

# Mitigation and adaptation of climate change in the conservation and preservation of architecture and funeral landscape in Qubbet el Hawa

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On the western coast, high-ranking officials and members of the elite from Elephantine chose the east-facing hill of Qubbet el-Hawa as a cemetery during the Sixth and Twelfth Dynasties. These tombs remained unexcavated until a few decades ago, which resulted in constant environmental conditions inside.

However, the process of exhumation and excavation of many of these tombs in the necropolis has accelerated their deterioration. Additionally, the effect of climate change, which includes increases in interior temperature and relative humidity, has further added to the problema. This research proposes a method for evaluating the impact of future climate scenarios on the preservation and conservation of tombs. An experimental method was followed, which combined analytical formulations and in-situ measurements. The climate change scenario predicted for 2030, 2050, and 2100 was based on the projected temperature variation. The case studies were the Qubbet el-Hawa tombs located in Elephantine, the capital city of the southernmost province of Upper Egypt until the Roman period. The data obtained from the monitoring campaign carried out in these tombs were used to validate simulation models. Design Builder, Energy Plus, and Dialux Evo were used to generate models that reproduced the tombs in detail, enabling the simulation of indoor environmental conditions. To ensure the preservation and conservation of this heritage, one of the main measures should be reducing fluctuations in air relative humidity and UV radiation in the interior space.

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