STUDY OF CONSERVATIVE CONDITIONS OF "EL PATIO DE ESCUELA MENORES" (SALAMANCA, SPAIN)

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The following petrographic study deals with the lithologycal identification of rocks, the recognition of the pathology and the evaluation of conservative state of the material used in "*El patio de escuela menores*", one of the most famous building placed in the "Old City" of Salamanca (Spain) (Fig.1).

Fig. 1. Salamanca (Spain). Red arrow shows "El Patio de Escuelas Menores": blue arrows indicates external façade wall in Calle La Plata and the red one the ancient fountain.

"El Patio de Escuelas Menores" is the building that housed the minor teachings College (Bachelor's degree) and its construction began in 1428, on the project of Juan de Álava, and it finished in 1533, when Pedro Chacón refined the facade using plateresc style.
The building is organized around a courtyard with a single plant and irregular sides, characteristic of Gothic style. The mixtilineal arches, the angled archways and the baroque banisters with plateresque pinnacles, designed by Architect Jerónimo García de Quiñones, remind to typical Salamantine flavor of other noble houses' patios [1].
This paper shows results obtained on the two following area:

- a limited zone of external wall with a pedestrian crossover arch;
- the ancient fountain placed inside the cloister.

The external wall is mainly made by a different kind of materials (Fig.2): Arcosic sandstone (Fig. 3a) and by Piedra Sangrante (Fig. 3b); meanwhile, the arc is build by blocks of Villamayor Sandstone, a very fine-grained sandstone (Fig. 3c) [3], with a recent concrete base. Spread to the wall is also possible to find small pieces of Shale, Granite, Brick and Cement (Fig.2).

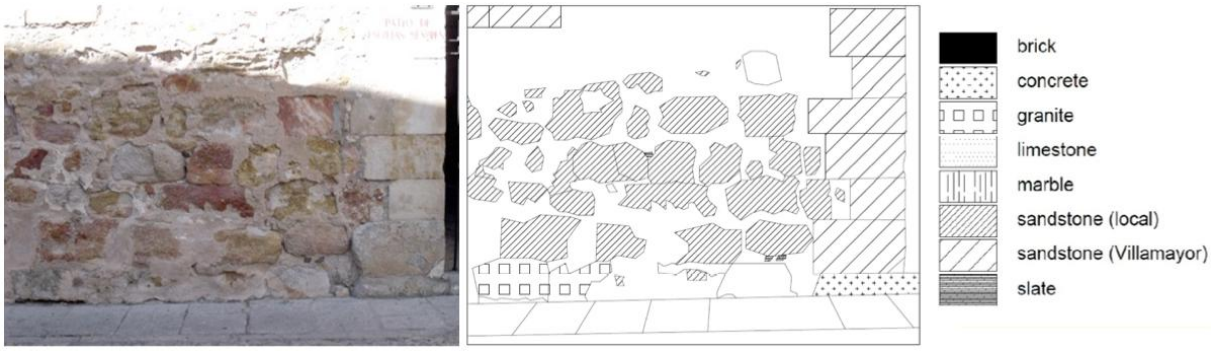

Fig. 2. External wall of Patio de Escuelas Menores: macroscopic petrographic characterization.

Fig. 3. Building's materials of external wall: a) Arcosic Sandstone (matrix with Quartz Clasts); b); Piedra Sangrante; c) Villamayor Sandstone.

These constructive blocks show different conservative condition and degradation phenomena: lacks, superficial erosion, shaped angle, etc. and other decay due to environmental exposure and to kind of materials (Fig. 4-6).

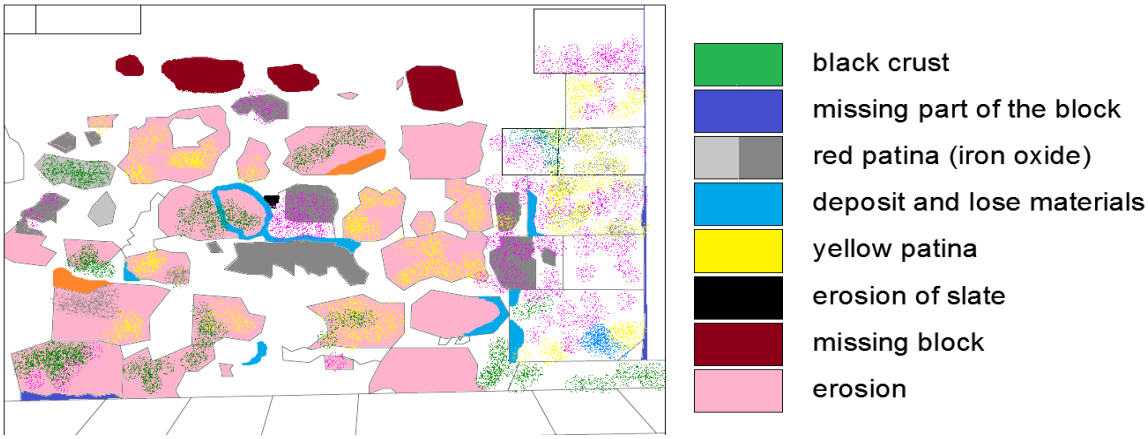

Fig. 4. Types of decays in the external Wall in Calle Plata.

Fig. 5. Coving (disaggregation of individual geologically weaker sandstone blocks due to the consequential effect of repointing the joints and beds with a too hard and durable cementius mortar), lack, superficial erosion.

Fig. 6. Superficial erosion, iron oxide decay (red), biological attack (spider web), lack.

Therefore, the use of rocks and materials with different physical-chemical-mechanical properties can cause stability problems to the architectonic structure with structural failures, such as those occurred following Lisbon Earthquake in November, 1st 1755. Indeed, one of the principle problems observed in "Patio de Escuelas Menores" are in the blocks that constitute the entrance arc and the external wall (Fig. 7).

Fig. 7. External wall: a) fissure's map on probably due to seismic event (red line); b) fissure and blocks' displacement.

Seismic activity, over the years, has created fractures on the wall and it opened spaces between the blocks and these ones have started to collapse. Furthermore, the consequently weight increase started to damage also the wooden inner structure (Fig. 8). However it's not possible to say that these ones have only direct correlation with the seismic activity, and it would be necessary to monitor them for a long period of time to give a more conclusive answer.

Fig. 8. The upper part of the entrance arc, where the blocks of Villamayor Sandstone have started to collapse (a) fissures in the wooden structure and fracture on the left internal wall (b).

In the centre of *El Patio de Escuelas Menores*, the ancient fountain shows four medallions of 16th century, which originally were at the *Colegio del Rey* [1]. Unfortunately, bad conservative conditions of the low reliefs do not allow to identify the persons engraved in the rock's plates. The fountain is mainly made by Limestone, probably the original material, but it is possible to observe different kind of rocks and concretes that could be referred to ancient and recent restoration acts. The miscellanea of materials and relative conservative problems were studied for each of fountain's four sides and for the interior base. Limestones, bricks, different kind of marble (Greyish Marble, Whitish grey marble, Rose marble, etc.) and granites, characterized by Quartz, K-Feldspar, Plagioclase, Mica and Kaolinite, were found, in different ratio, in all the sides of the fountain (Fig. 9-10).

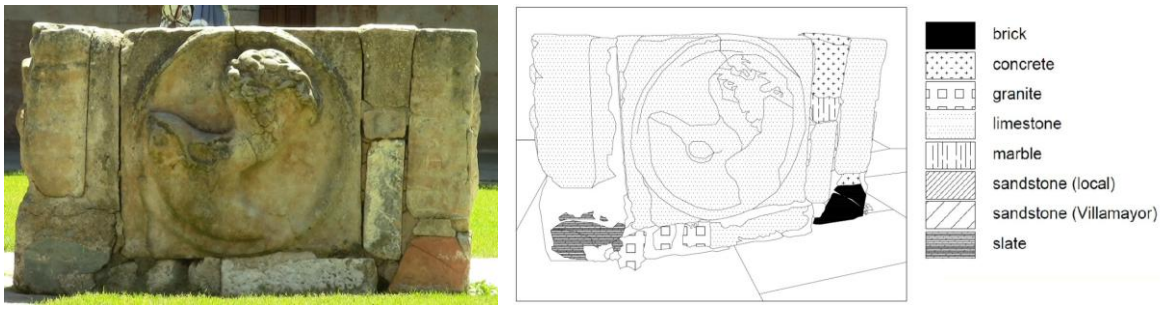

Fig. 9. The Northwest Wall of the fountain: map of material.

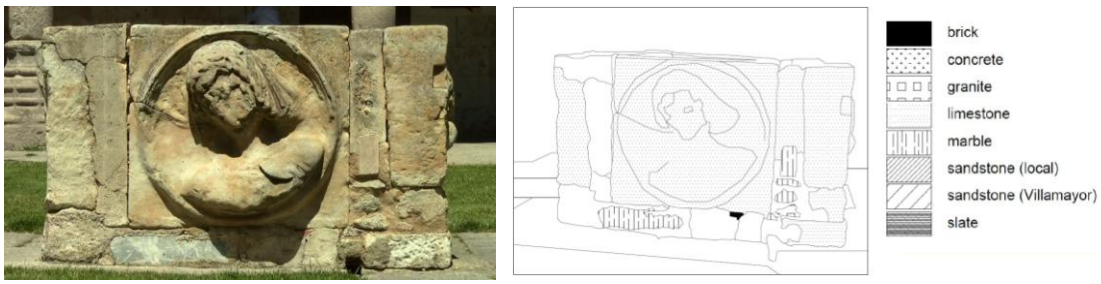

Fig. 10. The South-east Wall of the fountain:map of material.

The fountain shows lots of problems probably due to weathering, being exposed to environmental agents. It is possible to see erosion phenomena in all the four part of the monument and other localized area with different decay that could be dangerous for sculpture, etc. (Fig. 11-15).

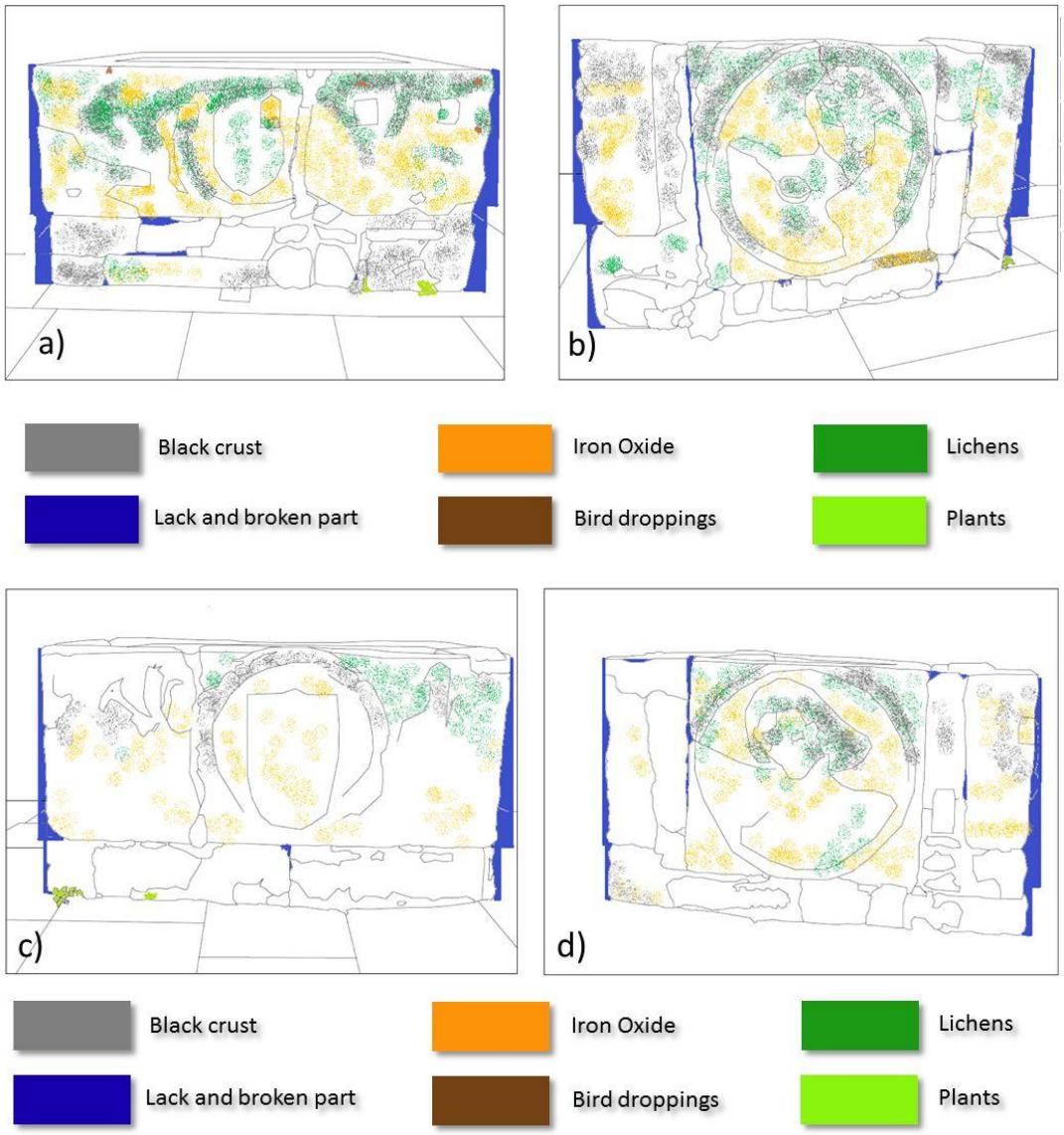

Fig. 11. Conservative condition's maps of fountain: a) N-E side; b) N-W side; c) S-W side; S-E side.

Fig. 12. Superficial erosion of bas-relief that caused loss of carved details, and smoothed shapes [2].

Fig. 13. Black crust, iron oxide patina (red patina), superficial erosion, lack material [2].

Fig. 14. Superficial erosion, black crust and lichen [2].

Fig. 15. Superficial erosion, iron oxide patina (red patina), human activities' decay (hole, scratched line, ecc.) on brick probably linked to re-used material, biological attack (lichens and plants) [2].

Biodeteriogena microorganism, such as lichen, were found especially in the upper part of the bas reliefs and on the higher part of fountains' block. It is possible recognize four different kinds of lichens: orange, yellow, white and black crusty thallus lichen (Fig. 16).

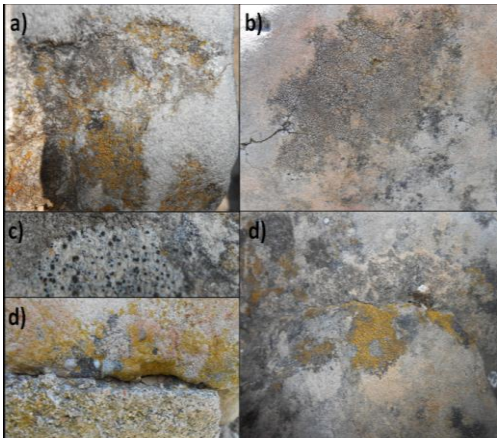

Fig. 16. Different kinds of lichens.

In conclusion, this study provides a preliminary materials' characterization based on macroscopic petrographic approach and it allowed to identify the main conservative problems. This base are useful to project immediate small "make sure" interventions of building and in support to future study for maintenance and conservation act.

References

[1] Álvarez, A. J., 2001. *El patio de escuelas de la Universidad de Salamanca*. Ediciones

Universidad de Salamanca.
[2] ICOMOS International Scientific Committee for Stone (ISCS). Comité scientifique international "Pierre" de l'ICOMOS, (2008), *ICOMOS-ISCS: Illustrated glossary on stone deterioration patterns*": 28-32, 42, 64.
[3] Nespereira, J., Blanco, J.A., Yenes, M., Pereira, D., 2006. Problems in the use of the Salamanca sandstone in historic monumets. In: Geophysical Research Abstracts, 8, 00940: 2.