Concrete facade conservation of the Peru Pavilion of Seville (1927). Analysis of decay and evaluation of protection treatments

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HISTORICAL INTRODUCTION OF THE BUILDING

The Peru Pavilion of the Iberoamerican Exposition 1929 (IE) is a building projected in 1927 by the architect Manuel Piqueras Cotolí (1886-1937). The time passed and the almost constant humidity conditions to which it is subjected (little sunlight, surrounded by great size trees, near Maria Luisa Park) have developed a constant decay. The building is included in the IE and Maria Luisa Park Cultural Heritage Catalogue

Image of the Peru Pavilion 1929

OBJECTIVE

The aim of this work is to analyze and determine the origin of the pathologies in the original concrete that constitutes the ornamental elements integrated in the brick facade of the Pavilion. Samples were extracted in order to analyse the most important physical, structural and mechanical properties to study their conservation status.

Analyzed materials are samples of prefabricated concrete taken from the decorative elements that make up the façades of the building.

In the picture it can be seen the thickness of the prefabricated section and the difference between the outer mortar layer and the concrete interior.

MATERIALS & METHODS

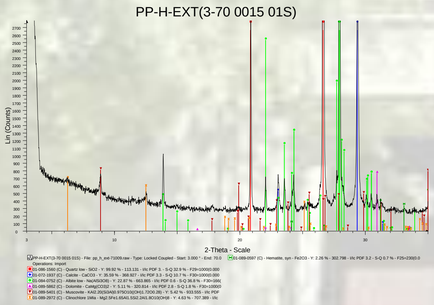
Analyzed materials are samples of prefabricated concrete and mortar from the decorative elements that make up the building façades. Chemical analysis (FRX) and mineralogical (XRD) and carbonation evaluation were developed; physical properties (porosity and water permeability) and compressive strength (UNE-EN-12504-1: 2001 and UNE-EN- 12390-3: 2003) were determined.

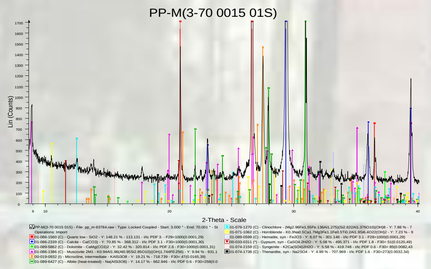
ANALYSIS OF RESULTS

Most of the mineral phases identified in mortar and concrete samples have been those that could be expected considering the nature of its components: quartz, feldspars (albite and microcline), clinochlore, hornblende, muscovite, hematite and dolomite. Traces of sulfated salts (syngenite and tenardite), formed by the reaction of gypsum (cement retarder) and/or its environmental alteration products with alkaline cations (Na^+ and K^+) have been identified (Setti, 2012).

The depth of concrete carbonation is influenced mainly by the following factors: environmental relative humidity, open porosity, cement dosage (kg/m^3) and the age of the concrete. The phenolphthalein test was performed on the three specimens obtained, giving mean values of penetration of 53, 57 and 53 mm, which denote a mighty carbonation advance. This has affected the concrete around of the metal armatures, resulting in their depassivation and oxidation that has caused the fracture of the concrete.

Setti, M. et al. (2012). Archaeometric investigation and evaluation of the decay of ceramic materials from the church of Santa Maria del Carmine in Pavia, Italy. Mat Const 62 (305): 79-98





The phenolphthalein test shows the depth of carbonation. The exterior layer (carbonated) has developed a lowering of the pH with respect to the non-carbonated interior layer, which maintains the initial concrete pH value (~ 13). In this range the indicator causes a purple coloration that does not appear in the exterior zone.

In the images it can be verified that the circumstance occurs both in the samples in which the exterior layer is made of mortar (A), as in those that are just of concrete (B).

CONCLUSIONS

- Obtained results do not allow to establish the existence of enough quantity of soluble salts to develop a degradative effect by crystallization and formation of efflorescence. The higher presence of sulfur in the exterior samples may be due to the migration of sulfate salts of Na and K (syngenite and tenardite), detected in mineralogical analysis, and the surface sulfur deposition (SO_3) from the combustion gases of vehicles.
- A clear front of carbonation has been observed, it has depth ranges between 5 and 6 cm, and it clearly reaches the position of framework its subsequent depassivation and deprotection, which has resulted in corrosion processes.
- Resistance values achieved for mortars and concrete have been very high, especially for the mortars, and they indicate that they are not developing any deterioration that affects their mechanical capacities.

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