allows us to identify as the most widespread pathology the disintegration of elements, typically due to the persistent infiltration of meteoric water from horizontal or slightly inclined surfaces (schematic illustration in Fig. 4).

This phenomenon is locally associated with the action of runoff, which has persisted due to certain errors in the design of the transformations and modifications that have occurred, especially for roofs, and due to unfavourable orientation conditions (already partially mentioned in the previous paragraphs).

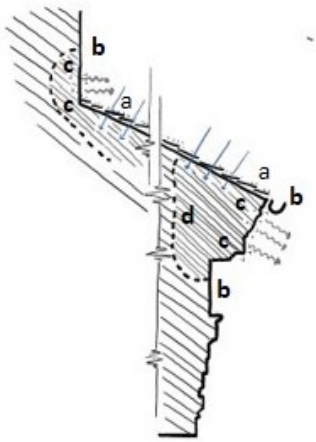


Fig. 4. Cross-section scheme of the parts of the 19th century façade characterised by the intermediate cornice, with illustration of the degradation mechanisms induced by typical phenomena of persistent infiltration from horizontal or slightly inclined surfaces towards the masonry below. **a-a** infiltration surface (with possible deposits of "smog"); **b-b** evaporation surface; **c-c** salt accumulation zones with consequent phenomena of efflorescence, inflorescence and subsequent disintegration; **d** infiltrated water diffusion zone. (Drawing by S.Fasana)

This type of phenomenon was certainly the most frequent cause of the phenomena that caused the most damage to the terracotta elements that make up the mouldings of the cornices and upper corbels.

In some cases, efflorescence phenomena can be observed (also on the support of the terracotta frames of large windows on the stone slabs that make up the windowsills). These manifestations can be attributed to the accompanying phenomenon of capillary rise of water made acidic by the presence of substances contained in the air pullution that is deposited on the horizontal surfaces of the windowsills and that is more adsorbed by the terracotta elements (more porous). Such solutions, which spread and penetrate into the brick elements of the cornices, are enriched by the decomposition of the substances present in the masonry. These substances, which evaporate near the surface, deposit soluble salts, the decomposition of which can be accelerated, especially at certain times of the year, by the concomitant action of frost and thaw and by crystallising, lead to the observed surface decays.

The particular solution adopted for the frames of the 19th century façade, with hollow terracotta elements made on a bench laid without specific precautions to prevent infiltration and the consequent stagnation of water, accentuated the problem (Fig. 5).

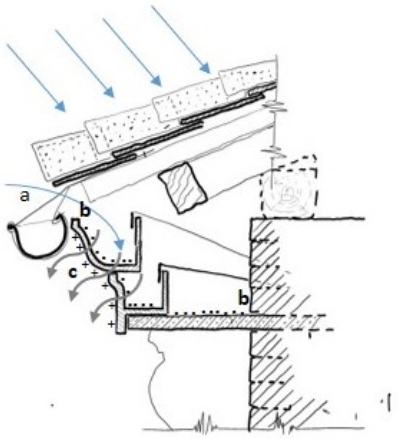


Fig. 5. Cross section scheme of the of the 19th century façade, illustrating the bending mechanisms and consequent degradation phenomena induced on the hollow brick modelled elements of the middle cornices. **a** possible points of infiltration from the eaves; **b-b** evaporation surface; **c-c** salt accumulation zones with consequent phenomena of efflorescence, inflorescence and subsequent disintegration. (see §2.1 and Fig.2) (Drawing by S.Fasana).

3 Conclusions: requirements for effective conservation planning

The brief outlines proposed for the case study addressed expose some key points underlying the design of an effective and coordinated Planned Conservation actions.

The interpretation of the mechanisms responsible for the degradation phenomena and the consequent identification of the associated causes are the necessary prerequisites for the definition of potential risks and the prescription of appropriate preventive measures.

The main obstacles include the difficulty in establishing and structuring a solid knowledge base of each building, with particular reference to the stratifications of the construction history, the design of building systems, the production methods of elements and the consistency of constituent materials, to the most particular construction details such as the terracotta frames, which were created to protect the building and not to cause deterioration.

In this sense, emblematic cases such as Palazzo Carignano are of great interest, not only for the possibility of carrying out specific in-depth studies, but also for the development of methodological approaches that can be used to set up similar processes for diffuse heritage [5].

In this respect, a promising result of the Main10ance Interreg research project could be applied to the case study of Palazzo Carignano. The *4Main10ance* digital platform has been developed with the aim of supporting the implementation of conservation and maintenance plans and of coordinating and registering the operational actions of the periodic controls foreseen in them. It consists of a web-based integrated gis-bim database tool developed with reference to the 'Sacri Monti' in Piedmont and Swizerland, as an emblematic example of architectural complexes of historical and cultural value, where the contributions of many different actors (e.g. managers, technicians, restorers, craftsmen) need to be coordinated. It is based on the definition of "risk phrases", which are conceived on the basis of the interpretation of the main degradation mechanisms, with reference to the technological consistency of the artefacts, the nature of the materials, their compatibility *in situ* and the exposure to possible degradation agents specific to the given environment. The "risk phrases" had been set up based on the lexicon of international regulations and standards.

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