The city hall of Camposanto and the conservation of its decorative concrete finishing

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From the direct observation and the instrumental analysis to the restoration project of the monument: the design path through the knowledge of an interesting example of XX century architecture, towards the elaboration and realization of conservation works

Fig. 1 - The main front of Camposanto city hall before the restoration works (photo Boschetti 2010).

The shared guidelines in conservation consider the survey as a pre-diagnosis phase and an important tool for the knowledge of historical building material consistency and state of conservation. Next to the interpretation of historical documents, the direct observation of the monument plays an important role: entering the building, touching its materials, examining its architectural forms, decorations and colours consistently and from different points of view, constitute the best way to actually "understand" the monument and its values. A conscious survey keeps track of the building geometry and dimensions, materials and construction techniques, and highlights its structural and superficial conservation problems. When necessary, the knowledge of the monument can be deepened through instrumental investigations, to be assessed on a case by case basis in relation to the specific context, the issues arisen and the objectives defined.
Direct observation and interpretation integrated with analysis, investigations and historical research lead to a comprehensive overview of the building and a complete diagnosis of its issues. These elements altogether constitute the foundation on which the conservation and restoration project will be developed.

The XX century Camposanto city hall and its decorative concrete finishing

The contribution aims at illustrating the role of direct observation and instrumental analysis in the conservation and restoration project of Camposanto city hall, a XX century monument hit by seismic events during the 2012 Emilia's earthquake[1] (Fig. 1).
Located in the flat countryside of Modena province, the town of Camposanto is characterized by small dimensions (a little more than 3000 inhabitants) and an urban asset organized in accordance with a regular grid. The building is situated in the southern part of the city, bounded by the irregular course of river Panaro, 200 mt away (Fig. 2). The front of the city hall is facing east, parallel to via Baracca, but rearmost. The access from the street goes through a green zone and an area paved with porphyry, a double filter that permits an outdistanced overview of the city hall.
The building is organized on three main levels with simple and symmetrical floor plan and a partially accessible basement. The front, symmetrical too, is horizontally subdivided by jutting frames. The set of architectural features of the facades reminds to the first decades of last century with regular lines, horizontal rhythm of the parts and sober decorations like string courses, frames and diversified surface

finishes. One of the main typological characteristics is the finishing simulating stone, carried out with specific superficial treatments. The lower section of the facades is finished simulating travertine *bugnato* and is bounded above by a moulding that runs along the whole building perimeter. The upper part is characterized by plastered walls and architectural elements coated with decorative concrete.
Analysing the detailed drawings of the monument original design, dated 1931 (Fig. 3), and studying pictures of the following decades, it was possible to compare the building with the situation at the time of its construction, started in 1933. By this time neither structural nor decorative changes had been produced. Since 1934 (year of its completion) to date, the building has always been used as municipal hall. The single and continuous destination of use during this time is probably the reason of its conservation and absence of significant alterations.

ANALYSIS OF THE MATERIAL CONSISTENCY AND STUDY OF THE DECORATION

The city hall is composed by masonry bearing walls: full bricks placed with lime and concrete mortar. The slabs are made of iron girders with small depressed vaults (full bricks *in foglio*) in the basement and girders with filler tiles in the upper floors; the roof consists of iron beams alternated with wooden joists, terracotta tiles, concrete screed and Marseille tiles. Analysing plasters and mortars through a direct and close observation, they seem to contain a significant amount of cement. The architectural and decorative elements are made with a cement grout too and are finished in order to simulate natural stone, the so-called decorative concrete (Fig.4).
At the time the city hall was built, stone effect decorations were commonly used. The practice of simulating nobler materials is documented in various historical periods; an example is the simulation of natural stone in the upper parts of the facades carried out by adding pigments or aggregates to the plaster preparation. Just before the concrete casting, salt crystals were added to the shuttering to reach the pitted effect of travertine. During the hardening, the salt melted creating an alveolisation typical of natural stone with vacuolar structure. This procedure came of age at the beginning of XX century in Rome where travertine was and is still commonly used in construction. However this technique is characterized by conservation issues related to weathering, as Paolo Marconi pointed out in relation to the easy perishability of finishing with travertine effect of Palazzo di Giustizia or “Palazzaccio” in Rome (Marconi 1988). Usually cement binder turned out to be strong and lasting even in an aggressive environment like the city, characterized by acid rain and pollution. The features that improve these qualities are linked with the accuracy in casting the concrete for decorations, the particle size distribution and the restrained fluidity of the grout (Torraca & Giola 1999).
The surface treatments, carried out also for the adjustment of mould-release possible flaws, could be made on both the fresh concrete and the dry one, obtained polishing with pumice stone or siliceous sandstone. In the city hall of Camposanto the alveolisation was probably carried out treating the surface with wire brushes, possibly wet with iron oxide or earthenware powder (Cerroti 2008). Also the pitted effect typical of travertine was probably obtained during the finishing rather than the casting. The master of stone simulation Giuliano Chiesi confirmed the practice of using salt dusted with iron oxides to obtain travertine alveolisation.
Melting salt crystals, the following superficial wetting created very convincing vacuoles and colour dripping (Cavallini & Chimenti 2000) (Fig. 5). Finally the simulation of travertine *bugnato* was made with wooden plank that engraved horizontal and vertical lines on the concrete surface (Fig. 6).
A more complex process has probably interested some architectural elements like the main front columns, characterised by two-toned striping. The marbling effect was reached preparing two grouts with the tone of the colours desired, spreading them in overlaid layers, cutting them into slices and putting the strips obtained one near the other on the inner core made of brick masonry (Cavallini & Chimenti 2000) (Fig. 7).

Fig. 2 - City hall localisation in the small town of Camposanto (Google Maps).

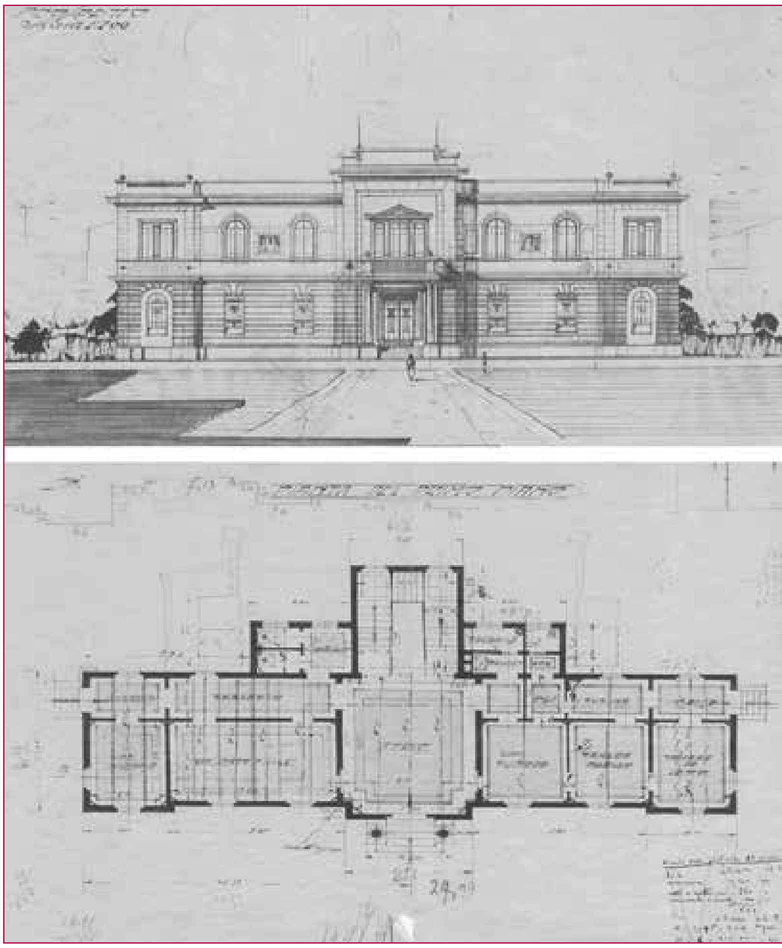
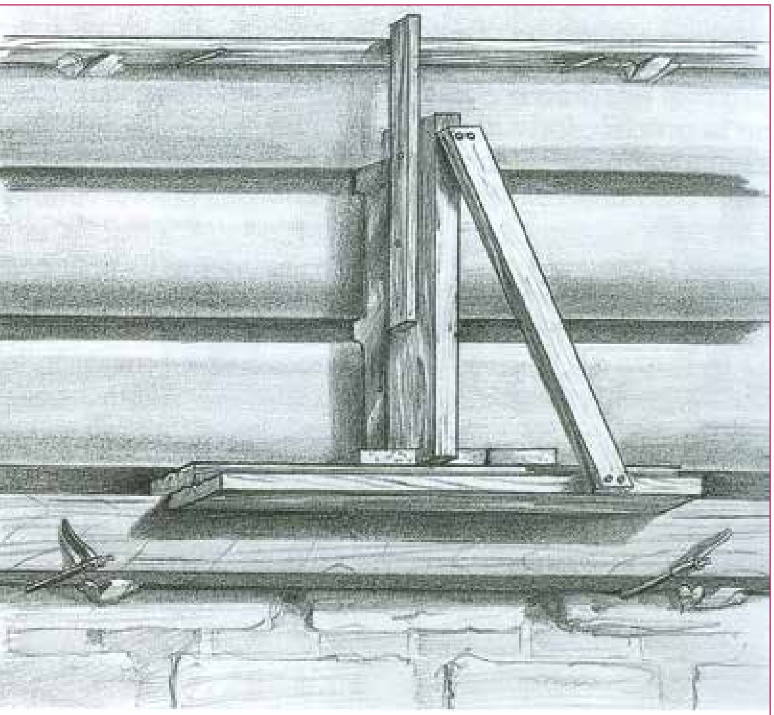


Fig. 3 - City hall construction project drawings (1931).

Fig. 5 - Decorative concrete finishing detail (photo Alvisi 2014).

Fig. 4 - Columns, frames and other architectural elements finished with decorative concrete simulating travertine (photo Alvisi 2014).



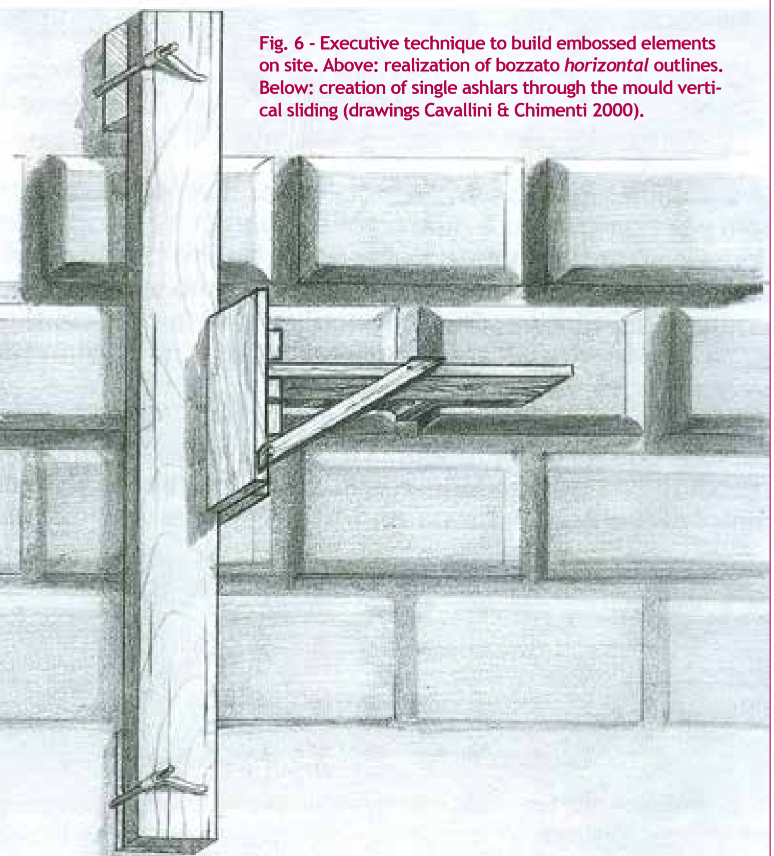


Fig. 6 - Executive technique to build embossed elements on site. Above: realization of bozzato *horizontal* outlines. Below: creation of single ashlars through the mould vertical sliding (drawings Cavallini & Chimenti 2000).

PARTICLE SIZE AND MINERALOGICAL PETROGRAPHICAL ANALYSIS

In order to guide the conservation works from the perspective of physical and chemical compatibility, particle size and mineralogical-petrographical analysis were carried out to know the characteristics of architectural elements made with decorative concrete[2]. Three plaster/mortar samples were collected from the shielded areas of external surfaces that had not undergone previous interventions; so the data acquired could as much as possible be trustworthy and give information about eventual superficial treatments not visible anymore in the macro-areas subject to weathering.
The following analysis had been carried out on the samples:

- stereoscopic microscope examination for qualitative analysis of the aggregate and the binder to identify additives and cementing level;
- acid attack micro-chemical analysis to describe the binder qualitatively;
- mineralogical analysis through X-ray diffraction (XRD) on fragments of the sample "as it is" crunched in an agate mortar;
- aggregate isolation through deionised water and ultrasounds disaggregation for a particle size and mineralogical analysis with stereoscopic microscope and following sieving;
- particle size analysis through sieving disaggregated sample with the appropriate number of sieves placed on a mechanical vibrating device;
- thin section mineralogical-petrographical analysis with polarizing microscope to study compositional, structural and textural features of the mortars.

These investigations let a scientific characterisation of the preparation mortars and the superficial finishing and provided information on the techniques used to carry out architectural elements and mouldings. The decorative concrete analysis (Fig. 8) highlighted two layers of different materials: the inner one, grayish and the external one, off-white. The first is a mortar made with lime and a plentiful amount of cement. The aggregate is composed by fluvial sand with conglomerate or sandstone particle size and granules rounding; the mineral composition presents quartz, feldspar, carbonate with metamorphic fragments of mica-schist, gneiss, ophiolite, and sedimentary fragments of pelite and marl.
The off-white external layer is composed by a hydraulic lime grout with sharp edged and average-thin particle sized carbonate aggregate. The fragments are obtained by the milling of sedimentary limestone rocks (artificial chippings);

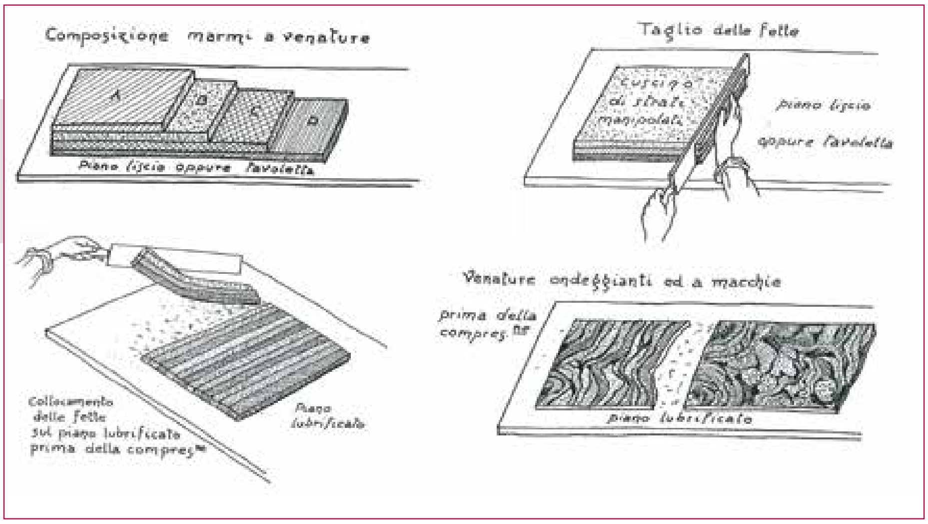


Fig. 7 - Preparation of decorative concrete simulating marbles with streaks: layers stacking made with two different grouts, slices cutting, placement of the strips obtained on a greasy surface and dough compression (drawings Cavallini & Chimenti 2000).

these consist of micro-crystalline and micritic limestone (like *Pietra d'Istria*) and biomicritic sandstone with Jurassic fossilized microfauna (as *Biancone* and *Bianco di Verona*).

The information obtained from the laboratory analysis had been useful to guide, from the perspective of physical and chemical compatibility, the preparation of the restoration mortars for the lacunae integration.

ASSESSMENT OF THE STATE OF CONSERVATION

The visual comparison of different periods photographs confirmed that the municipal hall had not been subject to significant changes[3]. However, the architectural and decorative elements of the facades had been affected by a pauperisation due to the gradual degradation of material and finishing, primarily for the exposition to weathering that caused a chromatic alteration. The close observation of architectural surfaces, that kept UNI 11182[4] dated 2006 as its points of reference, highlighted some conservation issues[5]. Two different kind of degradation forms had been identified: the first has inherent causes, connected with the characteristics of the cement component in the grout; the second has external causes, attributable to the weathering action, especially rain, freezing/thaw, wind and pollution. The latter kind appeared on the facades with difference intensity according to the surfaces orientation and location, protected or exposed to the direct action of weathering.

The degradation forms had been classified depending on the effects produced; the evaluation was based on visual and sound inspections, with the aid of optical instruments and percussion on alleged swellings.

Providing a synthesis of what was detected, the degradation forms identified can be gathered in three typologies (Fig. 9):

- material deposit: incoherent, cohesive, biological (moss and lichens), scaling and inappropriate anthropic addition;
- material removal: finishing pulverisation, run-off, erosion, lacunae development and lack of whole architectural or decorative elements;
- irreversible shape alteration: superficial and deep cracking, break in continuity, paint layers or decorative concrete swelling, detachment of material layers from each other or from the wall, shelling and iron oxidation.

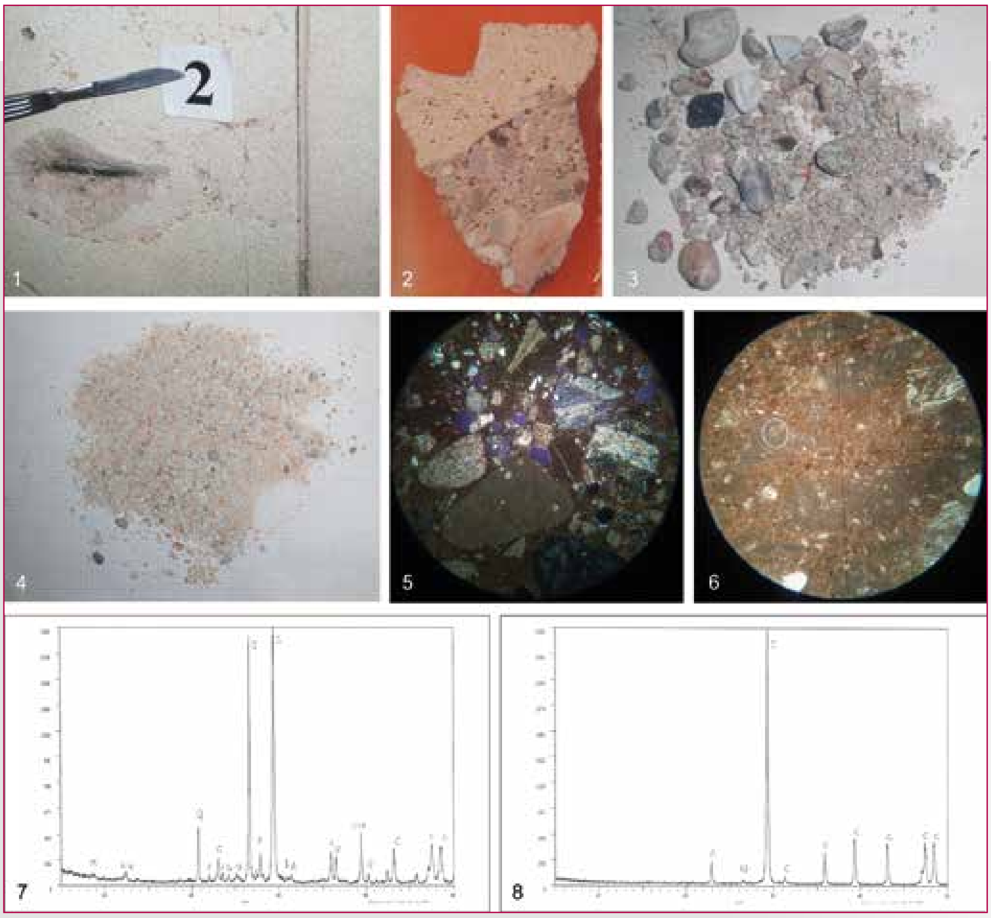


Fig. 8 - 1. Decorative concrete plaster/mortar sampling (sample n. 2); 2. sample stratigraphy: grayish inner layer (below) and off-white external layer (above); 3. grayish layer: sandy-conglomerate aggregate separated from the binder; 4. off-white layer: micro-chipping aggregate separated from the binder; 5. grayish layer: crossed nicols thin section (4x); 6. off-white layer: parallel nicols thin section (4x); 7. grayish layer: diffractogram (C = calcite, Q = quartz, F = feldspar, D = dolomite, M = mica, Se = serpentine, Cl = chlorite, A = afwillite); 8. off-white layer: diffractogram (C = calcite, Q = quartz).

Fig. 9 - Summary of the degradation forms observed on the city hall facades: 1. superficial deposit; 2. biological coating; 3. scaling; 4. pulverisation; 5. run-off; 6. superficial cracking; 7-8. deep cracking; 9. swelling; 10. detachment; 11. paint layer detachment; 12. lacuna; 13. whole element lack; 14. iron oxidation; 15. inappropriate anthropic addition (photo Alvisi 2014).

ELABORATION OF THE RESTORATION PROJECT

On the basis of the interpretation of analysis outcomes, the city hall facades had been considered subject both to physiological degradation of materials exposed to time and weathering and to the lack of maintenance. The goal established consisted of treating the issues observed but also removing to the root the causes identified, where possible.
Preceded by appropriate tests done on sampling areas for the calibration of executive parameters, the works carried out on the municipal hall facades are here summarised (Fig. 10).

1) preliminary operations:

- verifying elements stability and plaster adherence to the wall through knocking on the surface; following manual removal or attachment of the detaching parts with provisional work, temporary sealing, prop or bandage as appropriate;
- verifying rainwater outflow efficiency and replacement of the damaged elements in order to prevent water leak and percolation on the surfaces;
- doors and windows protection before cleaning;

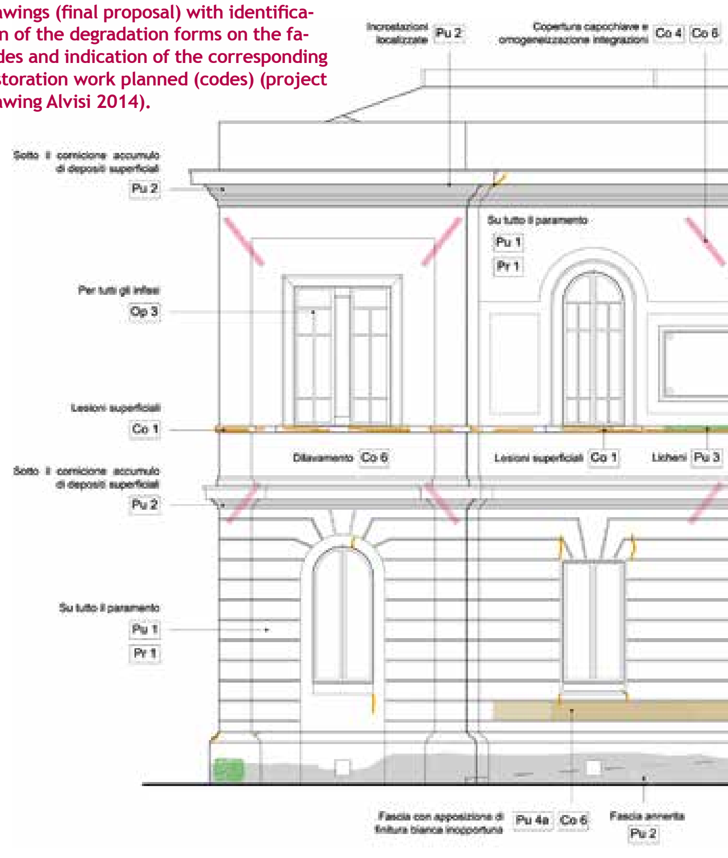
2) cleaning: operation carried out by respecting surfaces and patina of time, removing only what is damaging to the building conservation:

- incoherent deposits: dry removal with soft natural bristles brushes and vacuums;
- coherent deposits and scaling: removal with sponge and water;
- biological coating, moss and lichens: appropriate biocide application limited to the attacked area and following accurate surface washing with low-pressure deionised water;
- inappropriate anthropic addition: removal with caution to avoid damaging the surface;

3) consolidation and integration:

- superficial and deep cracking: grouting with a low saline hydraulic mortar prepared on site on the basis of laboratory tests results and coloured with the addition of organic and chemically stable pigments; application in layers where necessary and, after the first hardening, sponging with deionised water and sea sponge in order to expose the aggregate; sealing kept at the same level of the surface to facilitate the water outflow;
- detachment and shelling: attachment of the parts in risk of falling with stainless steel or fiberglass pins or annealed steel strings in relation to the element size;
- iron oxidation: cleaning, application of rust restraint agent and reconstruction of the lacking part;

Fig. 10 - Extract of the restoration project drawings (final proposal) with identification of the degradation forms on the facades and indication of the corresponding restoration work planned (codes) (project drawing Alvisi 2014).



- lacunae: integration with hydraulic mortar (same composition of the mortar described for the cracking) with aggregates characterised by particle size decreasing from the deeper to the more superficial layers. Verifying the new mortar-existing surface compatibility, to avoid the cracking and detachment of the new material because of the diversified reduction. A number of attempts on site led to the desired superficial effect, similar to the original one for colour and texture. The following stratigraphy had been applied (from the inside out): hydraulic mortar made with lime and eco-pozzolana; hydraulic mortar containing sand and brick shards: lime and marble powder bedding (2 parts of lime, 1 part of sand, 1 part of white marble and 1 part of yellow marble); superficial finishing with white marble[6];
- lack of whole elements: application of rust restraint agent, first layer of mortar with a composition such as to give structure to the element, second layer of lime mortar and the same finishing described for lacunae. This procedure had been carried out for the reconstruction of original geometries with at least 3-4 cm of thickness;

4) protection: superficial treatment based on siloxanes, water resistant and colourless.

CONCLUSIONS

The works on Camposanto city hall have been carried out in spring 2016 (Fig. 11). The direct observation of the monument and the interpretation of its values highlighted the significant role of its decorative concrete finishing. The implementation of instrumental analysis, accurately chosen due to the information needed about materials and compositions, completed the information-gathering studies, providing the basis for the elaboration of a conscious and coherent conservation project. Therefore this experience shows an interesting example of XX century architecture restoration, a topic not yet systematically studied and for which accepted methodologies are neither widely shared nor consistently adopted.

Fig. 11 - The main front of Camposanto city hall after the restoration works (photo Alvisi 2016).

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Abstract

The contribution intends to illustrate the design path towards the elaboration and realization of conservation works on the facades of Camposanto city hall (Modena province, Italy). Built in 1933, the municipal hall is characterized by simple and regular lines, horizontal rhythm of the parts and sober decorations. The building is enriched by a decorative concrete finishing that simulates travertine. In the context of the interventions planned after 2012 Emilia's earthquake, seismic improvement, energetic efficiency and facades restoration works were carried out. The latter needed an in-depth analysis of the material used to understand its characteristics and forms of degradation and to propose an accurate calibration of conservation solutions.

Note

1. Camposanto city hall was lightly damaged by the earthquake of May 20th-29th, 2012. The year after, a seismic improvement and restoration project started. Furthermore it provided energetic efficiency and architectural barrier removing works. The intervention was carried out between 2015 and 2016. Architectural designer and works director: arch. Alessandra Alvisi; structural designer and works director: eng. Giancarlo Boschetti; contractor: Edil Borgonovi.
2. The analysis were carried out by the geologist dott. Gian Carlo Grillini, after the monument survey and the sampling for laboratory tests (October 2015).
3. It is reported the recent construction of a wheelchair ramp on the main front of the building.
4. This is the update of *Raccomandazioni Normal*, especially of the document Normal 1/88 - *Alterazioni macroscopiche dei materiali lapidei: lessico.*
5. Here the aspects closely related to architecture and surfaces are analysed. During the diagnosis they have been put in relation with the structural issues so as to elaborate, in the following design phase, coherent choices. Indeed surfaces restoration and structural consolidation are parts of the same discipline.
6. Although called on site "marble powder", actually it is milled limestone.

Parole chiave

Camposanto, decorative concrete, simulated travertine, direct analysis, particle size analysis, mineralogical-petrographical analysis, conservation, restoration

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