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## EVALUATION AND CHARACTERIZATION OF BRICK MATERIALS FROM HISTORICAL BUILDINGS

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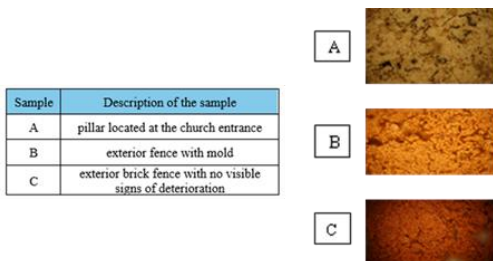
### **Introduction**

Historical buildings represent a valuable national asset, embodying a country's cultural, religious, and traditional heritage. Like other countries, Romania had centuries-old architectural and historical landmarks. These included archaeological sites, shrines, tombs, buildings, residences, monuments, and places of worship (churches and monasteries), the majority of which were constructed from bricks. The restoration of historical buildings from Romania represented a stringent necessity, given their invaluable significance from cultural, historical, and architectural perspectives. Beyond their symbolic importance, historical buildings had significant educational and touristic value, contributing to the sustainable development of local communities and promoting Romania's image in international arenas. However, due to the passage of time, unfavourable climatic factors, material degradation, and inappropriate interventions, many of these structures were at different advanced stages of deterioration, risking the loss of their authenticity and structural integrity. In this context, the restoration process was not limited to physical conservation but involved an interdisciplinary approach that integrated modern scientific methods of analysis and diagnosis, adherence to conservation principles, and the valorisation of traditional technologies adapted to the specific characteristics of each monument. Thus, the restoration of heritage buildings became a complex and responsible endeavour, essential for preserving and transmitting the cultural legacy to future generations, while also ensuring the continuity of the aesthetic and functional values of Romania's built heritage.

### **Materials and methods**

The heritage building was an Orthodox church constructed in the Brâncovenesc style between 1714 and 1715 (Buzău County, Romania), and it needed restoration. To support conservation efforts, a series of brick samples collected from the church walls were analysed to identify the types of aggregate and binder that had been used in its construction. The objective was to identify the types and properties of the

materials used, in order to select compatible materials for use in the restoration process. Thus, a series of morphological and structural analyses were performed, including optical microscopy (Figure 1), Scanning Electron Microscopy coupled with Energy Dispersive X-ray Spectroscopy (SEM-EDX), X-ray diffraction (xrd), and Fourier transform infrared spectroscopy (FTIR). It is important to mention that the sample collection was carried out with the consent and authorization of the competent authorities responsible for cultural heritage management.



**Figure 1.** Description and optical microscopy analysis of each sample

### ***Results and conclusions***

The experimental investigations provided detailed insight into the composition and characteristics of the building materials used in the church construction. SEM-EDX analysis revealed that the binders in the samples taken from the pillar located at the church entrance and from the exterior brick fence were carbonated non-hydraulic types. XRD results confirmed the presence of calcium carbonate phases typical for this kind of binder. FTIR spectroscopy identified organic components in the samples collected from the interior walls, which may have originated from residual traces of mural paintings or from the penetration of pigments and compounds used during the painting process into the mortar substrate. Additionally, samples from the exterior fence showed evidence of a compound likely to be an aluminosilicate binder characteristic of red bricks, containing calcium carbonate and organic substances. The presence of these organics was most likely related to mold growth on the surface of the exterior fence.

The identification of carbonated non-hydraulic binders in key structural elements confirmed traditional construction techniques specific to the period and style. Organic residues detected inside the church highlighted the impact of decorative mural paintings on the mortar composition, while the presence of aluminosilicate binders and organic compounds on the exterior fence suggested both material-specific characteristics of the bricks and biological contamination.

These findings emphasized the need to carefully select restoration materials that were chemically and physically compatible with the original ones to ensure the durability and authenticity of the restoration works.