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Investigation of Biological Defradation Mechanisms in Adobe Materials and Establishing a Systematic Behavioral Framework

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ABSTRACT

The deterioration of building materials is a complex and multifaceted process influenced by various environmental, climatic, and internal factors, which can generally be categorized under three main headings: physical, chemical, and biological degradation. As with all traditional and modern construction materials, it is evident that earthen-based materials, specifically adobe, are also profoundly subject to these impacts throughout their entire lifecycle. However, each material exhibits a unique performance and a non-uniform reaction when exposed to these degradation processes due to its specific mineralogical composition, porous structure, and local soil characteristics.
In recent years, while physical weathering and chemical transformations have been extensively documented in architectural conservation, the biological degradation mechanism—particularly in natural building stones and ancient masonry units—has emerged as a critical subject of extensive academic research and scientific inquiry. Despite its significant ecological advantages, carbon-neutral footprint, and historical importance, the biological vulnerability of adobe remains an area that requires much deeper investigation in the context of modern climate challenges.
This study specifically investigates the biological degradation framework of adobe materials, exploring how microbial activities, fungal formations, and organic growths interact with the material's inherently porous and hygroscopic structure. The research identifies the specific environmental factors, such as high humidity and thermal fluctuations, and biological agents that most significantly influence this process, ranging from moisture-driven fungal growth to various bacterial colonizations. The primary objective of this study is to gather comprehensive, empirical, and qualitative data on this traditional material, effectively filling a prominent gap in the current literature regarding the long-term durability of earthen structures. Ultimately, the study aims to establish a systematic and scientific framework regarding how adobe behaves in the face of biological effects. By doing so, it provides a crucial foundation for developing more resilient, durable, and sustainable earthen construction techniques and conservation strategies for the future of green architecture.

KEY WORDS:
Adobe material, biological degradation, material durability, earthen architecture, microbial deterioration