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Conservation of coral stone architectural heritage on the coast of East Africa

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Abstract

Much of the architectural heritage on the coast of East Africa was built with coral limestone and today it suffers from a severe decay. Swahili architecture and European colonial architecture are part of this heritage. After many observations at sites such as Inhambane, Ilha de Moçambique and Ilha de Ibo, we think that the phenomenon of regeneration of soluble salts is the main cause of degradation of coral stone buildings.
Knowledge and mastery of the physical and chemical phenomena in coral stone buildings are the basis of the preservation process. But the techniques of the past, when known to the restorer, can suggest the best way for the restoration and maintenance practices (Some topics of this theme: lime from coral - sand fluvial from the Ibo Island - *murrapa* juice, as an additive for mortar).
Finally, the paper proposes the idea of preserving historic coastal settlements in an optimal equilibrium with natural environment assets.

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Keywords: coral stone; conservation; soluble salts; tropical coasts, *murrapa*.

1. Introduction

My interest in coral stone buildings began in 2004 with the request for an opinion from the Director of the Cooperação Técnica da República Federal da Alemanha in Mozambique (former GTZ, now GIZ). The German Cooperators' intention was to use the recently restored church of Inhambane for an archaeological exhibition.

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They asked the Faculdade de Arquitectura in Maputo to assess the disintegration phenomenon of plasters reappeared on the church soon after restoration works and to suggest some procedure for achieve a regular course of the scheduled event[i].

2. Disintegration of coral walls

During my survey in Inhambane I was convinced that the major problem of deterioration in the church of Nossa Senhora da Conceição was caused by the migration of salts through the walls and that the slight deformation due to the collapse of the wall area facing southeast was to be considered stable. In a simple visual exploration of the oldest buildings in town, it was noted that the phenomenon of salt crystallisation must always have been present since their construction. In fact, many of the oldest buildings in Inhambane present quite a number of plastering patches; it is thus possible to compare samples of plaster in their time sequence in order to identify the different degrees of technical skills, strength and effectiveness. Even with no instrumental survey on the samples, the patches' position and mixture showed that in the past maintenance workers had realized that the problem to be solved was the inhibition of water penetration from the outside. They had made different types of mortar in order to get very low porosity plasters. In mixture of some patches I recognized *pozzolana* ash, in a relevant proportion. I thought it was not cement mortar because the analysed fragments showed a grey-red colour; furthermore, the ray-red granules were visible at first sight and the fragment, once compressed, lost its shape and became dust; that means it was made of a ductile material and then it didn't break sharply as it is typical of fragile things such as a fragment of cement mortar.

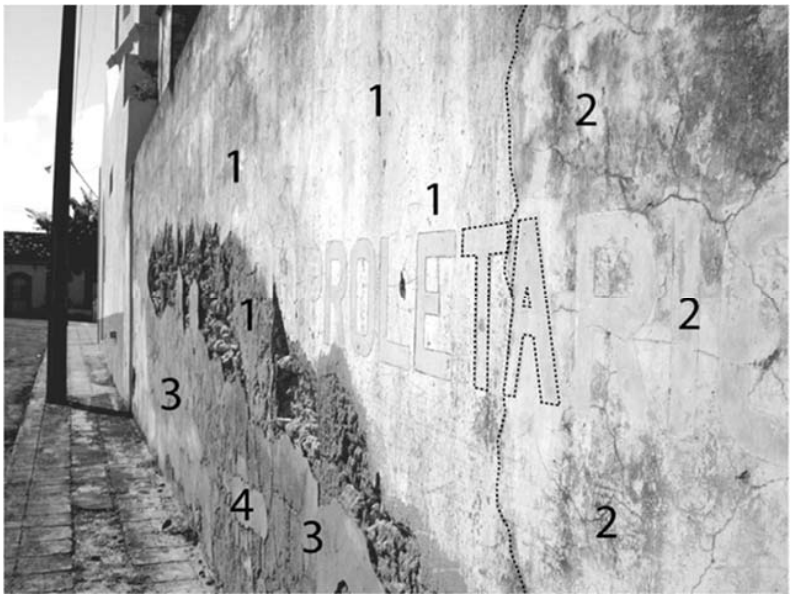

Fig. 1. Map giving the time cycle of disintegration of plasters and the wall in Inhambane.

In various processes of the historic heritage preservation, the salt migration phenomenon through the materials is being studied with the tools of chemistry. In literature may be found different ways to limit the process of disintegration of the masonry caused by the migration of saline solutions and the reformation of salt crystals due to water evaporation. In general, the disruptive phenomenon can be controlled working on a simple physical level, i.e. washing the walls with water, once the flow of saline solutions has been inhibited[ii].

When materials with open and homogeneous porosity are present, such as high-quality bricks or some types of compact rocks, the widespread moisture phenomenon can be controlled. The procedure is aimed at downsizing the capillary network by the use of lime or silica or various types of resins. These products are forced to flow and deposit themselves in the cavities at different depths, in a more or less predetermined thickness. In this way the pore width is reduced.