

# Consolidation works on sandstone monuments: A new approach

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## 1 INTRODUCTION

### 1.1 STONE DEGRADATION PATTERNS AT ATOUGUIA DA BALEIA VILLAGE

Portugal is the home of some very important buildings and monuments where natural stone is the predominant material, for example, in castles, churches, and palaces. Sandstones use is common in traditional buildings in western regions of Portugal (Peniche and Lourinhã) and in Algarve (Silves).

The International Council on Monuments and Sites—International Scientific Committee for Stone (ICOMOS-ISCS) [1] describes stone degradation patterns on monuments and ancient buildings. All of five families of ICOMOS-ISCS [1] patterns were found in the facades of the medieval monuments of Atougua da Baleia, in Peniche [2]: crack and deformation; detachment; features induced by material loss, discoloration, and deposits; biological colonization.

All porous building materials are reached by salt weathering effects near the shoreline and in desert environments. The seawater is the source of sodium chloride salt, absorbed by capillarity from the water table below foundations and by salt spray that reaches building facades. Salt effect on porous building materials is visible even at a distance of about 3–5 km from the coast, besides the decrease of circa 30%–50% on chlorides concentration in total deposition [3]. The oldest known reference about salt effects on buildings in desert environments belongs to Herodotus and was written in fifth century before common era (BCE). The Greek historian reported that salts injured the pyramids, cited in Ref. [4]. Lucas cited in Ref. [5] referred to sodium chloride as playing the most important leading role in the majority of conservation and restoration works on sandstones and limestones of dry environments—namely, in Egypt—followed by sulfates, carbonates, and nitrates. A recent report indicates general salt damage occurrence on the buildings of the Jazirat Al Hamra area in United Arab Emirates [6], a town located near the shoreline and in a desert environment.