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The Preservation and restoration Project of the Castello dei Paleologi in Casale Monferrato (Alessandria): The Works on the External Wall Surfaces of the Northern Bastions

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Abstract: Located on the western end of Casale Monferrato, close to the right bank of the river Po, the Castle is the result of a historical stratification of almost seven hundred years, during which the fortified complex has repeatedly undergone enlargements, reconstructions and building works required both by changeable and massive military needs and by the frequent changes in the intended use of the interiors. The first layout dates back to 1351 as wished by Giovanni II Paleologo and it probably lay on an older fortified construction as allegedly witnessed by the archaeological finds. At the beginning of the XVI century the changes in defensive needs brought about by the development of the firearms and by relevant new military techniques implied an adjustment of the Castle, in particular in the shape of the boundary walls. In 1590, with the construction of Cittadella di Casale, the castle morphed into a defensive structure of secondary relevance, getting back to a residential intended use. It was during this period that, under the rule of the Gonzaga family, the castle was embellished with artworks. In 1708, after the city passed under the rule of the Savoia family, the Castle again underwent a very long period of modifications of a military nature. Despite the removal of the external defensive fortifications, the Castle retained the military function till the '80s of the XX century. The purchase of the Castle by the Municipality of Monferrato occurred in 1999 and, starting from 2001, the castle has undergone a number of recovery works among which, lastly, the preservation and restoration project of the faces of the northern bastions, the first one to be carried out on the outer surfaces. On an ortho-photographic base, the external brick walls have been scanned morphological-stratigraphically, thus highlighting the modifications carried out on the building. The investigation on the degradation has put into evidence diverse pathologies which the project is trying to cure also in view of the subsequent maintenance works, keeping full respect of the stratigraphic plenty.

Key words: bastions, brick, restoration, maintenance

1. Historical Background

Located on the western end of the historical core of Casale Monferrato centre, almost close to the right bank of the river Po, the Castle reveals itself today as the result of a historical stratification of almost seven hundred years, during which the fortified complex has repeatedly undergone restoration, enlargements, reconstructions and building works required both by changeable and massive military needs and by the frequent changes in the intended use of the interiors.

The first layout of the castle seemingly dates back to 1351, when Giovanni II Paleologo [1] ordered its construction, which probably lay on an older fortified construction as allegedly witnessed by the archaeological finds from recent excavations. The XIV century fortress stood against the XIII century city boundary walls, developing inside the area surrounded by walls, it had got a rather quadrangular layout, featuring square angular towers and it stretched as far as the ancient *turris magna* which was put as a defence

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of the near *Porta Aquarolii*, the eastern access to the walled town. Starting from this date the construction works of the castle and the excavations of the moats began; the works ended in 1357 although some interruptions occurred now and then. The XIV century structure of the castle is detectable in the present eastern court: in particular, the ancient *turris magna* is still recognisable in the quadrangular tower present in the wing separating the two internal courts. The ancient moat would correspond to the underground level of the wing separating the two internal courts from the defensive works: a number of clues observable there vouch for this hypothesis, such as the inclined scarp profile of the lateral walls along the basements, their alignment with the structure of the *turris magna* and the manifest matter-constructive differences of the wall texture in comparison with the above standing vaulted one. During the first decades of the following century, after a short ruling period by the Visconti family (1370-1404), the castle underwent massive alterations by Teodorico II and later by Gian Giacomo and Guglielmo VIII: as a matter of fact Casale became the centre of the marquisate and the fortification had to permanently host the lords' residence. These enlargements and transformations pertained to the Casale built-up area too which was raised to the rank of *civitas.* A *palacium novum* was added to the Castle before 1427, thus doubling the fortress surface "by adding a second court to the West and by building a new boundary wall closed up by four angular cylindrical walls" [2]. The XV century layout [3] was quadrangular in shape, the two short sides coinciding with the two accesses to the East and to the West (respectively 50 and 60 meters long), whereas the major development pertained to the southern and northern fronts which covered a total length of about 100 meters each. At the ends of the eastern and western fronts two circular large towers were present whose "internal diameter was 18 ells and" whose "wall masts were 4 ells thick", each of them housing two casemates in the basement and on the ground floor; all around was the moat, connected to the river Po. At the beginning of the XVI century, however, the changes in defensive needs brought about by the development of firearms and by relevant new military techniques implied an adjustment of the Castle, in particular in the shape of the boundary walls and a refurbishment of the inner rooms: "within the '50s of the XVI century the castle had been provided with four ravelins, one spade-shaped to the west and three trefoil-shaped: probably they are the result of an intervention by Bonifacio III Paleologo. It was followed, in the years before the marriage of Guglielmo IX to Anna d'Alencon, by a massive restoration of the inner rooms. [...] Once the state had been recovered after the treaty of Cateau Cambrésis (1559), the dukes of Mantova deemed it urgent to take actions on the defensive systems. [In 1568] the two curtain walls in the north and in the south had already been so far enlarged as to gain that broken profile which they show still today, functional for the connection of the advanced works with the curtain and for their transformation into bastions. [...] By the end of the following year works drew to an end, and the northern and southern fronts of the castle were taken in hand" [2]. Very soon it became clear that the progressive silting over of the near Po river bend would be a problem and it would make the fortress vulnerable on the north-west side. Towards 1590, with the construction of Cittadella di Casale, the castle morphed into a defensive structure of secondary relevance, getting back to the primarily residential intended use. In the early XVII century Gabriele Bertazzolo concluded the works of the internal wing dividing the two courts, reshaping most of the inner spaces of the residence. It was during these years that, under the rule of the Gonzaga family, the castle was embellished with art and collection works. However, what had seemed to be the beginning of a glorious period for the castle was suddenly interrupted in the second decade of the XVII century, following a series of deaths which brought about the dissolution of the court and the subsequent abandonment of the castle. The war lasting up to 1618

accelerated the decadence of the castle. From this moment onwards the castle was actually only reworked to cater to military engineering purposes. In 1659, after the agreements of Vittorio Amedeo II of Savoia and the King of France, Casale underwent a massive dismantlement of the military defensive works, which caused the complete demolition of the citadel of Casale Monferrato and the sacrifice of defensive bodies on the western side of the castle.

In 1708, after the city passed under the rule of the Savoia family, the Castle again underwent a very long period of modifications of a military nature, aimed at catering to the defensive needs of the castle, neglecting the interiors which fell into a progressive depletion. These modifications went on during the XIX century because of the military needs of Casale in the Independence Wars. On this occasion, between 1857 and 1858, the State of the Savoia family decided to pull down the eastern ravelin of the stronghold.

Once the Independence War was over, the first pulled down ravelin was soon followed by the remaining three ravelins, pulled down between 1887 and 1904, because the defence of the fortress was not any longer deemed necessary. In the place of the by now obsolete defensive structures in 1907 the Mercato Pavia was constructed to the south. It was named after the rich Jewish benefactor and philanthropist who had left a great amount of money to the Municipality. Some years later, on the surface of the northern ravelin, the gardens were created as we can see them today. Despite the removal of the external defensive fortifications, the Castle retained its military function till the 80s of the XX century when the Italian Army left the structure which had been used since 1965 as a storage facility of the Reggimento Fanteria “Cremona”. The purchase of the Castle by the Municipality of Monferrato occurred in 1999 and, starting from 2001, the castle has undergone a number of recovery works among which, lastly, the preservation and restoration project of the faces of the northern bastions, the first one to be carried out on the outer surfaces.

2. The Eastern Bastions: The Features of A Fortified Structure

The Eastern front of the fortified system, which is the object of the intervention, heads towards the urban core of the historical centre, for which it represents a prestigious backdrop. The eastern prospect is almost 84 meters long, of which 37.5 meters for the central curtain wall and 23 meters each side for the two bastions closing it to the north and to the south: the height of the curtain and of the bastions varies between 14.5 and 15 meters.

The small fortress features an hexagonal shape, the four long sides (two each side) oriented along the east-west axis. The short sides to the east and to the west house the two main entrances to the fortification, whereas two further secondary accesses are present, located on the northern and southern fronts. The whole structure is surrounded by a wide moat with variable width and depth. On the four intersection edges between the east-west and north-south sides four circular bastions are present, base diameter 23 meters,

Fig. 1 View from the north of the south-east bastion, of the eastern curtain and of the counterscarp of the moat.

coping diameter about 20 meters. The wall thickness varies between 6.5 and 8 meters. The thickness of the eastern central curtain is inferior, 3.85 meters. The boundary walls feature an inclined scarped profile, particularly marked in the bastions. The brickwork support structure is separated from the coping with the battlements of the parapet by a rounded cordon made from sedimentary stone: the curtain instead features a brickwork cordon closing the scarp and a rectangular profiled cordon reconnecting with that of the bastions. The wall curtain, in its articulated stratification, is a good evidence of the size and complexity of the continuous changes the Castle has been undergoing in the course of time. In particular the eastern front houses the main entrance to the fortification which retains some traces of its XV century look. The access to the first inner court (the most ancient core) is defined by a round-arched portal with a frame in relief made from brickwork elements and featuring two coat of arms, the bigger of the two showing the arms of the Gonzaga and Paleologi families and the smaller the ancient arms of the Gonzaga family. Above the entrance portal the lifting system of the drawbridges is still well visible, featuring huge housings for the beams for the main entrance and for the small entrance door of the pedestrian passage, to the right of the main door. Inside the walls two square adjacent courts are present, separated by a central corridor developing towards north-south.

The final project, signed by the SAB Group esc and Emmequattro Associati, in 2008 made a 3D Laser Scanner survey of the Eastern bastions which was not possible to obtain: the executive project has updated the current state through a photographic campaign reproduced on an ortho-photograhic base; the brick walls have been read morphologic-stratigraphically, putting into evidence the different fixtures and the changes intervened on the built-up body. For the stone architectonic elements the general definition of *sedimentary stone* has been used. Through the non-close macroscopic analysis carried out in this executive planning phase we can assume the presence of sedimentary stone such as sandstone for the rectangular profiled cordon and a more compact sedimentary stone for the rounded moulded cordon, probably a limestone. The bibliographic information refer to the Villadeati stone [4]. In order to have a more detailed classification, some investigations for the petrographic recognition have been planned during the building site preparation with already mounted scaffolding.

3. Analysis of the Surface Deterioration

A macroscopic detection of the walls allows us to notice that the central area of the eastern walls shows in the upper portion minor degradation pathologies as it underwent maintenance works in 2009. The situation is different for the lower walls in the moat showing similar pathologies as those of the bastion surfaces, as well as for the border portions of the eastern curtain itself. The *washout* of the structures is constant both on the outer scarped brickwork surface and on top of the bastions where the soil with grass can only partially retain rainwater. Penetrating into the structure with no protection from above, this latter has brought about the *weakening and the de-cohesion* of the joining mortar of the masonry of the external parapet battlements and of the masonry parapets of the gunboats present on the platform, thus provoking a massive *masonry disaggregation* and fertile soil for roots to take hold. We can see caper plants, ivy, cane fields, lilies, wall pellitory which are infesting here. Also on the inclined surface of the bastions we can find some *vegetation with roots* together with *vegetation with no significant roots* (moss, lichen, moulds, seaweed), more consistently present on the north-east bastion. On the south-east bastion we can notice the presence of a big lot of white bricks: *the erosion with pulverization*, very much marked, *the decohesion and the differential degradation* of the bricks are remarkable and is a widespread phenomenon, widely present on the supporting structure of the bastion, mainly towards south-west.

On the eastern walls instead this occurs in concentrated areas, to the side of the entrance door on the left both in the central portion between the two cordons and in the right portion, above all under the brick cordon. All surfaces feature *surface deposit*; as it has not been completely removed by *washout*, bands in different colour are evident. On the south-east bastion a remarkable masonry *vacance* has become evident: the loss of material shows how restraints among the brick layers of the new coating of the 1559-1572 interventions are not so frequent. The upper and side portion of the vacance shows a drastic diminishing of the mortar-brick linkage with a consequent *disaggregation* of masonry. On the north-east bastion towards east a minor lack of material can be observed as well. On the south-east bastion, the wall towards the east, some crackings are detectable. As for the stone elements some *exfoliation* and *spalling* phenomena are detectable, above all on the rectangular profiled cordon of the eastern walls; also present are *surface deposit, erosion with pulverization, de-cohesion* of the mortar joints. Interruptions of the architectonic element are detected here too due to the presence of *vacances* with fall and loss of stone portions. The lower portion of the walls, both of the eastern curtain and of the bastions, feature a chromatic variation linked to the *presence of rising dampness* from the moat. In order to develop an accurate and appropriate methodology to eliminate the several colonisations from the brick and stone walls it has been suggested to carry out some specific biological investigations in the time before the building site is set which allow both to detect the organisms present and to understand their relationship with the substrate (adhesion, consistency, deep penetration of growth). Following are the suggested investigations: observations under the stereo-microscopy to examine the collected organisms and to analyse the nature of the sample material (NORMAL 19/85 *Autotrophic and eterotrophic Microflora: visual detection techniques*); observations of glossy sections (stratigraphic sections observed under the microscope in reflected light) to detect the growth consistency and check the presence of endolithic communities, as well as their distribution and penetration into the substrate (UNI 10922: 2001. Cultural Heritage — Natural and artificial stone materials — Preparation of thin sections (stratigraphic sections observed under the microscope in transmitted light) and glossy sections of stone materials colonised by biodeteriogens); observations of slides with unsealed samples to detect under the microscope the different microorganisms making up the colonisation (UNI 10923: 2001. Cultural Heritage — Natural and artificial stone materials– Preparation of biological compounds to be observed under the optic microscope); characterisation of the saline species (anions) present in the artificial mixes and in the walls (UNI 11087:2003 e UNI EN 16455:2014).

4. Analysis of the Environmental Impact

Intervening on the walls also means using chemical substances for removing both the upper vascular plants and the micro flora made up of seaweed-moss-lichens, widely present on the brick surfaces and on the stones. Alternative eco-sustainable solutions have been proposed to remove the biodeteriogens so as to prevent the workers from getting ill and to preserve the soil. The application of biocides — often repeated — is certainly delicate, but the washing up of the treated areas and the removal of biomass are the less controllable and more dangerous actions. The active ingredient suggested for the operation is the *benzalconium chloride*: it is a widely used cationic surfactant, approved by the institutions and by the scientific community, present in the products delivered by the restoration materials selling firms. However, in addition to having a certain toxicity towards man, it is a hazardous substance for vegetal and water species. Even if it is biodegradable, it persists in the soil for about a month. Consequently for the treatment of micro flora we propose to remove the biodeteriogens by using different methodologies in relation to the intensity of the biological growth. The additional use of *peroxide water diluted into 9%*

deionised water equal to 30V to better dehydrate and attack the more consistent bio films could represent one of the alternatives to the undifferentiated use of benzalconium chloride. This can be defined a real eco-compatible compound since its oxidant/reducing action transforms indifferently the organic material present in moss, lichens and seaweed, contrary to phytofarmaceuticals which must be specific for the single weed species. Its reactivity on carbonate stones and on bricks can be considered irrelevant, because the peroxide water acidity is slightly superior to that of pure water. Toxicity is at a minimum level for the workers as regular supplies of IPDs are enough to protect oneself in case of skin irritating contacts, with a great benefit for the environment though. Peroxide water works producing some oxygen as a residual material in a basic environment (carbonate stone), some water instead in acid environment. In addition to using mechanical devices for cleaning — such as sandblasting with eco-compatible products to remove the biomass caused by the chemical treatments — it would avoid pouring contaminated water into the soil thanks to the possibility of recovering and disposing of the dusts during the working phases. It is preferable to sandblast the surface removing coherent deposits, made up of inactive micro flora, carbonaceous particles and incoherent dirt, through the *Ibix system and Garnet powder — GMC 200 Mesh with 2 Bar pressure since consisting of almandine granules, and environmental friendly, non toxic natural abrasive material, different from the micronized silica-based products whose residuals remain in the environment if not perfectly removed and are health hazardous.* Thanks to its high molecular weight a low-pressure, more calibrated cleaning can be effected. Only later can the surface be mildly washed with a moderate-pressure hydro cleaner, as most of the polluting chemical substances will be no longer present.

5. Project Resolutions on the Eastern Bastions

The restoration work site will make it possible to integrate the direct knowledge of the castle of Casale Monferrato through an updating of the morphologic-stratigraphic reading carried out during the executive project phase according to the indisputable principle of the respect of the stratigraphic plenty present which is the starting and the end point of a restoration project [5-7].

Almost the entire walls of the external face are made of bricks of an artisanal fashion dating back to the mid XVI century, with massive subsequent reconstructions. On this surface the following actions are foreseen: Cleaning operations: Removal of vegetation with roots present on the walls and on top of the terraces through spot-on nebulisation of systemic phytopharmaceutical- and peroxide-based herbicide; removal of the micro flora (seaweed, moss, lichens) through a specific quaternary ammonium salt-based biocide product; removal of the inactive biomass such as moss through water-free mechanical operation; subsequent finish water-free cleaning through projecting-controlled sandblasting releasing natural mineral inert materials such as Garnet; mechanical removal of the mortar featuring de-cohesion phenomena or poor adhesion to the support with subsequent accurate cleaning of the joints to be filled up, also of the mortar with an eventually non adequate composition bonding agent; removal of the soluble salts through washing ups with deionised water and brushing with broomcorn. Consolidation works: replacement of missing and completely degraded bricks such as the white ones; the new bricks will be picked up among those recovered showing shape, size and colour similar to those degraded; imbibitions on dry surface of those bricks showing erosion with pulverisation through brushstrokes of Ethyl Silicate. Plastering works: filling up of the minor vacances widely present on the south-east bastion mainly and on the left portion of the eastern curtain with a mixture of natural hydraulic lime NHL 5.0 mixed with cocciopesto powder; reintegration of degraded or missing joints with mortar with natural hydraulic lime bonding agent NHL 3.5 and inert

materials selected conforming to the historical mortar. The mixture will be made according to the features of the mortar present as far as colour, tone and granulometry of the inert materials are concerned. The mortar will be worked on the surface with a sponge to make the charge of the inert material itself visible. The filling up mortar shall be laid under level by some millimetres to fully respect the detected stratigraphic relations. Final protection with water-based silicone product with water-repellent effect together with preventive new treatment with biocide sprayed in deionised water.

The inner walls of the bastions and the top cover of the external prospects are all brickworks of an artisanal kind, but they feature minor degradation phenomena. For these areas operations similar to intervention 1 are foreseen, although less numerous.

Both the two bastions and the eastern curtain feature a sedimentary stone cordon following the profile of the summit. For these stone elements some analysis are provided for the petrographic identification in order to carry out a focussed conservation intervention. Some sedimentary stone ashlars are also present aimed at lifting the drawbridges, the drainers together with a number of frames of bombers and gunboats. For the stone face following actions are given: Cleaning operations: similar operations as provided for in interventions 1 and 2. Consolidation work: following the petrographic analysis to ascertain the litho type, the portions featuring highly disaggregated material and differential degradation, erosion with pulverisation and exfoliation will be treated by imbibing a specific product so as to recover the initial physical-mechanic features. We propose to use ethyl silicate (such as CTS Estel 1000) if the stone material has got characteristics suitable for this kind of consolidation treatment, applied through imbibitions up to the optimum considered level. The surface shall be protected from weathering for the three weeks to follow; water-free insertion of through pins made of stainless steel, 9 mm. diameter as a footing for the stone portions being instable or yielding. In the portions subject to exfoliation and detachment we suggest to put spots of bi-component epoxy resin duly thickened with micronized silica; filling up of cracking with natural hydraulic lime mortar with a very low content of hydro soluble salts and inert materials with medium-high granulometry to be calibrated with respect to the matrix of the stone itself. When no architectonical continuity elements are present or in case of lack of static/conservative function for the surrounding walls (cordon, opening frame, ...) we suggest to intervene using stone dowels. Final protection with water-based silicone product with water-repellent effect together with preventive further treatment with biocide sprayed in deionised water. When those situations occur where the brick face has lost texture as in the upper portion of the big wall vacance of the South-East bastion and where no take-off and put-on operations are foreseen, the wall texture will be recovered by laying water-free helicoidal bars made from stainless steel. The terraces of the north-east bastion have got a recent plaster, not a lime-based one. It is decided to remove it and to recover the revealed face. Maintenance works of the iron elements present will be carried out. The merlons of the parapet of the bastion terraces need recovering in order to limit the flow of rainwater into the wall thickness of the bastion and to reduce the rooting of the weeds on the turf which will be preserved. What to do is digging by hand up to 40-45 cm. depth into the soil which will be temporarily put on the terrace; laying of a waterproof sheath, laying on slope of a 10 cm. thick gravel layer with draining function, laying of a mulching sheet impenetrable by the vegetative apexes now present, backfilling the soil previously dug. Some drains for rainwater will be made, and this will be intercepted by the waterproof barrier towards the inner side of the terrace; the rainwater will flow into the collection system of the white waters present on the eastern terraces plane.

The parapet merlons of the eastern bastion terraces will be equipped with fall-arresting devices with single anchorage points to safely carry out the maintenance of the grass which will grow again on the terraces in a regular way.

In order to prevent the vegetation with roots to get nearer to the prospects with brick face of the south-east bastion, of the eastern curtain, of the north-east bastion, a 90cm. wide stripe of gravel flooring is foreseen after mechanically lowering the soil by 15 cm.

The inner surface of non plugged bombers and gunboats, not protected by the metallic net, shall be accurately cleaned from guano, birds, shifted material of various nature.

For the big vacance in the face of the south-east bastion a masonry integration is foreseen with take-off and put-on operations on the rim where necessary with preventive load-bearing of the upper portion showing a reduction in the connection between brick and mortar, considering the recorded macroscopic detachment of the joints. For the new walls recovered bricks will be used with a recognisable wall texture of the wall layers to be agreed with the Superintendence Office through simulation and sampling (such as band (long side of the brick) -head (short side of the brick) at alternate layers).

Other reintegration works of the wall continuity are considered necessary for the abutments of the gunboats of the terraces of the Eastern bastions, now not fully visible due to the presence of soil and massive weeds. Accurate take-off and put-on operations are much needed for diverse portions of the top coping of the two bastions above the shaped cordon where the wall disaggregation looks worrisome. The areas where the pigeons rest will be possibly reduced by filling the bridge holes and the bombers/gunboats through a copper net duly shaped and fixed on the frames. The resulting material, not dangerous but not reusable, will be duly disposed of in an authorised damp.

All planned maintenance operations will be relevant to guarantee a temporal continuity for the benefits expected from the project.

6. Remarks

The project was made by the undersigned upon assignment by the Municipality of Casale Monferrato in October 2017. Advice for the interventions on surfaces has been provided by Monica Endrizzi, restorer of cultural heritage and for structures by Ing. Marco De Giacometti.

Fig. 2 Project table of the north-east bastion with counterscarp of the moat.

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