

# **I BO ISLAND IN THE QUIRIMBAS ARCHIPELAGO: AN ARCHITECTURAL HERITAGE WITHIN A NATURAL HERITAGE**

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*Keywords:* Ibo, Quirimbas, architectural heritage, natural heritage, coral stone

## **1. Introduction**

Interest in the architectural heritage built with coral stone in Mozambique began in 2004 on seeing the disintegration of the walls of houses and public buildings in the city of Inhambane [1]. From first observations, it was clear that the main cause of this disintegration was due to the presence of water-soluble salts. In aqueous solution, salts can be absorbed from the environment, but they may be present in the building materials before being used for construction, in solution or a crystalline state. The observations were extended from Inhambane to Ibo and the Island of Mozambique, where the same phenomenon was found.

The geographic regions affected by similar phenomena are distributed along the coasts included in the tropical zone and the topic deserves more attention, although it has recently gained some space in the literature on heritage conservation [2,3].

A wall of coral limestone can be contextualized in its physical environment through the technological and historical tools used by conservation specialists. However, a wider knowledge of the different ways in which nature and culture meet is an interesting path to explore not only for scholars but also for tourists and especially for the resident community.

The same phenomena are present in Inhambane and the Island of Mozambique and Ibo, but in Ibo, the correlation between the natural context and the local culture is more surprising than in other places. The culture, architecture and nature of Ibo are resources combined in a simple but peculiar equilibrium. The protection of this balance could be considered as an initial investment to preserve the value of the entire natural and cultural heritage. Understanding the interactions between nature and architecture can therefore begin with simple observations [4].

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## 2. The condition of the island

### 2.1. *An island between the reef crest and the back reef*

Ibo is part of the Quirimbas Archipelago, in the tropical area of northern Mozambique. Its surface is about 15 square km and it is one of the largest islands in the archipelago. The shortest distance between the island and the mainland is about 400 m. The island is surrounded by coral reefs in the northeast and large mangrove forests in the southwest. Some geographic features of the island and its district make transport routes and communication difficult.

On Ibo, like on the other islands of the Quirimbas Archipelago, there are no permanent streams of fresh water. However, on some islands, including Ibo, groundwater can be drawn from wells but it is not always drinkable. In Ibo, there are infiltration lines, especially in the mangrove plains to the north and east, where tidal flow and rainwater meet. In the southeast, partially separated from the sea by dunes, there is an open grassy plain. In the northwest, there is an agricultural area and a dense area of vegetation bordering the runway for small aeroplanes. The eastern part of the island is surrounded by a coral sedimentation platform overlooking the ocean and at low tide, allows the collection of seafood and shellfish.

Like other islands in the archipelago, Ibo consists of a coral limestone rock deposit. There are dune formations, in some cases covered with humus produced by tropical vegetation. Excluding the mangrove forests, a thin layer of moderately fertile soil covers the whole island.

The ongoing process of diagenesis in coral fragments and deposits of different origins is at an early stage and therefore the soil is permeable and not very compact. However, some limestone rocks often have a good degree of hardness and, in some deposits, are compact with a homogeneous structure, such as in the limestone platform on the east of the island.

The north and north-east coasts are bordered by coral rocks eroded by the waves and are hard with irregular edges. These rock barriers over time have caused the formation of the madreporic sedimentation towards the lagoon which protects the areas behind them from high tides and storms and given the island its appearance as we see it today. To the north, in the coastal areas between the two rocky peaks, there are flat dunes and a coralline limestone platform that is partially colonised by mangroves and a sandy beach.

The so-called Porto Interior is located on the west coast, with an entrance facing north. The west coast is characterised by deposits of sand and mud and, at the same time, is subject to the effects of tidal erosion. The harbour is the terminal part of one of the main tidal channels between the ocean and the lagoon, while on the opposite side there extends a large mangrove forest. Along the harbour, a wall with buttresses protects the island from tidal erosion (Figure 1).

Near the church, the quay is mostly occupied by old commercial houses with their moorings. The protective wall with buttresses is now at risk of collapse. In some places, the wall has completely disappeared, but the foundation base, made of hard square stones assembled with a strong binder, is still present.

The collapse of the harbour walls due to the action of the tide, necessitates immediate action. Low-intensity earthquakes have occurred in this area, but it

appears that they have not damaged the buildings. Although the lack of specific studies suggests that this phenomenon does not seem relevant to the island, it is still useful to study historical earthquake data in the region.



Figure 1. Porto Interior, Ibo Island. Porto Interior, Ibo Island. The buttresses prevent the collapse of the out-of-plane walls of the warehouses

## 2.2. The urban heritage

Ibo's architecture and urban landscape have been carefully studied over the past three decades and are still being researched. Fundamental studies were conducted by the Portuguese sociologist Carlos Lopes Bento [5] and the Mozambican architect Júlio Carrilho [6,7]. For those interested in the historic architecture of Ibo, Bento offers a vast collection of documents that reconstruct the formation of this town during the era of Portuguese colonialism. After resuming Bento's studies, Carrilho has made an analysis of the most recent conditions on the island.

As for architecture, Carrilho also carries out interesting research on the formal models of colonial residences, hypothetically finding a synthesis between different cultures:

Portuguese, Swahili and Indian. The historic architecture of Ibo is relatively recent and was largely built during the period in which the town played a significant role in the slave trade in the second half of the nineteenth century (Figure 2). But Carrilho's attention turned to other aspects in the formation of the urban aggregate: the relationship of the three forts with the main roads, the recognition of the Swahili-type house in indigenous neighbourhoods, materials and construction techniques, a comparison of old and current photos of the same architecture, etc.

These studies were integrated into Ibo's urban plan (*Plano de Urbanização da Vila do Ibo*), which was commissioned by the Cabo Delgado government and coordinated by Carrilho himself [8].

To protect the architectural and landscape heritage of Ibo and for the rational development of the island's population, the plan defines the urban area based on the different historical and functional characteristics.

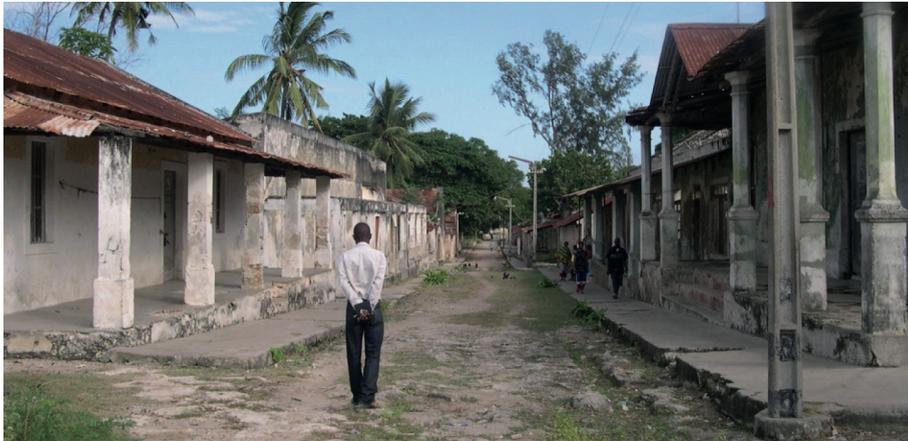


Figure 2. The ancient Maria Pia residential street today.

The town of Ibo is an urban complex which originated from two very different historical systems: the formal or planned system and the informal or unplanned system. The two systems are enclosed in two distinct urban areas and constitute the classic division of the colonial town: on the one side, the European and Asian population; on the other the indigenous population.

Revising the colonial division of two parts, the plan provides the creation of a third urban area in which to place the most useful infrastructures to improve life both in the formal and informal area. Consequently, the town is constituted by three large areas each with their own historical characteristics, namely: (i) the Formal Area, (ii) the Informal Area, (iii) the Transitional Area (Figure 3).

(i) The Formal Area, of approximately 23.3 ha, is made up of stone and lime constructions following a project and specific standards. A relatively small part of the population lives there. The Formal Area has an identifiable structure and the buildings have relatively homogeneous styles, presenting a clear overall unity. Formed by the most ancient and refined architecture, this area is largely abandoned, even though ownership transfers and the restoration of some buildings resumed in the late 1990s.

(ii) The Informal Area, of about 68.4 ha, has buildings made with stone and lime or structured with wooden poles (*pau-a-pique*), mostly covered with palm leaves (*macúti*), and is the result of a spontaneous process of occupation. More than 2500 inhabitants live in the area, the equivalent of about 75% of the island's population. The designation for this type of urban area is questionable. The informal settlement is, in most cases, the consequence of complex family processes in which the public authority is not always present. But this area shows great dynamism in social relations.

(iii) The Transitional Area, of about 13.6 ha, now establishes the interface between the Formal Area and the Informal Area, with constructions generally in stone and lime resulting from the recent expansion of the Formal Area, but without

a clear urban structure or recognizable spatial organization. Large spaces in this area can be planned to improve the entire urban layout [8].

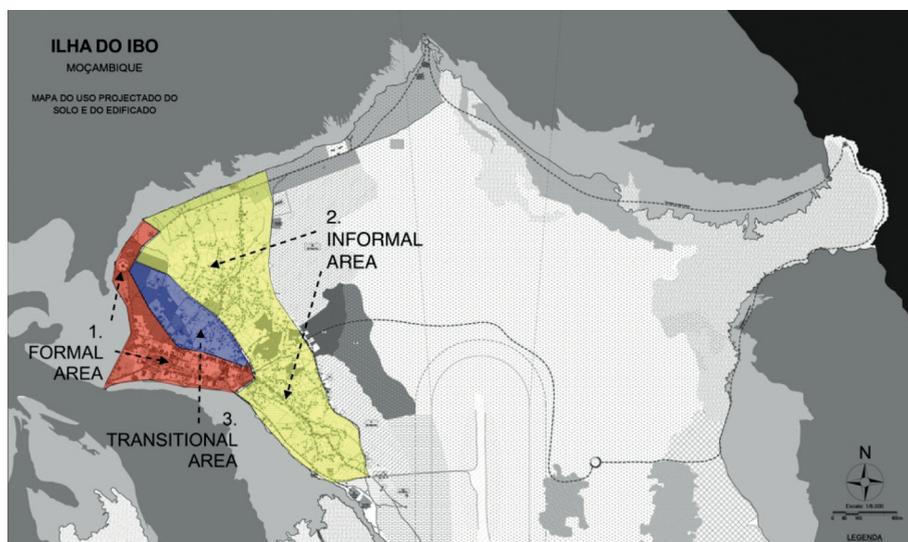


Figure 3. From the urban plan of the town of Ibo (2008): a re-working of the partial graphic map of the intended use of the soil and the settlement.

### 3. The situation between human and natural environment

With the adoption of the *Plano de Urbanização* in 2008, an administrative process was formally completed. Although the plan has exhaustively collected historical data and recent research results, it seems useful to consider the topic of building materials once more. The extraction of materials from the ground, and their use, constitutes a relatively new topic in this region, but it is causing growing interest in environmentalists and scholars. In Ibo, addressing the question of materials in empirical but factual terms has helped to fix the cultural trends in progress and to concretely implement the adopted urban plan.

The surveys and discussions carried out during the three trips to the island of Ibo, two in 2007 (the second visit was made with the technical team in charge of developing Ibo's urban plan) and the last in 2009, indicated that the above simple arguments can help to interpret heritage as a combination of the natural and cultural systems (Figure 4).

The island of Ibo seems the ideal place to treat each artefact or set of artefacts in their natural context, paying attention to the present (the object), the past (history) and the future (the project). Establishing the age of the island's heritage means introducing into the urban and environmental plan awareness of the present and of the past which will help to prefigure Ibo's future in a more critical and responsible way.

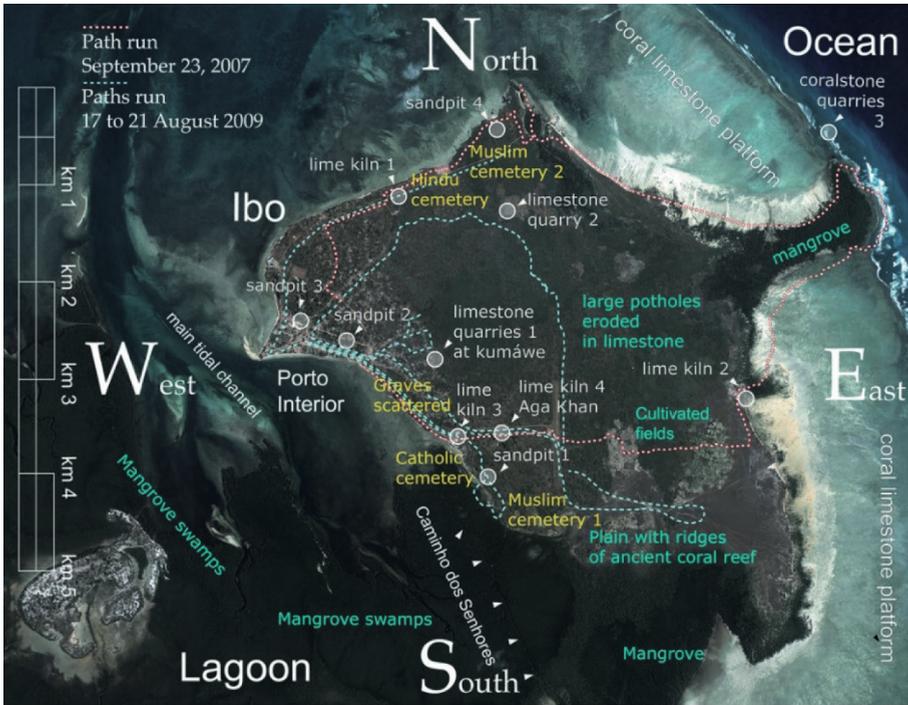


Figure 4. Field observations made by the author at Ibo Island during study visits. Paths drawn on Google Earth map, 2007-2019.

Cultural and natural heritage includes every past and present artefact as part of a geographical context. Bearing this in mind, we can imagine a definition for the cultural and natural heritage of the island of Ibo, where the geographical context undergoes a continuous natural transformation and where, today, urban culture is of a low level due to the economic situation of the people which is almost at the limit of human survival. Visiting the town of Ibo, we immediately perceive the difference between the many abandoned Portuguese buildings and the inhabited indigenous ones. It is, however, misleading to focus attention only on the styles we define with the terms Portuguese and indigenous. Carrilho's studies and the *Plano de Urbanização* give useful indications in recognizing traces of the contamination between Portuguese settlers, Swahili people, Indian traders, and ethnic groups such as Makua, Mwani, Makonde. But what is the awareness of the cultural and natural heritage of those who now live on the island?

### 3.1. Looking for a link between the human and the natural environment

To try to understand how the population of the island maintains a balance between the town and the natural environment, let us first consider a list of places that feed the construction process, the maintenance of buildings and the possible development of the town (Figure 4).

### 3.1.1. Monumental Sites

In addition to the monumental buildings listed in the *Plano* and already recognized as such in the nineteenth century maps of the island, we found some artefacts of historical and monumental interest that deserve more attention, especially from the population: the Hindu cemetery, the Islamic cemetery, the fortified building called *Casa das Cobras*, the lighthouse keeper's house, the Catholic cemetery, scattered tombs near the Catholic cemetery crossed by the road leading to the airport (Figure 4). These sites are abandoned like the colonial monuments listed in the *Plano*. A systematic survey could accurately define the entire system of cemeteries, either in use or abandoned, as monumental areas protected by the public administration, so that they can be easily identified as the historical and cultural heritage of the different religious communities living on the island.

### 3.1.2. Expansion of the island

Several areas have been identified where the mangrove forest is expanding; new mangroves can be found growing on the mineralized coral reef platforms in the North and East. It would be important to establish to what extent the mangroves have expanded to the south and west, where in some places, we can see the erosion caused by the sea and some accumulations of soil deposited by the flow of rainwater. Configuration processes in the balance between various natural phenomena must be determined to identify the most suitable areas to use or exploit, for example, for cutting wood, needed in the maintenance of buildings.

### 3.1.3. Lime kilns

We have identified four open-air kilns for cooking lime. Unlike closed kilns, open ones are not very efficient. They require large amounts of fuelwood and do not allow uniform combustion of the processed mineral. We also noted that a substantial part of the coral material had not been burned completely and would therefore probably not be used but discarded. This is due to the fact that if the non-calcined limestone is mixed with the calcined limestone, the lime is likely to have poor mechanical properties. There is, however, an advantage in open kilns because the calcined limestone is able to make good use of rainwater in the final hydration process, but the casual aspects of this final step make the benefit uncertain. We consequently believe that a closed kiln is preferable. The creation of a closed kiln for cooking lime gives some interesting advantages: lime production is simpler and more controlled, the lime has a constant level of quality and, finally, a large quantity of firewood is saved.

### 3.1.4. The coral reef and the limestone quarries

We noted that the limestone loads in the three open kilns consisted of fragments and debris of mineralized corals. According to the information of local producers, the limestone for these kilns is usually collected in the most accessible part of the coral reef along the north and east sides of the island, preferably coral skeletons with thin pores. In order to restore public or private historic buildings, it is essential to define precisely the conditions and methods for collecting limestone as well as minimize the degradation of the coral reefs and madreporic deposits in case of a possible increase in demand.

### 3.1.5. *The sand quarries*

For security reasons, after the ban on extracting sand from the pit near the houses in the Formal Area of the town (Figure 4, Sandpit 2), the Administration authorized excavations in an area behind the Catholic cemetery at the edge of the sea (Figure 4, Sandpit 1). It was possible to visit the new quarry and examine the extracted sand. The sand dug in the old forbidden pit – a deposit of marine sand – is different from the sand excavated today in the new quarry, a river deposit. This sand is grey and composed of silica and quartz granules. The study of this material and the extraction site is important in understanding how the mortar mixtures were prepared, as well as learning more about the presence of underground fresh water at depth and the soil itself. A river sand deposit on a coral limestone island is a great advantage but, as in the case of the limestone supply, sand removal must be controlled by the public administration even for small quantities.

### 3.1.6. *The impenetrable mangrove forest*

There are two main ways to enter the Ibo mangrove forest, the perimeter of the forest and the *Caminho dos Senhores* artificial channel. Existing pedestrian paths suggest that there is a local habit of accessing the mangroves from the island itself for the exploitation of mangrove timber for carpentry, construction and so on. The conditions of *Caminho dos Senhores* (about 3 km) can be evaluated in terms of tourism or local communications with the island of Quirimba. The intrusive trees growing along the channel, which are cut during its maintenance, could be used to feed the lime kilns and the timber used for construction.

### 3.1.7. *The cultivated fields*

The crops — rice, vegetables, and fruits — and their geographic locations on the island are of great social and cultural interest. Administrative provisions should protect and develop this unique and interesting agricultural production system. There is also talk of relaunching the production of Ibo coffee. However, at present it is only a hypothesis which would require impact studies on business and on environmental compatibility (Figure 4).

### 3.1.8. *Roads and paths*

The network of roads and paths is the sign that best represents Ibo's urban and environmental culture: a true model of study and application. The entire network of permanent paths should be mapped, including those that are no longer used but still remembered. Neither should the fishermen's paths on the coral platform be ignored; they are recognizable and viable even when they are submerged by the high tide.

### 3.1.9. *Drinking water and domestic soil pollution*

The collection of existing studies on Ibo and the Quirimbas Island Park, as well as the related discussions suggest that knowledge of the hydrogeological conditions of the soil and subsoil is a prerequisite for any management plan. Considering that on the island there are about 150 non-drinkable water wells, with an average of 10 meters depth [8] and that the island is part of the continent's alluvial basin [9], it would be useful to check whether pristine waters could be drawn by drilling one or two wells in depth: this option would be a convenient alternative to an aqueduct that

brings drinking water from the mainland to the island through the lagoon (Figure 5). While on the one hand, the traditional practice of collecting seasonal rainwater in the cisterns remains valid, a 35m or 50m deep well for drinking water could qualify the town and if placed, for example in the Transitional Area (Figure 3), might determine a moderate urban density or a better placement of new buildings for public use, such as schools or markets [10-13]<sup>1</sup>.

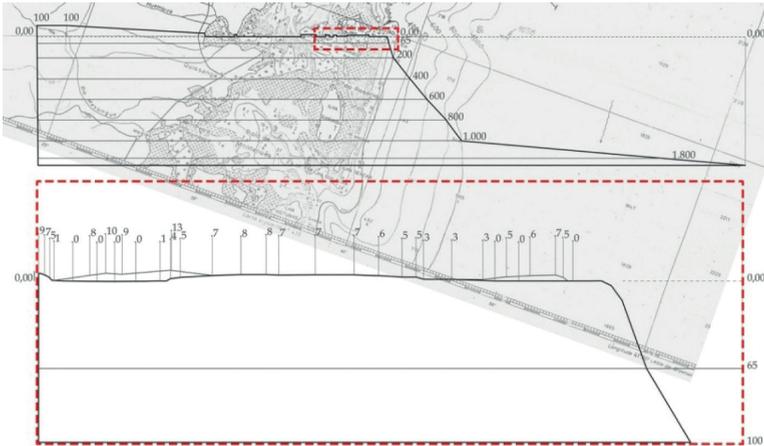


Figure 5. An extended section of the continental margin through Ibo. The hypothesis to be verified is the presence of a deep layer of fresh water from the mainland to the subsoil of the island.

In addition to the problem of the pollution of existing wells due to human activities, specific studies on environmental impact are essential to verify contamination between saltwater and fresh water at various levels of groundwater, during high tide cycles and during periods of rain.

### 3.2. Priorities in the conservation of cultural and natural heritage

A plan for heritage conservation with such complex relationships between human and natural values must depend on a long-term program, in which actions are based on a priority scale, carefully using the scarce donations that are available for funding and improving strategies to maintain what has already been rehabilitated.

Being as the process of rehabilitation of the architecture in stone and lime is very long, the owners of the historical architecture, whether uninhabited or in ruins, are obliged by the public administration to keep the property free from spontaneous vegetation to improve public hygiene and at the same time, preserve the architectural heritage. The vegetation that grows between the ruins does not protect them, for example from the sun or rain, but hides them, thus avoiding a visual inspection of the degradation: visual inspection is the first step in the procedure to preserve artefacts that are exposed to all kinds of conditions and climate (Figure 6).

Between 2006 and 2010, a foreign institutional donor, the United States Agency for International Development (USAID), funded the “Northern Mozambique Tourism

Project” during which the perception of priorities in rehabilitation work was slightly improved. During this period of time, for example, we saw that the demolition of the parapet on the waterfront at the entrance to the town was suspended: unlike in the initial project, the operators thought that repairing what already existed was a better option than demolition and subsequent re-building, even if of poor design and construction. But in general terms, it would perhaps have been more appropriate for the donors to have prioritised the consolidation of the western part of the town, where there is an ancient phenomenon of erosion that threatens all the buildings on the waterfront.



Figure 6. Wall in Rua Maria Pia. Observation of the phenomenon of disintegration where the different conservation state of the two sides (left and right) is evident and has been caused by the use of different plasters and exposure to sunlight.

Within the same program, another case that showed a wise approach to safeguarding Ibo heritage was seen in the temporary works designed to protect those monumental buildings where restoration was particularly expensive or where further studies were needed to develop appropriate methods for recovery. One example is the *Fortim de São Jose*, where the architectural project manager spent all the time that was needed in developing the right technology to reconstruct the flat roof of one of the casemates. During this long waiting time, a temporary roof in galvanized sheet was put in place.

Two interesting consolidation tests of the wall were observed on both sides of the *Fortim de São José* gate (Figure 7). The tests, carried out in 2005, had given a negative result: the lime mortar had not hardened, but gradually crumbled into dust at the foot of the wall. Performing the tests before the widespread application of the planned consolidation technique had been the right choice, as some errors were subsequently avoided when work was resumed two years later.

Through an empirical approach and observing test results, the island's population was able to learn about the construction technique used by the ancient Portuguese settlers and thus understand how it makes extensive use of the natural resources of their island. Knowledge of the construction system and availability of the building materials on site are two conditions that seem to guarantee the ordinary maintenance of the rehabilitated architectural heritage.



Figure 7. Left: consolidation tests on the Fortim de São José gate. Right: detail of the limestone disintegration in the ruins observed on the Rua Maria Pia.

### 3.2.1. Stones

The explanations given by the inhabitants during the Ibo study visits suggested where exactly on the island the building stones had been extracted. But only during the third visit, was it possible to fully understand the meaning of the answers given by the local *pedreiros* (builders) to questions during the previous visits, that is, where did the coral stones to build with come from? The vague answer was always the same: *em todo lado* (from everywhere).

Two examples of houses under construction in the popular area (the Informal Area) near the football field were observed. On these two building sites, the coral rock blocks, walled up with red earth mixed with water and lime, were extracted inside the perimeter of the house's property. Digging only one meter deep into the sandy soil, the limestone skeletons of ancient coral colonies are readily available. The pieces can therefore be easily extracted and used in the construction site.

In Ibo, there is a place called *kumáwe* (*ku* = area, *mawe* = stone) in the regional Kimwani language. This site is at the highest point of the island, at an altitude of 13 meters above the current average sea level. Here, traces of the excavations for the extraction of limestone are still visible. Some appear to be from ancient times, others are more recent. In the courtyard of some houses it is still extracted for the local market. The limestone *kumáwe* is very compact with a uniform matrix, so it can be cut directly into orthogonal profiles to obtain regular blocks more suitable for the construction of higher-quality houses. It is best used in the construction of walls with overlapping blocks and can be classified under the term 'bioclastic rock'. There is another type of coral stone used for building which can be classified under the term 'bioherm rock'. This last type is a coral conglomerate, which is sometimes not very cohesive and often contains large pieces of coral skeletons [15].

Searching for the stone quarry used to build the great fortress of *São João Baptista*, a depression in the nearby terrain was thoroughly explored. In historical maps, this

depression in the soil is called '*Pântano secco na estiagem*'. No clear traces of excavations have been found, but there is a strong possibility that the depression may have been produced by digging for the supply of building materials [2].

On the contrary, at the *Fortim de Santo António* clear traces of excavation were observed. The sediment in which the military building was found was a compact calcareous coral platform. Regular rock cuts on the north and west sides at the base of the building show the compactness and other features of the flattened area. Even more evident is the pronounced depression south of the fort, which may be the result of excavations to extract building material.

### 3.2.2. Lime

Among the open lime kilns observed, some are cyclically activated, such as the two near the Catholic cemetery (Figure 8), while others have been found abandoned, as indicated on the 2007-2009 visit map (n.2, Figure 4) on the north-east coast.

The information collected and the direct testing of this kiln have given evidence of an artisan production for the market of Pemba, an important city on the continental coast about 100 km South of Ibo. The limestone to be cooked comes from different sites of the island and is chosen according to its intended use. A special case is the use of lime obtained from the calcination of the shells to whitewash the interior walls of the houses, making them more habitable because they reduce the perception of humidity in the rooms.

According to the local producers we interviewed, the best quality mortar for plastering the walls is obtained from corals from the coral reef edge, west of the lighthouse. A visual inspection revealed that also the sedimentary limestone taken from the *kumáwe* site and around the military barracks near the coconut palms is of excellent quality to produce lime. This limestone is very compact and uniform and has the texture of small crystals.



Figure 8. The lime kiln in the open air at the entrance to the Catholic cemetery.

From the first direct evaluation of the sands used on the construction sites, it seemed that the granules were silica rather than limestone. Local workers said the material had been taken from the island itself.

Until 2007 the sandpit, excavated among the oldest colonial houses, was still used for small buildings in the Informal Area, but in 2008, the administration decided to ban sand excavations there because it threatened the stability of the surrounding abandoned houses. This measure was the effect of an emergency that a programming of urban resources would probably have foreseen and, therefore, avoided.

Other existing quarries were enlarged or new ones opened in areas outside the town for the many restoration yards that have been set up in recent years (Figure 9, left). It is curious to note that the two main ones are found near two cemeteries, a Hindu one to the North and a Muslim one to the South (Figure 9, right). This could suggest that there was a possible correlation between the excavation for the tombs and the discovery of river sand which was very suitable for mixing in a lime mortar.

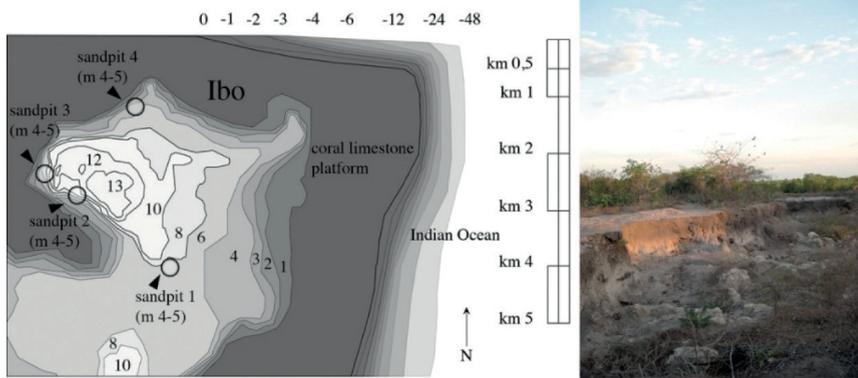


Figure 9. Sand site survey in Ibo. Sandpit n.1 on the map.

Since it was easy to verify the siliceous or calcareous nature of the sand, three samples were taken from three different quarries. The test showed that the three samples were silica sand because they did not produce any chemical reaction during the experiment. When in contact with hydrochloric acid (HCl), silica sand stays in its state of physical integrity. On the contrary, when the calcareous sand comes in contact with the acid it reacts and releases carbon dioxide (CO<sub>2</sub>). This simple experiment shows that the continental sand deposits are found on the island itself and justifies the whole study when we try to correlate sea levels, coral reefs, and human settlements.

#### 4. Conclusion

The balance between the natural and human heritage on Ibo has been presented in general terms and as a problem open to discussion. The solution to this problem seems to be in the hands of the island's population, indeed, community participation in the conservation of its heritage began with the preparation of the *Plano de Urbanização da Vila do Ibo*, in 2007. Part of the population that

emigrated from the island in recent years, is coming back, but the number and type of migrants that returned were not evaluated. Nevertheless, the *Plano* does include areas for urban expansion; however, in order to use the island's resources sparingly and to safeguard the culture of the community, these areas of urban expansion should not be used until the existing town is completely rehabilitated and occupied.

The restoration of stone and lime houses in the Formal Area (Figure 3) is more problematic than that of the popular traditional houses in the Informal Area (Figure 3). In the first case, the community has been offered a choice between restoring or reconstructing. The island builders have lost the memory of the old colonial techniques and therefore more easily construct new buildings of little architectural value in place of the ruins of the colonial houses.

Local administrators attempt to maintain control over historic buildings and preserve them by applying existing regulations but with little success, as many historic houses are now in ruins or abandoned.

Today there are obvious intentions to speculate when negotiations involve the island's historic houses. Houses are purchased in ruins, so in some cases the site is kept clean, but rehabilitation does not follow. In other cases, it is tourism companies and international cooperation projects that have rehabilitated some historic buildings and thus contributed to the recovery of old construction techniques and the qualification of local workers.

For the restoration of stone and lime buildings, local materials such as sand and limestone are required. At present, the local supply of building materials is treated as a normal administrative problem, as indicated by the *Plano*. It evidently provides no protection for the integrity of the island. It would therefore be necessary to introduce into the *Plano* a special chapter for the management of the natural resources of the island and the continental coast in order to avoid future environmental emergencies caused by disordered rehabilitation, deforestation and dangerous excavations.

## Notes

<sup>1</sup> The extended section between the mainland and the continental edge on a track crossing Ibo, combines data from two maps: the Carta Hidrográfica da Foz do Rovuma ao Ibo of the Instituto Hidrográfico de Lisboa, 1965 (work copy by courtesy of Patricia Oberreuter) [14] and the Plano Topográfico base, hoja 1 e 2, 1997 in the Libro Blanco de los recursos naturales de la provincia de Cabo Delgado (Mozambique) – Agencia Española de Cooperación Internacional – Union Europea (copy at the Faculty of Arquitectura e Planeamiento Físico in Maputo) [12].

The hypothesis of the presence of fresh water in deep soil has been discussed with the geographer Patricia Oberreuter Tapies [10] of the National Geological Museum of Maputo. The most important orientation texts, cited in the bibliography, are by Peter John Ramsay [11], Agencia Española de Cooperación Internacional [12], and Russell Arthurton [13].

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## Biographical notes

**Maurizio Berti** is an architect specialised in architectural restoration work. He graduated and trained at the University of Venice and University of Padua. He obtained his PhD at the Sapienza University of Rome. For thirty years, he worked as an architect-restorer in the municipality of Padua. As an adjunct professor, he has taught at the Eduardo Mondlane University in Maputo, at the Sapienza University of Rome and the Carlo Bo University of Urbino. As an associate professor, he has been the dean of the Faculty of Architecture at the Lúrio University, Mozambique. His publications concern the preservation of cast-iron architectures, historic fortifications and coral stone buildings.

## Summary

This paper presents the method adopted in the study of Ibo, a small island of the Quirimbas Archipelago in northern Mozambique. Ibo is part of a larger study, begun in 2004 which is still ongoing. In the first phase, the author's attention was focused on the restoration of the historic architecture built with coral limestone. But very soon it became evident that it was necessary to study the context in which these coral architectures were built. After a few years of careful observation, it was apparent that coral stone architecture is strongly conditioned by the knowledge and conservation of the natural environment in which it is built. And in the case of Ibo, the beauty of its heritage and its conservation lies in the delicate balance between architecture and nature.

## Riassunto

L'articolo presenta il metodo adottato nello studio di Ibo, una piccola isola dell'arcipelago delle Quirimbas nel Nord del Mozambico. Questo caso è parte di un più ampio studio, iniziato nel 2004 e tuttora in corso. In una prima fase, l'attenzione dell'autore si concentrò sul restauro dell'architettura coloniale portoghese lungo la costa orientale dell'Africa. Ma ben presto, fu necessario studiare il contesto in cui sono state costruite queste architetture impiegando il calcare corallino o, in termini più generali, il calcare madreporico. Dopo alcuni anni di attente osservazioni, si può dimostrare che l'architettura costruita con la pietra corallina è fortemente condizionata dalla sua conoscenza e la sua conservazione dipende dall'ambiente naturale in cui è stata costruita. Nel caso di Ibo, la bellezza del patrimonio e la sua conservazione risiedono nel delicato equilibrio tra architettura e natura.