مملكة البحرين

مجموعة التشريعات الصادرة في مملكة البحرين خلال الأعوام 1988 - 1991 م

دائرة الشئون القانونية

2002م - 1423 هـ

القسم الخامس
مرسوم بقانون رقم (11) لسنة 1982

في شأن حماية النخيل

نحن عيسى بن سلمان آل خليفة

أمير دولة البحرين.

بموجب الإعلان على الدستور.

وجلى الأمر الأساسي رقم 8 لسنة 1975.

وبناء على عرض وزير التجارة والزراعة.

وبعد موافقة مجلس الوزراء.

رسماً بالقانون الآتي:

مادة 1 -

بموجب قطع النخيل أو التسبب ببديعة صورة في وقفة نموه.

ويحدد وزير التجارة والزراعة بقرار من حالات التشخيص بقطع النخيل.

مادة 2 -

على ملأ النخيل العناية بحماية النخيل الملهوم لهم ومراعاتهم على نحو يكفل استمرار بقائه.

ومحافظة على بهائه.

مادة 3 -

يصدر وزير التجارة والزراعة قرارات تنظيم ما يلي:

1 - تحديد العدد الإجمالي من النخيل الممكن زراعته في الدولين الواحد للأرض ال_irrigation الجيدة.

2 - وضع نظام الحوافز للمزارعين بغرض تشجيعهم على الأكثر من زراعة الاصطحاب الجديد من النخيل.

3 - تنظيم استيراد وتصدير فصول النخيل وإجزاؤاتها ومنتجات النخيل.

4 - تنظيم عمليات تسوية النخيل وإجزاؤاتها ومنتجات النخيل وعلى الأخص تنشيط العلاقة بين المنتجين والجهات المهتمة.

5 - وضع نظام لتشجيع زراعة النخيل في الجداول المنازلية والعامة.

مادة 4 -

بتعاقب كل من يخالف احكام المادة الأولى أو الثانية من هذا القانون بالحبس سنة لا تزيد على ثلاثة أشهر وغرامة لا تتجاوز خمسمائة دينار أو بمثابة ماليين العقوبتين.

مادة 5 -

يكون لوزير الري وادارة الزراعة الذين ينصبهم وزير التجارة والزراعة لهذا الغرض سلطة جذب المزارع للتحقيق من تطبيق القانون كما يكون لهم سلطة ضبط ما يقع مخالفًا لاحكامه وتحرير المحاضر اللازمة وأحالتها إلى الادعاء العام.

الجريدة الرسمية - العدد 1570 - الخميس 15 ديسمبر 1982 م
لوزير التجارة والزراعة إصدار القرارات اللازمة لتنفيذ هذا القانون.

على وزير التجارة والزراعة تنفيذ هذا القانون. ويتم به بعد ثلاثة أشهر من تاريخ نشره في الجريدة الرسمية.

أميم دولة البحرين
عبسي بن سلمان آل خليفة

صد در في قصر الرفاع:
بتاريخ: ١ ربيع الأول ١٤٠٤ هـ
الواقف: ١٠ ديسمبر ١٩٨٣ م.
Legislative Decree No. 21 of 1983
With Respect to Protection of Palm Trees

We, Isa Bin Sulman Al Khalifa, Amir of the State of Bahrain;
Having reviewed the Constitution; and
Amiri Order No. 4 of 1975; and
Upon the submission of the Minister of Commerce and Agriculture; and
Following the consent of the Cabinet of Ministers

HEREBY DECREE THE FOLLOWING LAW:

Article 1

Cutting palm trees or causing the cease of its growing in any manner is prohibited.
The Minister of Commerce and Agriculture shall determine, by an order from him, the cases permitted for cutting palm trees.

Article 2

Owners of palm trees shall provide care to the palm trees owned by them and irrigate them in a manner that contributes in the continuity of their existence and maintaining their beauty.

Article 3

The Minister of Commerce and Agriculture shall issue orders to regulate the following:
1- Specify the appropriate number of palm trees that could be planted in each 1000 square meter of new agricultural lands.
2- Establish an incentive scheme for farmers to encourage them increase planting new types of palm trees.
3- Regulate the import and export of palm shoots, their parts and palm trees products.
4- Regulate the marketing of palm trees, their parts and products, and particularly to regulate relation between the producers and the bodies involved in manufacturing and marketing of dates.
5- Establish a programme to encourage planting palm trees in domestic and public gardens.

Article 4

An person who contravene the provisions of Articles 1 and 2 of this Law, shall be guilty of an offence punishable by a term of imprisonment of not more than three months and a fine not exceeding five hundred dinars or to either of these penalties.

Article 5

The employees of the Directorate of Agriculture who may be appointed by the Minister of Commerce and Agriculture for such purpose shall have the authority to enter farms and gardens to ensure that this Law is applied. They shall have also the power to record any offences that may be occurred and make the necessary report and submit it to the Public Prosecutor.

Article 6

The Minister of Commerce and Agriculture may issue the necessary orders for the implementation of this Law.

Article 7

The Minister of Commerce and Agriculture shall implement the provisions of this Law which shall be come effective after a period of three months form the date of its publication in the Official Gazette.

Amir of the State of Bahrain
Isa Bin Salman Al Khalifa

Issued: at Rifaa Palace
On 6 Rabi’e Al Awwal 1404 H
Corresponding to: 10 December 1983
The Bahrain Fort

History

A detailed history of the building is known. The Portuguese ruled Bahrain for 80 years from c. 1517 A.D. But two factors in particular probably led to the erection of such a giant fortress there. First was the uneasy hold of the Portuguese over the allegiance of the Bahrain’s. Second the increasing conflict with the Ottomans for hegemony of the Gulf after 1550 A.D. By 1590 Persian strength had grown so much that they, in turn, were posing a serious challenge to the Portuguese in Bahrain, finally taking the island in 1602. There is distinct possibility that the Portuguese built the fortress on the site of an earlier Bahrain castle.

Drawings survive in the Archives in Lisbon showing a five-sided fortress in a somewhat simpler form than the surviving building with three or four circular bastions, and several higher towers. Although these are said to date from early seventeenth century, it seems likely that they represent the fort in the form it assumed after being strengthened c. 1550, and before the final remodeling all Portuguese forts in the east received under the direction of leading Italian and Spanish military engineers brought out for the purpose c.1590. As far as is known, no Portuguese plan or drawing of the building in its final form is in existence.

It is likely that the Persians used the fortress, as they are known to have done Hormuz, during the succeeding period of their rule of Bahrain, which lasted until c.1750. But as the Persian hold on the island loosened in the 18th century, its seems that maintenance of the fortress diminished, allowing the onset of the decay which has to destroyed the curtain walls and the interior courtyards. The great bastions, being composed of work done in ashlar under strict supervision of skilled military engineers, have fared best with time. There does not seem any evidence of Persian alterations to the bastions.

Old painting from the Portuguese archive in the early sixteenth century
Before proceeding further with the digging, which will add to the present architectural heritage, it seems advisable to protect quickly what has already been dug out, and to make it an attractive site understandable for the visitors.

Being aware of their having with this site a unique source of cultural and tourist riches, the government of Bahrain decided, in the years 1986-1987 to set up a program for restoration of Bahrain Fort. Most fortunately in the case of Qalat Al-Bahrain, the cultural interest does not conflict with economic interests. The appeal for Tourism will depend largely on the quality of rehabilitation of this unique architectural heritage.

Two aspects of the site rehabilitation will be examined in the present report:

- The safeguard of the site
- The preservation of the monuments which have been found on it.

Four thousand and five hundred years of uninterrupted human occupation of the Qalat Al-Bahrain site have left us impressive remains, some of them nearly intact. Not more of one third of this magnificent heritage has been dug up. What has already been found is most spectacular:

- The Delmon city wall (3rd millennium B.C)
- The Kassite warehouse and place (2nd millennium B.C)
- The Tylos period coastal fortress (C. 100BC) reused during the 14th century as a warehouse for overseas trade with China.
- And lastly, touring above the whole scene, the magnificent medieval fortress which was restored by the Portuguese in 1561.

Bahrain Islands in 1538
Bahrain Fort model before restoration 1987
Town and Fortress

Since the early centuries of Islam, the main settlement of the island had developed around the mosque of Suq al-Kaharmis, a situation completely altered by the 14th century. In an inscription of 1374, that original town is called Bilad al-Qadim (the old country or town), meaning that a new town had replaced it. The new town, Manama, situated close to deep sea harbour, was the town known to the Portuguese whose name they had deformed into Benamar, as reported in some chronicles. But the appellation they used more often was “the town” or “Bahrain”, which proves that at that period Manama was the uncontested main settlement of the island.

As for the location of the fortress, that can also pose a problem. One of the better known Portuguese miniatures of Bahrain shows two fortress at the beginning of the 17th century: one to the North of the Bahrain island, and another to the South of Muharraq island. There are no sources that date the construction of either. One Arabic inscription, still in place in the islet of Jidda which mentions the restoration of “the Bahrain fortress” in 1561, without specifying its exact location. Nevertheless the name “Portuguese Fort” has been traditionally linked to the Bahrain Fortress, and also the European design of its bastions suggests that the fortress mentioned by the Portuguese sources of the 16th century is certainly the one situated on the Northern coast of the Bahrain island.

With such a confirmed location, this fortress still poses one further problem. Why was it that in 1529 and 1559 both Badr al-Din and Mu'aiad successively entrenched themselves in the Bahrain fortress, while in 1521, Muqrin faced the Portuguese in the fortified town of Manama? Having transformed the town into a military target, he had exposed it to pillage and massacre. His successors, by enclosing themselves in the fortress, limited the consequences of the attacks to the fighters only. The thought that comes to mind is that during Muqrin’s time there was no fortress at Bahrain, but it came to be only some years later. This hypothesis is disproved by archaeological evidence, as will be shown further in the script, and also by two written sources. One is by the Caireen historian, Ibn Iyad, who informs us that in 1521, the Bahrain Fortress fell into the hands of Europeans. Also a few
years later, but prior to the Portuguese siege of 1529, a Portuguese document also mentions the existence of a fortress, of inferior quality, in Bahrain. If this fortress existed at the time of Muqrin, how can we explain, that he like the Bahrain governors who followed him, did not entrench himself in it at the time of the Portuguese Attack?

A possible explanation could be as follows: it is most probable that the princes of Hurmuz built the Bahrain fortress at the end of the 14th or beginning of the 15th century, at the time when their influence extended over the island. Similar to other areas under their control on the coast of the Gulf and of the Oman sea, they had established a Baluchi garrison there, which was mentioned in 1529 and 1559. During the years when Ajwad ben Zamil and his son Muqrin, member of the powerful Banu Jaber Arab family, were trying to free themselves from Hurmuz influence, the Bahrain fortress had either escaped their control or, more probably, had been abandoned by its garrison and fallen into ruin. In both cases, Muqrin could not make use of the fortress and, therefore, it was from his town and with his people that he attempted to resist the Portuguese landing.

In 1529, both the context and the protagonists were different. Badr al-Din, Governor of Bahrain, rebelled against the Hurmuz-Portuguese power, responsible for exorbitantly raising the tribute imposed on the island. The Baluchi garrison assigned to keep the fortress refused to be implicated in his rebellion and abandoned its post. This rebellion by Badr al-Din seemed, however, to be a defense of his personal interest rather than the protection of the inhabitants of the island. He did not seem to be very popular since he needed to take hostages from the town and lock them up with himself in the fortress.

Each of the protagonists in this conflict, held an ambiguous role: the Portuguese, on the one side, pretended to be repossessing the fortress for the Prince of Hurmuz, while in reality they intended to control the revenues of Bahrain Badr al-Din, for his part, defended the island fortress while in reality he hoped to leave with all the wealth he could lay his hands on. And finally, the Baluchi garrison ought to have followed orders of the fortress governor, but anxious lest they should follow a rebellious governor, and unsure of the real issue behind the fight, preferred to leave the scene.
It was finally in 1559 that the Amir of Bahrain, Murad, a loyal tributary of Hormuz, defended the fortress against the Turks and naturally he was helped in the task by the Portuguese and the Hormuzi. In all three cases it seems that the fortress was being used for the protection of Bahrain by the Hormuzi princes.

Archaeology offers the irrefutable proof that there was a fortress at Qalat al-Bahrain before the siege of 1529, during the lifetime of Muqrin and probably before that. When the French Archaeological Mission made various soundings in the fort, known as the Portuguese Fort, between 1980 and 1985, it discovered that in the interior of its partially collapsed walls there existed a much more ancient fortress. The latter fortress had medieval features and was badly adapted to artillery warfare, but also fitted the term "corral" as the Portuguese called it. In contrast, the fortress from which Barad al-Din resisted the Portuguese attack in which an enlargement of the former fortress, was stronger: its exterior walls and bastions could well resist the Portuguese of 1561 that finally adapted the medieval fort to the war technology of the 16th century. Before examining the three phases of construction, let us review what archaeology has revealed concerning the site prior to the construction of the fortress.

Qalat Al-Bahrain is a slight elevation above the surrounding palm-tree. Its altitude is due to the accumulation of archaeological vestiges, superimposed on one another since the third millennium B.C. Overlooking the most ancient of these vestiges, let us concentrate on the one monument which occupied the northern part of the site area a few centuries before Hijra. It was a small square fort, each side extending 52 metres and surrounded by a large and deep dug out moat. Being situated between this moat and the sea, and also protected from unwanted landing by a coastal wall, this citadel was impregnable.

In the 13th century, these ruins had been restored by a governor of Fars, for the purpose of using the fort as a ware-house for his commercial interests at that time, Chinese products arrived in abundance at Qalat al-Bahrain. However, by the end of that century or
the beginning of the 14th century, the fortress was abandoned and crumbled naturally, because of the tide erosion and due to a slight modification of the shore line. The site was partially covered by a cemetery belonging to the village that developed in the southern section of the site. Whether little or naught had remained of this original construction by the end of the 14th century, a tradition lasting long centuries surrounding this fortress at this particular site remained alive, especially to governors and influential merchants of the Gulf area, who have close contacts with Bahrain, at the end of the Medieval period. It was at the hands of Gulf governors that the new fortress was rebuilt, a short distance form the ancient one, further inland.

At this period, the site still provided various advantages: it was the most elevated point on the coast (9 metres), form which one could advance to the high seas through a controllable channel, the larger part of which could serve as a mooring when the North-West winds were wild. There still exists today, at the North-West edge of the channel, the base of a tower, built of ashars and measuring 9 metres each side. Facing this tower, all along the eastern side of the channel, at depth of two metres at low tide, a large number of pottery fragments dating from the 14th - 16th centuries were discovered: this was, in front of the fortress, the harbour mentioned several times by the Portuguese chronicler.

We should finally add that this site, which had been occupied for millennia, represented and enormous quarry for stones. The digging out process of the moat for the new fortress must have provided a huge amount of good quality stone and contributed to the material construction of the fortress. This moat had a probable depth of 5 to 6 metres, a perimeter of 110 x 110 metres and width of 6 to 7 metres.

Therefore the site where the fortress of Bahrain was going to be built had advantages which had been recognised since the time when, a thousand years earlier, the ancient fort was raised and when, in the 13th century, it was restored.

The circumstances in which this new fort was built are, as we have seen, still unclear, as unclear are the features of the monument itself. No representation, either literary or iconographical, survives. Nothing but the observation of the vestiges of the building, made difficult by the following restorations which concealed, almost entirely: this first phase.
"Badr al Din’s fortress was situated on a rise above the harbour which was protected by a very small island on which fishermen used to shelter. On the perimeter (circumference) of this fortress there were seventeen towers (cubiles) built of stones and lime, and a barbican (barbacane). All these constructions had crenellations and loopholes. There was a very beautiful keep and in one of its towers there was the gate of the fortress, very well furnished. The barbican was surrounded by a large moat with its drawbridge. There were some houses of poor people within the wall, and Raia Barbadin ordered them demolished and burned before Simao de Cunha came."

Bahrain Fort in Portugese Documents
First Phase:

At this phase, the south-west of the fortress was marked by a roughly round tower whose only the upper part is still visible today; this explains the rather small width of its wall.

On the south part of the tower-wall one can see the basement of a small turret which was slightly protruding outside of the tower itself.

Such a turret, called "pepper-box" of "échauguettes" was frequent on the top of the towers; a man well sheltered inside was able to watch the very foot of the tower and its immediate surroundings down himself.

The wooden remains of its floor and its staircase will allow to restore properly this important part of the watching of the fortress.
South West Round Tower Islamic period during restoration

South West Round Tower Islamic period after restoration
Second Phase:

In this phase, the wall of the old tower has been reinforced by a thick new wall (1). All around the corner-tower has been established a bulwark of "fausse-braie" supported by rammed earth and limited, outside, by another thick wall (2). This wall protects the lower part of the building and the bulwark allows the soldiers to easily go from one side to another side of the fortress (3).

For a better watching, an upper wall-walk (4) has been set-up, from which the gun-men can shot through the crenellation of the outer tower (5).
Third Phase:

Without destroy the corner-tower of phase 1 and 2, the Portuguese bastion has been built in a forward position. Its bulge allows a better watching of the moat and the two walls running on both sides.

Furthermore, the two domed chambers (1) distributed inside the bastion are a good shelter for cannons defending the wall from the enemy attacks.

At this phase, the bulwark runs at the level of the upper one of phase 2, whilst the former lower wall-wald has been blocked. (3). The terrace of the bastion dominates two meters higher.
The Bastions

They are of high architectural quality. They enable complete defense of the whole site: the cross fire from the casemates does not leave any dead angle in the moat, and the upper guns are in a position to sweep in grazing fire all the surface of the tell. Each bastion therefore, performs a task which in turn, determines its structure.

The South Bastion

The south bastion is obtusely shaped, so that its two faces are completely inflated from the casemates of the collateral bastions. Moreover, to absorb the frontal flat shots, a “bufer” of rammed earth was created in the core of its salient.

At the lower level, two doors to be locked from the outside led through the gorge wall down to the flank casematte. These are both roofed with domes on squinches, with a vent at the keystone to evacuate the firing smoke. Each gunport is protected, on the outside, by a member masonry protruding from the bastion, the orillon, meant to prevent the “coup d’embrasure”: an oblique shot where the enemy bullet can ricochet off the gunport’s cheek and get into the casemate. To widen as much as possible the firing angle, the orillon’s inner flanks have been built parallel to the gunport’s cheeks, and to reduce the weakness of the corner, the edges facing the besieger, square at the base, are rounded in the upper portion.

At the center of the gorge, a stair leads to an intermediate landing and then up to the platform. At the landing level, in the axis of the bastion, a small room, once probably roofed, was used as a date-press (or matbaa), maybe in a later period. On the platform, the parapet was pierced along the flanks, by two gunports, whereas the frontal defense relied on armes d’epaule, firing in barrette, i.e. over the parapet itself.

On the east flank, the bastion was linked to the first enceinte by a wall in which a gunport is likely to have existed, to cover the south portion of the faussebraie. If the niche at the gorge would have shielded the artillery-men at the moment of the shot.
South East Bastion before restoration 1987

South East Bastion after restoration 1994

Architect: Ms. Khatoon Al Ansari - State of Bahrain
South East Bastion from inside the Fort before and after restoration
South East Bastion

† Architect: Ms. Khatoon Al Ansari - State of Bahrain
Detail drawing of the chamber in South West Bastion showing the type of structure use on it

Architect: Ms. Khatoon Al Ansari - State of Bahrain
Pillar structure system

Ventilation for the firing smoke

Firing point for the Cannon

The interior of South West Bastion chamber
Drawing of the South West Bastion before and after restoration

South West Bastion after restoration
The North-West Bastion

The North-West bastion is the smallest one, but also the most refined and the best preserved. As in the south-west bastion, a "lock-chamber" formed the junction of the bastion with the inner enceinte. The access to the platform was directly from the first enceinte across the roof of the "lock-chamber". This chamber, which leads to the bastion casemates, is likely to have once been connected to the roof with a ladder through a manhole. It also linked the west faussebraie to the north with doors to be locked from the inside so that it would be used to break the circulation in case of assault. In order to protect these two doors from oblique shots, the "lock-chamber" itself was given two orillons (one is today collapsed), slightly protruding from the bastion gorge: here are placed two niches of embrasures allowing the defenders to shoot frontally, along the flanks of the bastion. From the "lock-chamber", a single staircase leads to both the casemates. Of the two chambers, one is roofed with an elongated oval vault on squinches, the other by a dome on "pseudo-pendentives", both of which have vents at the keystone.

Each flank gunport is protected by an orillon whose inner corner, rounded at the top, becomes sharp edged at the bottom so to minimize the risk of a coup d'embrasure. In the middle of each bastion face, two loopholes splayed inwards for rimes d'épaule are coupled in the same niche, about one meter above the casemate floor: their height allows shooting across the moat, in grazing fire, on the glacis.
North West Bastion before and after restoration

The firing location in North West Bastion
NORTH BASTION - SOUTH LOOPTHOLE

NORTH BASTION - SOUTH GUNPORT

NORTH BASTION - EAST GUNPORT

The firing diagram for the North West Bastion

Architect: Ms. Khatoon Al Ansari - State of Bahrain
Ceiling of the hall of North West Bastion during restoration

North West Bastion after restoration in 1997

The North West Bastion staircase
North Elevation before restoration
North Elevation during and after restoration

Architect: Ms. Khatoon Al Ansari - State of Bahrain
North-West tower section, phase I.

North-West tower section, phase II.

Elevation of the North West part of the fortress Phase I to III.
North Elevation after restoration
Section of the Super Tower

Propose

South elevation before and after restoration

BAHRAIN FORT
SOUTHSIDE ELEVATION

1987

Architect: Ms. Khatoon Al Ansari - State of Bahrain
South elevation and Super Tower before restoration in 1987

South elevation before restoration in 1987
South West Bastion in south wall in 1987

South elevation before restoration in 1987

Super Tower and South Elevation Before and during restoration

1987

1989

Architect: Ms. Khatoon Al Ansari - State of Bahrain
South elevation after restoration
East Elevation before and after restoration
East Elevation south part

The Bahrain Fort mont before restoration in 1987

East Elevation

1987
West Elevation before and after restoration
West Elevation after restoration in 1994

North West part of the fortress

Architect: Ms. Khatoon Al Ansari - State of Bahrain
West Elevation

West Elevation before restoration

Architect: Ms. Khatoon Al Ansari - State of Bahrain
Bahrain Fort before and after restoration
During the excavation season, as well as the former ones, we had the opportunity to understand the stratigraphy of the site up to the bed rock: the section 1 shows the archaeological layers below the fortress, the section 2 shows the archaeological levels just outside the North West bastion.

Upper part of the buildings as they can be restituted

Cross section showing historical period of the Bahrain Fort

Architect: Ms. Khatoon Al Ansari - State of Bahrain
BAHRAIN FORT
BAHRAIN FORT
BAHRAIN FORT
The Spur Tower

At the center of the south front, where the enemy would attack, an odd work which blocks throughout the faussebraie and whose salient resembles an eagle beak, overlooks the whole site. Its unique structure— a curved layout with a triangular salient, becoming horse-shoe shaped at the top—reflects a search for a solution of two different problems: on the one hand, giving the enemy bullets oblique surfaces so to deflect them, on the other, allowing fire in all directions.

So, the central tower task was twofold: to act as a shield for the keep and to survey, from its high platform, the tell borders where the besieger, well concealed, could have gathered men and materials. The tower was certainly open at the gorge so to be under the keep control. Its floor, four meters higher than the fausse braie provided another firing level with several frontal loopholes: six of them are still visible. On the sides, two double splayed gunports enflaid the faussebraie of the collateral bastions. Indeed, the tower could act as a reverse fire casemate in case the first defensive work had fallen.

Remains of timbers protruding from the masonry suggest a strong wooden balcony, possibly resting on a central pillar conceived to absorb the vibrations of the light gun shots. Actually, the trace of a 0.55 meters wide frontal embrasure proves the platform to be equipped with artillery, likely to be on wheels. The parapet allowed the arquebus to shoot in barrette.
The "Fausses-Braies"

In addition to the bastions, the fausses braies have been excavated: the whole west one, part of the North and South ones.

On West side, two floor levels have been kept: to the south, the 2nd phase level, and to the North, the 3rd phase level, one and half meter higher.

This decision has been taken according to the principle of this restoration, which is to show as often as possible, the different periods of the building. We think that the final visual effect will be not unpleasant, if the necessary care is given in this restoration and explanations well displayed. Also a very good knowledge of architecture of 14-16th centuries will be necessary to the architects in charge for this restoration.

The restoration of the parapet edging the fausse-braie will make problem, since very few of it is preserved. Only a piece of the lower part of the parapet has been uncovered on the North side of the fausse-braie. Its pattern could be kept for the West side also, but the shape and size of its openings, are unknown.

Nothing of the upper parapet is remaining. We have to imagine it from the old drawings showing the fortress of the 15th-16th centuries: a lot of them is available and it is better to take from them informations than from a very late building as Itifa fortress.

The South front will be more simple, with just some large gun-ports open in the parapet of bastions and curtains. An accurate restoration of the parapets is required since they will take up a great deal of room in the final visual effect of the fortress.
Mortar Experiments

- Further experiments on mortars have been carried out in order to obtain a mix which is structurally as well as visually similar to the original ones. As far as the intervention to be carried out on the Portuguese parts, the most satisfactory mortar seems to be a gypsum / lime mix. To help the curing of the lime - lacking any pozzolanic materials and avoiding Portland cement which performs very badly in this aggressive environment, P.F.A. (pulverised Fuel Ashes) could be used also giving the right color.

For the time being the mix used is as follows:

2 lime : 1 Saudi Gypsum : 1/4 PFA : 2 1/2 Double washed marine sand : 1 washed aggregates sieved from excavated material.

The materials are mixed dry to avoid the gypsum to hydrate and water is added only before use.

- Cubes for compression test have been made of this mortar as well as of the different lines available in Bahrain, their results being ready next month.

- As far as the Islamic mortar is concurred, satisfactory mixes have not been found yet. Experiments with burnt sea clay (Tin al bahar) are to be made.

Super Tower from inside during restoration
GYPSUM TESTING FOR BAHRAIN FORT RENOVATION

The samples were tested for compliance with the chemical requirements for plaster of aris, of BS. 1191 part 1, the results are as follow:

<table>
<thead>
<tr>
<th>TYPE OF TEST</th>
<th>BS. REQUIREMENT</th>
<th>SAMPLE RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur trioxide</td>
<td>a) Not less than 3%</td>
<td>44.45 %</td>
</tr>
<tr>
<td>content.</td>
<td>b) Not less than 2/3 Sulphephur trioxide.</td>
<td>40.2 %</td>
</tr>
<tr>
<td>Calcium oxide content.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mgo + Na20 content.</td>
<td>c) Not more than 0.2%</td>
<td>0.245+Na20</td>
</tr>
<tr>
<td>Loss on ignition.</td>
<td>d) Not more than 9% and not less than 4%</td>
<td>2 %</td>
</tr>
</tbody>
</table>

CONCLUSIN:

The table above shows that the sample does not comply with the BS. requirements, in c and d.
LIME TESTING FOR BAHRAIN FORT RENOVATION

The samples were tested for compliance with the chemical requirements for high calcium hydrated lime of B.s.890, the results are as follow:

<table>
<thead>
<tr>
<th>TYPE OF TEST</th>
<th>BS REQUIREMENT</th>
<th>SAMPLE NO.</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1269-1</td>
<td>1269-2</td>
<td>1296-3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A'ALI</td>
<td>HAJI</td>
<td>AISCO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>HASSAN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon dioxide.</td>
<td>Not more than 6</td>
<td>2 %</td>
<td>13 %</td>
<td>5 %</td>
<td></td>
</tr>
<tr>
<td>Insoluble matter.</td>
<td>Not more than 1</td>
<td>1.14 %</td>
<td>1.13 %</td>
<td>0.3 %</td>
<td></td>
</tr>
<tr>
<td>Lime plus magnesium.</td>
<td>Not more than 65</td>
<td>87.2 %</td>
<td>67 %</td>
<td>75 %</td>
<td></td>
</tr>
<tr>
<td>Magnesia, MgO.</td>
<td>Not more than 4</td>
<td>5.5 %</td>
<td>3 %</td>
<td>13 %</td>
<td></td>
</tr>
<tr>
<td>Soluble salts.</td>
<td>Not more than 0.5</td>
<td>0.4 %</td>
<td>0.52 %</td>
<td>0.37 %</td>
<td></td>
</tr>
<tr>
<td>Soluble silica</td>
<td></td>
<td>--</td>
<td>2.1 %</td>
<td>3.6 %</td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSION:

The table above shows that none of the samples complies with the BS requirements.
THE CUBES RESULTS:

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>FAILURE LOAD (KN)</th>
<th>COMPR. STRENGTH (N/MM²)</th>
<th>COMPR. STRENGTH (KGF/CM²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A'ALI - PPA DRY</td>
<td>2.2</td>
<td>0.2</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>3.8</td>
<td>0.4</td>
<td>4.1</td>
</tr>
<tr>
<td>H.H</td>
<td>6.5</td>
<td>0.7</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>4.4</td>
<td>0.4</td>
<td>4.1</td>
</tr>
<tr>
<td>AISCO</td>
<td>5.9</td>
<td>0.6</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>6.3</td>
<td>0.6</td>
<td>6.1</td>
</tr>
<tr>
<td>B. MIX DRY</td>
<td>28.6</td>
<td>2.9</td>
<td>29.6</td>
</tr>
<tr>
<td></td>
<td>34.1</td>
<td>3.4</td>
<td>34.7</td>
</tr>
<tr>
<td>B. MIX WET (O°C)</td>
<td>23.7</td>
<td>2.4</td>
<td>24.5</td>
</tr>
<tr>
<td></td>
<td>24.9</td>
<td>2.5</td>
<td>25.5</td>
</tr>
<tr>
<td></td>
<td>49.2</td>
<td>4.9</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>39.5</td>
<td>4.0</td>
<td>40.8</td>
</tr>
</tbody>
</table>

RESULTS OF COMPRESSIVE STRENGTH TESTS ON 100 MM. CUBES - MORTAR.
BUILDING MATERIALS:

The Building Materials used in the construction and derived from the local environment of either the gulf or land.

1. GYPSUM:
This is processed sea stone brought from different parts of Bahrain it was arranged in square or rectangles shapes of 10x20 ft. over wooden canal like construction the stone were piled on the set areas palm leaves were then burned under the stones.
The processed stone was then crushed, shifted and stored in sacks. It usually took five to ten men to make Gypsum. Some songs came to be associated with this work, sung by the workman “ Ya Allah Ya Aawin” - God is the helper.

2. YEDH’A:
This was obtained from the trunk of a dead palm tree. The trunk was cut in to long strips which were used in building foundations and roofs.

The use of Yedh’a on the construction of Spur Tower

Architect : Ms. Khatoon Al Ansari - State of Bahrain
3. CORAL AGGREGATE BLOCK
(Hadjar Al Bahr, Sea Stone) are obtained from rock that originates in the sea, formed by the Coalescence of Crystallized Carbonate of Lime, it is a very strong stone by it is high salt content renders, to use it in the construction, should be washed properly before using.

4. PJISS:
Lime stone based on Hydrous Calcium Sulphate, Crushed and burnt provides the powder to make plaster (Coating and Stucco) and the mortar binding the Stone in the Masonry. It is generally imported from Saudi Arabia.

BAHRAIN FORT BUILDING METHOD IMPLEMENTATION

1. THE FOUNDATION
They are about a two metre deep more compact Calcareous Stones are utilised to protect the base of the walls from too much dam prise all the foundation of the Bastions were built on the bedrock.
2. THE GROUND SURFACES
The courtground surfaces are usually from beaten earth
the revetment of the flooring of the rooms is with a simple
finished mortar.

3. THE WALLS
The walls of the Fort are composed of coral block rubble.
The thickness of the external walls varies from 1.5m to
2.5m at their upper sections the bonding is from mortar
made from Gypsum, Lime and high percentage of sand.
The internal Partition are often supporting walls the walls
heights reaches up to 15 metres but the Bastions walls
reaches some of them up to 25 metres.

4. THE ROOFING
The roofs of the normal rooms at the fort are flat but slightly
sloping to eliminate rain water. The north Bastion and
Southeast Bastion built in volt system support by some log
(palm tree trunks), but the Southwest Bastion Root built
with two arch pillars and volt ceiling and the two pillars
linked by logs.
SPUR TOWER
The structure supporting the flooring is composed of palm trunk and covered by masonry of varying thickness covers the whole, finally a coating of mortar is applied as a floor finish for the roof floor about.

5. LINED SPANNING
Beams and lintels: the beam that support the walls and sometimes part of the floors infrastructure consist of a number of logs strong together which are then embedded in the masonry.
The Coatings: Coating play an extremely important role in protecting the masonry from the surrounding damp. It consists fundamentally of a more or less homogenous mixture of Gypsum (Calcium Sulphate) and of the Lime (Calcium Carbonate), but all the front elevation and Bastion were covered with special carved lime stone cut from Jada Island.