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Petrographic Characterization of Partition Wall Mortars of a 19th Century Building

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Abstract

The structures rehabilitation involves a rigorous pathological diagnosis defining the conservation state and possible impact of those pathologies in the structure. This work is focused in aerial and hydraulic lime mortars and gypsum plasters petrographic study of a building from the 19th century existing in Felgueiras, Portugal. This building is representative of the buildings that was built in same period in this city. The mechanical and water absorbing behavior of mortars is important to know the mineralogical composition of the mortars, as well as, identify the pathologies and rehabilitation techniques adequate to contain the problems that may occur in the mortars and consequently on the structures. The case-study building is a typical masonry structure building with lime mortars, with wood floors and roof. Deterioration caused by capillarity and infiltration is present among other pathologies. A petrographic microscope was used to analyze a sample of a partition wall mortar, allowing to identify the mortar layers, and for each layer the minerals and their dimensions. Also a qualitative study of the binder/minerals volumetric plot and the size of the minerals and of the voids/hollows can be made. The exterior layers have, usually, finer aggregates and higher binder ratios (1- part aggregate to 1, 2 or 7- parts of binder).

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1. Introduction

Traditional masonry construction is based in using the local resources, techniques and skills inherited from the ancestors [1-3]. In this kind of construction was not done a formal design, or construction process, being the construction form, material and methods made following the local concept of the era of construction [1, 2, 4]. Masonry structures are composed by stone bounded with mortar, arranged irregularly [1, 5].

The building rehabilitation to be performed correctly should require accurate knowledge about the existing buildings and the use of adequate rehabilitation techniques guarantying functionality, preservation of the cultural and original features and safety [3, 6]. For the restoration of masonry structures are necessary two main procedures: jointing and grouting (refilling gaps and hollows regaining reliability) [7]. The new mortars should be compatible with the original ones [7]. Cement-based or polymer-based materials use may induce damages in traditional structures [8].

The study of historical buildings and mortars is important to determinate the technological parameters that give different properties to the final material [9].

Optical microscopy and polarized light, is an useful instrument for crystalline materials analysis, both natural and synthetic origin [10]. The mortars mineralogical constitution is very important to understand the mechanical behavior. A petrographic experimental campaign was carried out to study mortars minerals, from mortars extracted from a Romantic/Revivalist character building from the 19th century, existing in Felgueiras city, Portugal. This building was implemented in a region with an annual moisture of 80%. The ground floor is composed by exterior and interior structural masonry walls. The first floor by exterior masonry structural walls and interior by wood partition walls. The second floor is exteriorly limited by the roof and has the interior divisions realized with wood partition walls. The roofs with wood beams and wooden slats with wood of cone or pine. This study focus on the petrographic analysis of the mortar of a partition wood wall.

2. Petrographic behavior experimental campaign

2.1. Principle and components

The petrographic microscope is fundamental to see the minerals present in mortars, due to their reduced dimensions. This kind of microscope is no more than a usual microscope, adding two polarizers above the incident light. The petrographic microscope (Fig.) is composed by an optical system: eyepiece, Amici-Bertrand lens, analyser, objective, mobile condenser, iris diaphragm, fixed condenser, blue filter and polarizer. In addition, it also includes a mechanical support composed by: tube, arm, revolver (or objective support system), platinum, macro and micrometric rack of vertical platinum handling, and a base [11, 12]. The petrographic analysis allows to identify the various layers and minerals of the mortars.

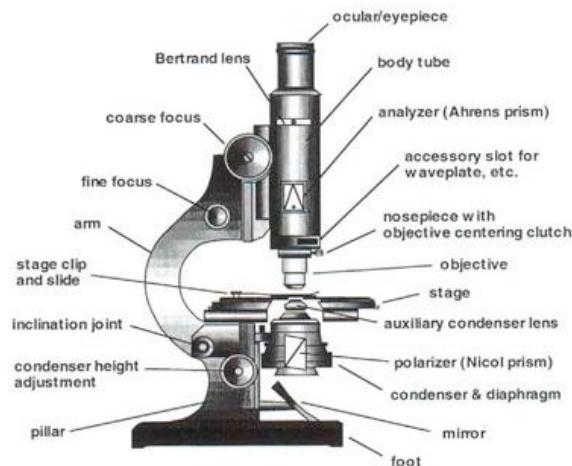


Fig. 1. Diagram of petrographic microscope (image from: [15]).

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