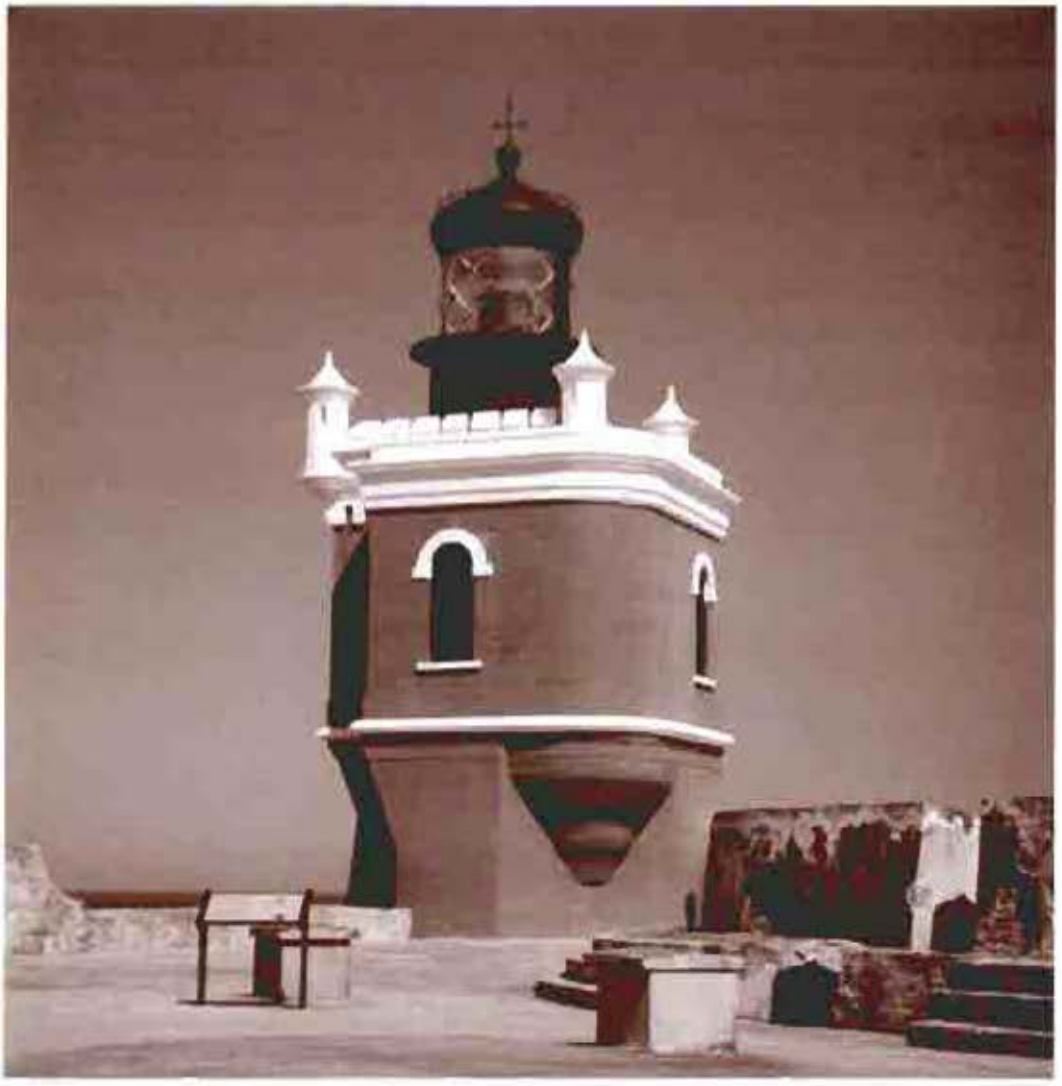
Third International Symposium of Historic Preservation on Puerto Rico and the Caribbean

May 9-13, 1994
San Juan, Puerto Rico

LECTURES



National Park Service
Southeast Field Area - Gulf Coast Cluster
SAN JUAN NATIONAL HISTORIC SITE

United States Department of the Interior

NATIONAL PARK SERVICE
San Juan National Historic Site
Fort San Cristobal
Norzagaray Street
Old San Juan
Puerto Rico 00901-2094

IN REPLY REFER TO:

A82
April 11, 1997

Memorandum

To: NPS "Community"

From: Superintendent, San Juan National Historic Site

Subject: Distribution of Publication

Enclosed for your information and use is a complimentary copy of Conferences published in relation to the ***Third International Symposium of Historic Preservation on Puerto Rico and the Caribbean,*** compiled by Milagros Flores, San Juan National Historic Site Historian.

These publications marked the ending point of the Symposium that took place in San Juan, Puerto Rico on May 9 through 13, 1994. During this event we were honored to have the participation of recognized specialists in the field of Historic Preservation representing the countries of United States, Spain, Cuba, Netherlands, Colombia, St. Kitts, Bonaire and Puerto Rico.

This book contains useful case studies and strategies for specialists and non-specialists in technical information on resources preservation, not only in the Caribbean, but to all National Park Service areas nationwide. It is intended to help us reach out to our partners in preservation a grand undertaking to reinvigorate America's sense of its past and to make it more likely that an educated public will help us assure the continued preservation on the American landscape.

This publication is available in English and Spanish and were printed separately.

We hope you will find this book useful and appropriate to your work in preservation and managing cultural resources.

William P. Crawford

Enclosure

THIRD INTERNATIONAL SYMPOSIUM OF HISTORIC PRESERVATION ON PUERTO RICO AND THE CARIBBEAN

May 9-13, 1994
San Juan, Puerto Rico

LECTURES

Compiled by:
Milagros Flores Román

National Park Serive
Southeast Field Area - Gulf Coast Cluster
SAN JUAN NATIONAL HISTORIC SITE

Photograph cover: Lighthouse Castle San Felipe del Morro after restoration of 1992.

Photograph back cover: Lighthouse Castle San Felipe del Morro before restoration of 1992.

ISBN-1-881712-01-X

Printed by: Repro gráfica Inc.
Río Piedras, Puerto Rico
1996

National Park Service
Fort San Cristóbal
Norzagaray 501
San Juan, Puerto Rico 00901
Tel. (787) 729-6777
729-6653
Fax:(787) 729-6665

This publication has been possible thanks to the contribution of
Eastern National and Monuments Association.

PREFACE

The United States National Park Service is proud to present this publication in a bi-lingual (Spanish and English) format for all who are interested in preserving this World Heritage Site.

This publication is a series of lectures presented by scholars and researchers from many countries who participated in the Third International Symposium on Historic Preservation in Puerto Rico and the Caribbean. The Symposium was held on May 9-13, 1994 at the San Juan National Historic Site, San Juan, Puerto Rico.

We want to give special recognition to the panelists that contributed their time, share their research on this Symposium, the third of a series that was presented to help preserve and protect the wondrous places being protected in the Caribbean.

This Symposium has helped us reach out to our partners in preservation a grand undertaking to reinvigorate America's sense of its past and to make it more likely that an educated public will help us assure the continued preservation of the American landscape. Parks are not just relics of the past. They are calls to action to sustain the present for a better future. They are not remainders but reminders. Reminders of what has been lost, and also reminders of what may yet be preserved.

Like other government agencies, the National Park Service is striving to become more effective in meeting our mission by better serving the public. For National Park Service Managers and historians, this has emphasized the urgency of strengthening bridges to varied public audiences as well as to research educational institutions. Resource preservation and education in the National Park Service require wide-ranging communications and partnerships with all professional and interested parties whose skills and advocacy help meet the public's need to understant the past.

It is our hope that these published lectures will facilitate connections and a sense of community between managers of cultural sites in the Caribbean. It is also our hope that a wide range of institutions and individuals can be our partneers in the shared responsibilities and challenges of public history today.

W. P. Crawford
Superintendent

Mark R. Hardgrove
Deputy Superintendent

ACKNOWLEDGMENTS

As coordinator of this Symposium I would like to express my appreciation for all of the support I received for this successfull event. The Third International Symposium on Historic Presevation in Puerto Rico and the Caribbean was held at San Juan National Historic Site on May 9 through 13, 1994 in San Juan Puerto Rico. Over two hundred professionals attended and gained extensive technical knowledge from the presentations and hands on seminars which took place in our Park which is also a UNESCO World Heritage Site.

I would like to thank Superintendent William P. Crawford and Assistant Superintendent Mark R. Hardgrove for there continious support for to the park's research program, contribution of valuable ideas, and providing opportunities for higher education through three consecutive symposiums over a six year period of time.

I would like to mention all those lecturer's that because of causes out of there control could not travel to San Juan to present their lecture but did send their papers to be included in this publication. Presenters are: Juan Manuel Zapatero, Ph.d. (Spain), Blaine Cliver, Arch. (U.S.), and Otto Reyes, Arch. (Puerto Rico).

To the Department of State of Puerto Rico, to Ricardo Alegria, Ph.d Director of the Center of the Advance Studies of Puerto Rico and the Caribbean and to Architect Efrain Perez Chanis for the donation of the exhibition The Fortified Caribbean.

Finally I would like to recognize all my co-workers of the San Juan National Historic Site for their individual contributions. To all of you thanks for your support, was a pleasure working together. We can all be proud of what we have achieve through team work and partnership. This publication is a result of both.

Milagros Flores Roman
Historian
Symposium Coordinator

III International Symposium for Historic Preservation in Puerto Rico and the Caribbean

May, 1994
San Juan, Puerto Rico

Papers

*Translated from Spanish.

Notes on the History of Preservation and Restoration of the San Juan de Puerto Rico Historic Zone

Dr. Ricardo E. Alegría, Puerto Rico

Until the first few decades of the 20th century, the city of San Juan was the most important residential, government, commercial, and cultural center in Puerto Rico. Founded in 1508-1509, originally in the Caparra area, around 1519 it was moved to an islet next to the bay. There, our national cultural life flourished, and it was from there that resistance was offered to the attacks and invasions of the Caribs, the English and the Dutch from the 16th to the 18th centuries.

In 1892, under the pressure of "progress", the wall known as Puerta de Tierra, which enclosed the eastern side of the city, was demolished. Soon, urban development began in the closer areas: Puerta de Tierra, El Condado, Miramar and Santurce, and the exodus of residents and business to the new urban areas gradually began.

At the end of the 19th century, during the Spanish-American War, San Juan was bombarded by the American Navy. But only a few buildings such as the San José Church and the Ballajá Barracks suffered any damage.

By the 1930's, the historic center of the city showed signs of neglect and deterioration. Many of San Juan's families—*sanjuaneros*—who had traditionally inhabited the older great houses of the city, as well as some businesses, specially the banks, had moved to the new residential and business districts of Miramar, El Condado and Santurce.

Some people felt that the way to bring back the historic Center's vitality was to substitute the old buildings for modern ones that would reflect the new times and progress. Thus, very valuable historic buildings were demolished, such as the San Francisco Church, built in the 17th century, substituted by a simple five story structure that housed a Catholic school. A block of beautiful colonial buildings next to the Plaza Mayor or Parade Square, was demolished to give way to two high-rise commercial buildings, thus destroying the harmonious architectural composition that until then had surrounded the plaza. The attempts to demolish the Capilla del Cristo, in the name of progress, and connect Cristo and Tetuán Streets, met resistance from the citizenry, who felt that the structure was one of their most beloved historic landmarks.

During the 1940's and the Second World War, when many of the most important historic buildings on the north side of the city were in the hands of the United States Army, several blocks of houses were demolished, between Cristo and San Sebastian Streets next to Plaza San José, the Santo Domingo Convent and the Ballajá Barracks. This demolition of colonial buildings was done in the name of progress and to provide a parking area for the military.

These demolitions spurred the defense of the historic district of the city, and thanks to the initiative of a group of citizens and historians, in 1948 the City Government of San Juan and the Planning Board approved a historic zone in which demolitions were prohibited unless authorized by a commission of historians, architects, and citizens who were interested in conserving historic structures. This legislation made demolition of the structures a little harder for those who in the name of progress insisted in creating a "Little New York", but it did not encourage restoration.

Old San Juan was in a process of outright decay. The grand houses of the 18th and 19th centuries which had been built for single families were now in ruinous condition and divided into anti-hygienic apartments. Some of these had become dwellings for a dozen low-income families. The structural condition of many of these houses was precarious and many were on the verge of collapsing on their inhabitants.

The different stories of the historic zone were painted in different colors and the façades were mutilated with concrete balconies and large metal windows; and glass store windows covered the ground floors. There was no control over the installation of large signs painted on the wall or hanging out from the façade. Some of these were neon lighted metal signs.

The government had begun to move its offices to areas outside of Old San Juan. The commercial banks and merchants were following suit.

It was not until the 1950's when concern for the future of our cultural heritage and the threat hanging over its different manifestations brought on by rapid and overwhelming sociocultural change, in turn a result of the industrialization of the county, prompted the Commonwealth of Puerto Rico to sponsor legislation on cultural issues. The most important of these measures, part of public policy known as Operation Serenity, went into effect in 1955: the Institute of Puerto Rican Culture (IPC). The Institute was founded as a fully-autonomous public corporation.

At the same time the Institute of Puerto Rican Culture was being created, the Economic Development Company, the government agency with the necessary financial means, acquired five buildings in the heart of the historic district on Cristo Street, to offer an example of what the city would be like if its historic structures were restored. The agency would restore them and show that there could be commercial activity with all modern comforts without altering the colonial architecture. The acquisition and restoration of four of these buildings stimulated the development of the zone. Two of them had been houses of prostitution which blighted the whole area. Another of the buildings was restored to house the Casa del Libro, a museum devoted to exhibits of the history of typography. Another of the buildings acquired was of recent construction and was abutting—and damaging— the Capilla del Cristo. It was demolished to restore the Chapel's architectural integrity; the chapel itself was restored by Institute of Puerto Rican Culture personnel.

Soon, we at the Institute of Puerto Rican Culture realized that it was useless to continue legislating to prevent the buildings from being demolished unless a way was found to encourage owners to restore their properties. The state could not aspire to restore all of the buildings in the historic zone.

Proprietors who were interested in restoring their buildings could not find the necessary financing because commercial banks refused to lend money for masonry structures that in some cases were over two-hundred years old. This led us to ask the Government Development Bank to offer loans. The bank then provided loans for up to thirty years at an attractive interest rate.

The former Carmelite Convent, located on Cristo Street facing the Cathedral, was in danger, because the idea was to sell it for demolition and conversion into a parking lot. This situation would have greatly damaged the area, and therefore, in view of the historic and architectural value of the Convent, the ICP declared it a historic landmark, preventing demolition. Shortly thereafter, an investor acquired the Convent and restored it as a luxury hotel, following ICP requirements. The presence of the El Convento Hotel has been very benefical to the restoration and revitalization of the area.

With the government's collaboration and specially with the support of Governor Luis Muñoz Marín, we submitted legislation granting financial incentives to owners who restored according to ICP specifications. These included tax-exemption for property taxes from 5 to 10 years, according to the work being done. The ICP offered architectural consultation at no cost and sold hard-to get materials such as ironwork, brick, floor tile and wood beams. Some time later the Legislature passed laws granting tax-exemption on income derived from rental of these properties.

Today Old San Juan is resurging as a residential, commercial, government and cultural area. Many of the families that had abandoned the area have returned. A dynamic and efficient commercial sector has evolved, serving the community as well as being attractive to tourists. The government has kept some of its main offices in the area and detained the exodus to other parts of the city.

The Institute of Puerto Rican Culture has acquired several buildings of historical and architectural value, which have been restored to be converted into small monothematic museums. These, along with the port area, have made the city a powerful tourist attraction.

The historic San José church, built in 1532, has been restored, and while continuing to have its religious function, has been used for concerts of religious music.

The Santo Domingo Convent, for many years the Headquarters of the United States Armed Forces, was returned to the Commonwealth of Puerto Rico and restored by the Institute of Puerto Rican Culture to be used as its main offices and as a cultural center. Other historic buildings

returned to the State have been restored for different cultural uses.

Additional historic structures, such as the Municipal Theater, the Treasury, the former Casino de Puerto Rico, now a Government Reception Center, and the former Princesa Jail, have been restored.

The United States National Park Service has restored the El Morro and San Cristóbal castles, and these are both important tourist attractions. During the commemorative activities of the Quincentennary of the Discovery of the Americas and Puerto Rico, Governor Rafael Hernández Colón's administration executed major restoration work in the port area, the Paseo de la Princesa and the Ballajá Plazas. The Ballajá Barracks have been duly restored and now houses the Museum of the Americas on its second floor.

Today, Old San Juan, one of the oldest urban centers in the Americas, is an example for other cities in the Americas, where, as in our own city, slum areas have developed, threatening extermination of the city. Our legislation designed to encourage property-owners has been a model for many other cities.

There is a great danger that the success that has been achieved, especially in regards to increases in property values, may itself encourage aspirations to increase the population density, as is being attempted in the southern side of the city, where the zoning laws are not in effect. A Great Wall of high-rise buildings is being constructed, which will probably increase traffic problems and affect adversely the development of the whole area.

Historic Preservation in Puerto Rico: Taking Stock

Ignacio Olazagasti Colón

Introduction

The last few decades have witnessed an upsurge in architectural restoration of numerous structures dating from the last century, and the early years of the present century, which will draw to a close in six years. At this juncture, then, it is important to take stock of what has happened in this important area of our cultural heritage.

The purpose of this document is to set forth the different levels of information and action that are present in historic architectural preservation and to reflect on certain situations that we have experienced during our administrative and field work.

Preservation at the State level

Legislation on Historic Zones and Zones of Public Interest

In chronological terms we can say that the historic preservation movement in Puerto Rico began to take shape officially and institutionally based on two important legal elements.

The first is the passing of Act 374 on May 14, 1949. In its most recent version, this law, which has been amended more than five times through the years, states as its purpose "...to empower the Planning Board of Puerto Rico to create historic or tourism zones, and to regulate by diverse means, the development and construction in said zones through harmonious planning; to grant authority to the Regulations and Permits administration with regard to issuance and regulation of construction, use, and other permits, and to grant participation to the Institute of Puerto Rican Culture and the Tourism Company in the administration of the law; to establish requirements, procedures and guidelines to govern each zone; and to impose penalties of various kinds for violations of this law and regulations." (Harvey, 1993; 243)

Through this law, which went into effect six years before the Institute of Puerto Rican Culture was founded, the first steps were taken to se the course for the preservation of our national historic architecture. Thus, the first historic zone to be established comprised the few blocks of old buildings, in very deteriorated condition, located within the confines of the walled city of San Juan. The law put a necessary check on the "ghettoization" of the centuries-old colonial garrison town, which the commercial banks of the time considered a slum. The text of the law sets forth guidelines for the process of recovering the buildings and public spaces within the walled city and other zones that were established later.

The law in its initial form specified the parameters for the preparation and submittal of architectural drawings, obtaining construction permits, the procedure for approval of permits, the establishment of historic and tourism zones, and penalties for violators of the legislation. (Harvey; 1993; 243-247)

Parallel to this law, several guidelines were established regarding specific properties to ensure their future protection. Among these are Act #75, April 25,1935, which provided for the "transfer of the Porta Coeli convent and grounds, to the city of San German, and to provide for the immediate execution of work to prevent the ruin of this convent." (Harvey;276); Act #37, April 1, 1950, which states as its purpose "to convert into a historic landmark the house where the forefather Luis Muñoz Rivera was born and the tomb containing his mortal remains in the town of Barranquitas", (Harvey;1993; 277). Today, both landmarks are important museums belonging to m Institute of Puerto Rican Culture, the first being a National Museum of Religion and the second a Museum and Library.

This original legislation opened the way for a broader range of preservation work.

The Creation of the Institute of Puerto Rican Culture

The Institute of Puerto Rican Culture was created by virtue of Act #89, June 21, 1955, in which its purpose, authority, and functions were defined. The first section sets forth the 'creation

of the Institute for the purpose of contributing to the preservation, advancement, enrichment, and dissemination of the cultural values of the People of Puerto Rico." (Alegría; 1978; 257) In the amended act, in the fourth section o functions and authority, we fin "to preserve, protect, restore , and study real and personal property" [4 (a) 1]..."to determine which buildings, structures, and places in Puerto Rico are of historic or artistic value; to adopt regulations establishing procedures to be followed in this determination or statement" [4 (a) 7.].

And "To advise the Planning Board with regard to construction regulations in such zones that are determined to be historically valuable zones;make recommendations to the Planning Board on those measures of an aesthetic or historic nature to be taken relative to proposed construction in said zones of historic value; it being further provided that the Permits and Regulations Administration shall enforce this regulation." [4 (a) 8] (Harvey; 1993; 185-187).

The founding of the Institute of Puerto Rican Culture is in our view the second important legal element. One of the primary responsibilities of the Institute of Puerto Rican Culture, through the Historic Zones and Landmarks Program (recently refurbished as the Office of Architectural Heritage), was the purchase and/or expropriation, and active participation in the restoration of major historic landmarks. Among these we can mention the Caguana Indigenous Ceremonial center (pre-Colombian, Utuado); the Caparra ruins (16th century, Guaynabo); the Santo Domingo Convent (16th century, San Juan); the San Juan Cathedral; the Plazuela de las Monjas (17th century, San Juan); the Casa Blanca (16th to 18th centuries, San Juan); La Fortaleza (16th to 18th centuries, San Juan); the San José Plaza (16th century, San Juan); the Porta Coeli Church, 17th century, San Germán; the Casa de Dos Zaguanes (17th century, San Juan); the Casa de los Contrafuertes (17th century, San Juan); Plazuela de Santo Domingo (17h century, San Juan); the Capilla del Cristo (18th century, San Juan); the Casa del Callejón (18th century, San Juan); Fort San Gerónimo (18th century, San Juan); the Conde Mirasol Fort (19th century, Vieques); the San Francisco Church (17th century, San Juan); the San Juan City Hall (18th century, San Juan); the Arsenal at the Marina (19th century, San Juan); the Casa del Libro (19th century, San Juan); the Caguas City Hall (19th century); the Palace of Justice (19th century, San Juan); the Church of Santa Ana (19th century, San Juan); the Cemetery Chapel (19th century, San Juan); the Birthplace of Luis Muñoz Rivera (19th century, Barranquitas); the Birthplace of José Celso Barbosa (19th century, Bayamón); the Fine Arts Museum (19th century, San Juan). (Alegría; 1978; 59-60.

Recently, the Institute has worked with the Armstrong-Poventud, Wiechers-Villaronga, and Serrallés houses, all 20th century, in Ponce; the Vives Sugar Plantation (18th and 19th century) in Guayama; the Art Deco Matienzo Music Hall (20th century) in ; and the Casa de la Masacre (20th century) in Ponce.

A consultation program for review of drawings and restoration wok was established through this office to aid owners of historic buildings. Technical and professional staff perform a substantial service in consultation and review, as well as maintaining an inventory of restored structures An important function of the reprogram is implementing the tax provisions of Act #7, March 4, 1955. This law, amended in Act 94, June 20, 1960, has as its purpose "to exempt from payment of property tax all real property which is restored, improved or reconstructed, preserving the characteristics of the Spanish colonial period, in the historic zone of the City of San Juan Bautista, of Puerto Rico, or any historic zone established in Puerto Rico by the Institute of Puerto Rican Culture." (Harvey; 1993; 258-259)

Recently, historic sites have been included, by virtue of Planning Board Regulation Number 5, Regulations for Historic Zones and Sites, which went into effect on January 14, 1993.

A historic site is defined as a "Property worthy of conservation, designated as such through a nomination and designation process. This may include grounds, structures, historic objects, and a general environment." (Planning Board; 1993; 2-20)

The new legal development is of vital importance, opening the way for the protection of numerous historic sites that are not related to historic or tourist zones. This allows for the preservation of sites that would otherwise be lost in the wake of the uncontrollable process of urban growth and construction in this country.

Historic Zones

One of the important tasks the Institute of Puerto Rican Culture has accomplished over the years has been the establishment of historic zones. With the creation of the San Juan and Ponce zones, two historic districts of great urban and economic importance were given a protective shield. Thanks to the legislation we have mentioned here, many buildings have been saved.

Historic zones were developed later in Manatí and Guayama and are under study in San Germán, among other major towns.

Regional Offices

Between 1987 and 1992, as part of the administrative reorganization of the Institute of Puerto Rican Culture, regional centers were established in Ponce, Mayagüez, Humacao, and Arecibo to cover the South, West, East, and North, respectively.

One of the main objectives of the regional office was to provide technical consultancy on conservation, preservation, and restoration of the architectural and archeological resources of the region, while also advising, evaluating, and endorsing construction, use, and demolition permits, and for tax exemption for structures in historic zones. Advice was to be given on the official designation of historic zones, sites and structures. The most important contribution of the regional centers in regard to architectural resources is that they provide a full-time technician and to advise the local public, and initiate an inventory program in the region.

The Office of the San Juan Historic Zone and the Study of the Comprehensive Revitalization of the San Juan Historic Zone

"The Study of the Comprehensive Revitalization of the San Juan Historic Zone has been carried out under an International convention signed on March 20, 1989 by the Governments of Puerto Rico and Spain."

"The entities that have had the direct responsibility for implementing this Convention have been, on behalf of Puerto Rico, the Institute of Puerto Rican Culture and the State Historic Preservation Office, and for Spain, the Spanish Agency for International Cooperation and the National Quincentennial Commission."

The following agencies and entities have also contribute din different ways to the Study of the Comprehensive Revitalization of the San Juan Historic Zone:

- The Municipality of San Juan
- The Planning Board
- The Regulations and Permits Administration
- The Environmental Quality Board
- The Department of Natural Resources
- The Housing Department

The San Juan Study is integrated into the Program for Comprehensive Revitalization of Historic Zones of Spanish America, undertaken by the State Society for the Quincentennial (Spain). A similar study, undertaken in the city of Ponce was the precursor for the one in San Juan. The Ponce study, once finished, has been used in the implementation of the corresponding Historic Zone Office, and a good number of its recommendations have been incorporated by the Planning Board in its Special Guidelines for the Regulation of the Ponce Historical Zone, which was included in the recently approved Historic Sites and Zones Regulation (Planning Regulation Number 5).

This framework has allowed for very encouraging results in a short period of time, not only checking the process of deterioration of the historic zone, but also allowing for the definition of conditions in which the deterioration may be reversed.

The following are the objectives of the Study of the Comprehensive Revitalization of the San Juan Historic Zone, as well as the projects carried out by the Program for the Revitalization of Historic Zones in Spanish America:

1. Preparation of Special Guidelines Regulating the Old San Juan Historic Zone, including the most general levels of regulation of the urban complex as a whole, to very specific aspects of an individual block or building.

2. Implementation of an Intervention Program, defined by a strategy aimed at the revitalization of the urban fabric of the San Juan Historic Zone.
3. Creation of a permanent Office of the San Juan Historic Zone, associated with the Institute of Puerto Rican Culture, comprised of personnel trained during the Study , and expert personnel from agencies such as the Regulations and Permits Administration (ARPE) who are responsible for enforcement of current regulations, always with a view to ensuring inter-agency coordination that will make the endorsement and permit procedures simpler, faster, and more objective.
4. Implementation of an Intervention Program as projected in the Revitalization Study, through the designation and joint financing of the projects defined by the program through Puerto Rican and Spanish institutions." (E.R.I.C.H.S.J., 1992: document)

Planning Regulation Number 5, Regulation of Historic Sites and Zones

An important concrete result of all this work carried out by the technical offices of the Ponce and San Juan Historic Zones was the creation of the Regulations for Historic Sites and Zones. These Regulations are part of the legal corpus of the Puerto Rico Planning Board, under the Office of the Governor.

The Regulations have "the purpose of protecting, improving and conserving historic sites or zones that are representative of or reflect the social, economic, cultural, political or architectural history of Puerto Rico; protecting the historic sites or zones for cultural development, ad for tourism and the general welfare of the community, and for research and education; ensuring that the use of the land is conducive to the preservation of the historic context."

'The Regulations supersede the Regulations on Historic Zones (Planning Regulation Number 5) established under Acts Number 374, May 14, 1949, and Number 213, May, 1942, as amended."

"The Regulations include all recent concerns and procedures regarding the regulation and protection of historic sites and zones. They benefit from the studies on preservation carried out in recent years, particularly the studies done on the Once and San Juan Historic Zones, a joint effort of the Institute of Puerto Rican Cultures, the Office of the Ponce Historic Zones, the State Historic Preservation Office, the Spanish Agency for International Cooperation, and the Spanish National Quincentennial Commission.

These Regulations on Historic Sites and Zones include the regulations which apply to all historic sites and zones as well as individual chapters that are applicable only to specific historic sites or zones. The last section of the Regulations includes chapters covering Special Guidelines for the Regulation of Historic Sites or Zones for particular places that are supplementary to the general provisions of the Regulations, applying them in detail. These special guidelines, which include zoning and regulatory maps, are based on detailed inventories and recommendations for regulations. IN the historic sites and zones for which there are Special Guidelines, the zoning districts provided for in the Puerto Rico Zoning Regulations (Panning Regulation Number 4) are substituted by these specific guidelines adapted to the particular circumstances of the specific historic site or zone. These special guidelines have the function of modifying, providing details, and adapting the general provisions of the Regulations according to the specific characteristics of a particular historic site or zone. Any area designated as a historic zone and those historic sites whose complexity should so warrant must be studied individually to analyze the uses and structural characteristic s with a view to generating Special Regulatory Guidelines.

The purpose of the present version is to reflect and incorporate in the Regulations the experience gained during the implementation of the regulatory provisions, especially in the Ponce Historic Zones." (Planning Board; 1993: Explanatory Memorandum).

Laws Protecting Archeological Resources

Another important achievement in the last few years has been the creation and passing of Act 3, July 12, 1985, for the Protection and Preservation of the Caves, Caverns or Sinkholes of Puerto Rico; Act 10, August 7, 1987, for the Protection, Preservation and Study of Sub-aquatic Sites and Resources; and Act 112, July 20, 1988, for the Protection of ON-land Archeological Resources.

(Harvey; 1993: 293-316)

These three laws all seek to protect archeological elements and resources on land, in caves, caverns, sinkholes, and submarine sites. To implement them, ON-land and Sub-aquatic Archeology Councils were created. The Councils have administrative offices, libraries, and technical and professional personnel with which to manage the implementation of the laws.

The Puerto Rico General Archives

One of the fundamental achievements of the original administrative activities of the Institute of Puerto Rican Culture was the creation of the Puerto Rico General Archives, under Act 5, December 8, 1955, known as the Puerto Rico Administration of Public Documents.

In terms of what we are discussing here, the Puerto Rico General Archives is a very important and special center. Among the various kinds of documents held at the Archives, those in the following collections are particularly significant:

a. Public Works Collection
b. Municipal Collections
c. Agricultural and Survey Collection
d. Antique Photograph Collection
e. Maps and Drawings Collection
f. Antique Postcard Collection
g. Rare and Reference Book Sections

These collections as a whole contain thousands of maps, drawings, documents, photographs and descriptions of buildings, bridges and different types of structures all over the island, from the early 19th to the mid-20th centuries. This wealth of documents lies in boxes and horizontal filing cabinets, virtually untouched, rarely consulted, and then only superficially, by the few users who are aware of its existence.

In addition, in 1991 a project was organized to computerize the maps and drawings in several of the series in the Public Works Collection. The project was left unfinished due to limitations in funds and personnel assigned.

On the other hand, the recently opened Images in Movement Archives, attached to the Puerto Rico General Archives, has a rich and varied collection of films created both by government agencies and private industry in Puerto Rico. These films show many views of structures, making them an invaluable source for 20th century history.

The Puerto Rico General Library

The Puerto Rico General Library was created under Joint Resolution Number 44, June 6, 1967. Among its many valuable bibliographic resources are a collection of newspapers and magazines, a sizable collection of are and old books and a Vertical Archive. As in the case of the Puerto Rico General Archives, the corpus of this material is of significant value for the study of architecture and urban development in Puerto Rico during the last years of the 19th century as well as during the 20th century. Both information and documentation centers have an enormous potential, which until now has only been slightly explored.

Critical Reflections

In the apparent calm a storm is brewing. A straightforward reading of what has been set forth here could leave one with an image of an ideal and organized management of historic preservation at the national level. The reality is, as in any situation in which powerful economic and political interests are involved, that cultural action as been affected.

As we have said, the Institute of Puerto Rican Culture has the enormous responsibility of regulating the different phases of historic architectural preservation as well as undertaking projects on its own structures and sites. The issue is that the cultural institution does not carry out this task in isolation.

In the structure of the country's government there are more than twenty-five agencies, corporations, offices, bureaus, etc. that have on their list of properties structures that may be

categorized as historic sites. By the same token, each of these government entities has a budgetary assignment known as capital improvement funds or for the improvement of infrastructures.

According to Catholic tradition, one may sin by commission as well as by omission. On the other hand, there is an old legal saying to the effect that ignorance of the law is no excuse for failure to comply. The government is so oversized and the bureaucratic web is so tangled, that many historic structures are altered, changed, restored, or mutilated without even the knowledge of the Institute of Puerto Rican Cultures, let alone the chance to take action.

The disproportionate resources of many of these bodies, such as the Public Buildings Administration and the Department of Education, to mention two examples, and their markedly political administrative allegiances, lead them on many occasions to ignore or to disregard the regulations we have mentioned. The situation is aggravated when we find that the Regulations and Permits Authority itself, the administrative arm of the Planning Board on a technical level, frequently does not have a clear understanding of the legal framework of historic preservation. Thus, we have seen construction or demolition permits granted to projects that have never been submitted to the Institute of Puerto Rican Culture, and that lack the appropriate studies and endorsements. What is even worse, there have been projects in which documents have been falsified or altered to obtain the permits in violation of regulations that were in effect.

Amidst this tangle, the Institute of Puerto Rican Culture is burdened with more and more responsibilities, more administrative work, and too few technical professional staff, as well as professional consultants, to be able to fulfill its mission as a regulatory body and active conservationist.

As to funding, the political balance is systematically weighted in favor of projects of political value, whether at the municipal or state level. Very rarely does administrative sanity prevail over the raw muscle of political lobbying. We have seen how the financial pie is distributed like war booty in legislative caucuses behind closed doors, benefiting specific projects which do not necessarily have any merit. We have the same kind of issue with the technicians from the Budget and Management Office (O.P.G.). The issue of capital improvement at O.P.G. is aggravated by the fact that on many occasions the office has not had staff trained in construction, and much less in historic preservation. The technical and professional staff of this office have and excellent administrative knowledge usually related to construction issues, in many areas except historic preservation. The staff, unfortunately, are dealing with the documents included in the respective budgetary proposals submitted by the agencies, the tri-annual and annual plans for administrative and government priorities, and the political commitments of the administration currently in power.

The situation has an adverse effect on the list of historic structures included in the government's perpetual inventory. There is always a jail that is more important than an old bridge, a General Services warehouse that is needed more than an old railway station. The most depressing aspect of the situation is having to hear the opinions of the office staff to the effect they would not support assigning funds to fix a pile of dilapidated and useless bricks, as was said of the ruins of the Hacienda Vives at Guayama, now programmed to the Sugar Museum of the south.

To give some concrete examples, I will mention some of my own experiences and my position in each case.

The Institute of Puerto Rican Culture has been burdened with a considerable increase in its work load and responsibilities during the last decade. However, in real terms, its budget and staff have waned considerably. In order to fulfill its mission the Institute must take leadership in the Government regarding all aspects of historic preservation. Decisions on the administration of historic preservation policy should be in the hands of the Institute, rather than being an agency comprised of an amorphous array of regulations. It is important that staff be reinforced so that there can be a true technical and professional section for consultation and administrative processing of plans and projects, both in established historic zones and in zones under consideration.

There must be a group of consultants that are specialized in certain areas of preservation that can aid in decision-making. Activities at the regional level should be intensified and carried out before the little that remains is lost. The administration of historic preservation personnel must be

centralized to avoid having a system with so many heads. This does not mean a loss of flexibility or rolling back on regional activities, but a master plan for the Island should be established and we should not continue with the free-for-all situations we have seen on occasions. This kind of plan would be helpful in achieving a better use of human and fiscal resources.

With regards to capital improvement the Institute of Puerto Rican Cultures should have control at a central level of all historic sites that belong to the Institute. Likewise, it should have a budget assigned for structures and their restoration and maintenance. This proposal, while no too attractive in terms of the bureaucratic apparatus it implies, is necessary for saving these structures from their deaths.

Just as comprehensive technical studies were carried out at the Ponce and San Juan Historic Zones, they should be carried out in other towns around the Island. Although in the past the Institute of Puerto Rican Culture has counted on the help of Cultural Centers and other volunteers in these towns, this is not sufficient for such a sophisticated and complex task.

In terms of documentation, the inventories of the historic zones that are being studied, the traditional houses in other towns, and the registration of several recent structures which are meritorious for being representative of other architectural periods, and being important works by Puerto Rican professionals.

As part of this need for documentation, urgent attention must be given to the physical, administrative, and fiscal reorganization of the Puerto Rico General Archives. As Professor Luis de la Rosa stated several years ago, "The Puerto Rico General Archives is the memory of the Nation, and we cannot allow it to become and ossified institution."

All the collections must be organized. Although the documents are located in boxes with very sparse markings, they are an important source of information. There is very little that is really accessible to the public. This situation of a lack of accessibility means that one of the most complete sources or architectural documentation is difficult to handle, and therefore, difficult to use to any advantage. The infrequent military conflicts on the island allowed for the preservation of resources that would have otherwise been sacked or burned. Nevertheless, the lack of funds to provide for their proper handling, results in an access so limited or no access at all, that they might as well have been lost.

There are also several issues to be addressed on an academic level. We have the good fortune to have some excellent engineering schools at the Mayagüez Campus and a school of architecture at the Rio Piedras Campus, both part of the University of Puerto Rico. Recently, private universities have begun to include engineering programs among their offerings.

However, there is no formal concentration or core of courses on Historic Preservation. At this same gathering, the Second International Symposium, in 1991, Architect Perez Chanis made the same plea, supporting it with a proposal he had submitted to the School of Architecture for the creation of a graduate program on Historic Preservation. He was able to prepare this document due to the fact that he had a sabbatical leave from the school. At the time, the current Dean, who was present at the Symposium, welcomed the professor's proposal.

As you can see, the years have gone by, Deans have come and gone, and the proposal has not been implemented. This is a sorry state of affairs, as the school is an excellent teaching institution, with a tradition of having trained a body of competent and serious professionals. At a time when historic structures are included in the projects contracted with professionals, it is imperative that the materials and the project itself not be, as in the past, the object of on the job training.

Although the view of academic administrators may be that there is no justification for establishing a full graduate program in the field, a concentration with at least five or six courses could be designed. We now have the food fortune of having many professionals on the island, in several areas of construction, who are also knowledgeable in historic preservation. Opportunities to share work experience, as during the three symposia sponsored by the National Parks system of Puerto Rico, are the exception rather than the rule, as are the activities of Historic Preservation Week sponsored by the State Office for Historic Preservation. There is still a great need for contact among professionals in the federal and national systems.

In addition, the new administration has as its slogan "the reinvention of government," and

accordingly has promoted the creation of "umbrella" departments. In my view, this is a good time to gather up the many programs that are spread all around the government and centralize them in one administrative and budgetary space. I am obviously referring to the Institute of Puerto Rican Culture. Instead of an agency with nominal legal power and a flimsy budget, there should be an agency with real power and a full budget. At a time of budgetary limitations, the centralization of services and resources may facilitate addressing the situation. Besides, historic preservation and the reuse of structures may be a solution to the search for office space by government agencies. It is a way of rescuing the past to solve present and future issues.

And finally, we must recognize that we have achieved a lot in our country compared to other places, including the United States, whose programs are more recent than ours and are based on our experience. But we must not be complacent with things as they are, there is a lot that remains to be accomplished, and we have the professional an technical ability need to do so.

Bibliography

Alegría, Ricardo E., *El Instituto de Cultura Puertorriqueña 1955-1973, dieciocho años contribuyendo a fortalecer nuestra conciencia nacional*, San Juan, Puerto Rico, 1978.

Consejo para la Protección del Patrimonio Arqueológico Terrestre de Puerto Rico, *Reglamento #4643 para la Radicación y Evaluación arqueológica de Proyectos de Construcción y Desarrollo*, Instituto de Cultura Puertorriqueña, San Juan, Puerto Rico, 1992.

Estudio de Revitalización Integral del Centro Histórico de San Juan, Prontuario de la Presentación del Estudio de Revitalización Integral del Centro Histórico de San Juan, San Juan, Puerto Rico, 1992.

Harvey, Edwin R., Legislación Cultural, Legislación Cultura Puertorriqueña y Legislación Cultural Comparada, Instituto de Cultura Puertorriqueña, San Juan, Puerto Rico, 1993.

Legislation and Regulations of the Government of Puerto Rico (Available from the P.R. State Department)

Archeology: Protection, Conservation and Study of Subaquatic Archeological Sites and Resources (Act 10, August 7, 1987); Protection of Land Archeological (Law 112, July 20, 1988); Protection and Conservation of Caves, Caverns and Sinkholes of Puerto Rico (Law 111, December 7, 1988)

Historic and Tourism Zones: Basic Guidelines, Act 374, May 14, 1949; Proclamation of the Governor of Puerto Rico, October 13, 1954, Administrative Bulletin 135; Property and Income Tax, Act 7, March 4, 1955; Application of Acts, March 10, 1958, Reasonable Rents act; Income Tax, Act 70, July 3, 1986; Historic Zone of the Municipality of Ponce, Marina Street Sector, Act 81, July 6, 1985; Landmarks and Historic Sites of Puerto Rico, Act 13, July 1, 1947; Buildings and Other Structures of Historic and Artistic Value in Puerto Rico. Basic Guidelines, Act 3, March 2, 1951.

Institute of Puerto Rican Culture: Organic Act, Act 89, June 21, 1955; Joint Resolution on Finances, #70, June 30, 1986

Specific buildings: Regulation for Protection of Porta Coeli Church and Site, Act 75, April 25, 1949; Luis Muñoz Rivera House, Historic Landmark, Act 35, April 1, 1950; Regulations for Historic Heritage, Ponce de León House at Caparra.

Materials and Construction Techniques in Caribbean Architecture during the Sixteenth to the Eighteenth Centuries: Recommendations for their Conservation

Augusto Martínez, Architect

Introduction

The earliest recorded European construction in the Caribbean dates from 1492, when after the Nao Santa Maria sank on a reef off the north coast of the Island of Hispaniola, Cristopher Columbus ordered the construction of a "Fortified Tower" with a "large cavern" or excavation in which he left forty well-supplied men with wood scrap and some furnishings and munitions.

This was a provisional structure built with materials imported from Europe, (a ship). Later, towns began to be constructed with indigenous techniques, and materials that were native to the region, labor and supervision being supplied by Spanish master builders, carpenters, and masons. Some new cities succumbed due to the fragility of the materials, and thus the recently founded Cartagena de Indias was destroyed by fire in 1552, its structures of palm leaves, wood and wattle and thatch reduced to a pile of ashes. From then on, noble materials such as limestone, brick, cured hardwoods, and lime and sand mortar, began their reign lasting well into the nineteenth century.

During the 70's and 80's I began to wonder how it could be that besides the fortifications, other structures such as Churches and some grand houses from the seventeenth and eighteenth centuries had been able to survive for 200 or 350 years without hardly any care. I am referring to their stone and brick walls and columns, and their original plastering, which had defied the phreatic action and saline humidity.

And what was so surprising and amazing, and if I may say so, poetic, was that the tile roofs with wood frames were still standing, with no evident structural or leakage problems, in spite of the torrential rains and tropical storms that prevail all over the Caribbean.

My curiosity prompted me to ask myself the following question: If these old buildings from the 16th, 17th and 18th centuries are still alive and functional, what could be happening with the comprehensive repairs and restorations that had been done barely 15 or 20 years ago? Their roofs evidenced leakage and humidity problems even when modern sealants had been used; the plaster and stucco were disintegrating due to the saline efflorescence; not to mention the woodwork on roof frames, doors, balconies and so forth, which were already showing structural failure, on the one hand, and on the other, were victims of predators such as termites and others, who were fast advancing in their clandestine destructive labors. As to the paint on walls and woodwork, the deterioration was also noticeable, synthetic varnish and paint did not produce good results.

To determine what could help improve the quality of these conservation projects, I began a very interesting and comprehensive research project, which after twenty years of experience and study would yield what we are now doing at Cartagena de Indias. One of these research projects was carried out with a group of young architects*, former students of the Jorge Tadeo Lozano College, who later prepared a dissertation with the title "Historic Construction Systems", for which I was Director, and which was unanimously praised by the Examining Jury.

During the research we have carried out, we have found several structures, and production centers used in the construction of the city of Cartagena de Indias and its fortifications, comprised of kilns for producing lime, brick and roof tile and wells and pools used for leaching the lime and supplying water for the work camps. There are a total of seventeen kilns, which could produce sufficient lime for construction and maintenance of the entire city. We also studied many drawings and documents in the Archivo de Indias at Seville and at the Madrid Military Historic Service, and analyzed old treatises on military and civilian construction.

*Research team architects: Alfonso Cabrera Cruz, Rosmary Martelo Osorio, Rosa Elena Martínez Vásquez, Beatríz E. Martínez Vásquez; Advisor: Augusto Martínez Segrera

Architect Beatríz Martínez did a study on trimwork, including long lost and forgotten techniques, focusing on the issue of recovering the historic trimwork of Hispano-Arabic origin still extant in Cartagena, which we could only hope to conserve by studying the old treatises, particularly those by Diego López de Arenas, and a recent work by the Spanish architect Enrique Nuere with whom we corresponded and consulted.

I would like to emphasize the importance of the high quality of the workmanship that still prevails at Cartagena de Indias, since it is thanks to the continuity of this craftsmanship that we have been able to do so much in our conservation work.

We will now see the slides with which I will try to explain as clearly and concisely this accumulation of practical experience applied to the conservation of historic structures, and then I will offer some written recommendations which may be useful in conservation work and are not at all difficult to apply.

General Recommendations
Walls and Foundations

In general all the foundation work of the old city of Cartagena, including fortifications, is in perfect condition, partly due to excellent construction techniques used in the foundations and partly due to the natural condition of the soil on the historic island of Calamarí which is ideal for supporting bearing walls. It would be wise, however, to halt immediately all heavy motor vehicle traffic in the historic center, especially the street known a Calle de Ronda, next to the walls, as the damaging effects of this traffic have begun to be felt in this sector. I have seen cracks in some houses, and in the masonry of the scarp walls and bastions, something that in years past was insignificant or simply did not exist. To restore these we must use construction techniques and materials that are compatible with the originals; in their absence, it would be better to do nothing, unless the degree of deterioration threatens collapse.

I can give you the example of an old wall that had been eroded by the wind and the passage of time. If it may be consolidated with compatible materials such as brick or stone masonry, why should we use reinforced concrete, cinder blocks, or artificial stone? A further issue is the finishing of the new work which should show that it is recent, clearly showing the date the intervention was made. A case in point is the Manzanillo Fort, where similar techniques, compatible with the originals, were used, but differentiating the intervention, by color, texture, or signage. It would be acceptable to use new materials, when a study of the historic structure shows that it is necessary for stabilization and consolidation, in this case the Venice Charter itself authorizes—if we may use that term— the use of appropriate contemporary materials to "save" the historic structure.

As an example, I would like to mention the injection of concrete into the submarine foundations of the San José de Bocachica Fort in 1982, where the Scuba divers of Bocachica were able to inject a mix of lime, cement, sand, aggregate and rock in a web of polyethylene bags. The cave-like spaces under the foundations were threatening the stability of the entire structure of the historic building resting on them. If we fin eroded original plaster work which has exposed the original brick masonry, we leave it untouched, unless the wall is in danger of collapse. The patterns and textures that time has created on the wall should not be intervened: the historic structure should wear its age with dignity. There is no need to be so presumptuous as to cover up or adorn it; it would be like doing a skin implant on a centenarian. "Guatavization"* of the city has come into fashion in the last five years and the cases of making colonial residences "more colonial" are quite common, even counting on approval from the authorities or their just "looking the other way". I can mention the case of a house on Santo. Domingo Street where the founding father José Fernández Madrid lived, and whose modest brick façade was destroyed in order to install an artificial stone façade that would be more appropriate for a cheap theater set.

It is truly inconceivable that some residents of Cartagena have proposed "fixing" the walls with the sets that were prepared for the movie "The Mission" on the city's fortifications.

*Guativization: The term refers to the historic town of Guatavita which had to be moved to another location, and was rebuilt in the ""colonial style"

Woodwork

In general, the historic woodwork is in good condition, but there is a substantial amount that shows deterioration due to abandonment and lack of maintenance. It is incredible that we still have balconies that are more than two-hundred years old in perfect condition, with barely any maintenance or conservation, contrasting with balconies I have seen that were restored 15 or 20 years ago that are almost totally deteriorated.

The main enemies of wood are humidity, the sun, temperature changes, bacterial agents, fungi and insects such as various kinds of termites and poor workmanship, etc. If there is a single factor that contributed to conserving the woodwork of ancient Egypt, it was precisely that country's dry desert climate.

Another factor that has contributed to the conservation of woodwork in Cartagena has been the use of hardwoods that are resistant to our climate such as *carreto* (*Pithecellobium saman*, rain-tree), *guayacán* (*Guaiacum officinale*, lignumvitae), *polvillo* (*tabebuia serifolia*, yellow poui), and *canalete* (*Cordia alliodora,* Spanish elm) to mention a few.

If we add to this woodcutting and carving techniques using fully mature wood and cutting it according to the lunar cycle, it is no wonder that we can still enjoy an authentic eighteenth century balcony. The woodcutting techniques are from the Islamic heritage, inherited in turn from Persians, Byzantines, Phoenicians and Roman, not only in regards to lumbering but also woodworking and cabinetmaking.

The following should be borne in mind for woodwork conservation:

- Avoid having the wood coming into permanent contact with humidity or changes in humidity and dryness especially in poorly ventilated areas.
- Examine the piece for evidence of insects or fungi and proceed immediately to fumigate for which good quality commercial products may be used, applying them with a brush, sprayer or syringes to inject the product in small orifices.
- If necessary replace the affected or rotted part of the wood with a piece of the same quality. This must be done very carefully, using the same quality material as the historic wood, and the new piece may be joined using pegs or resins as appropriate. This was done quite well in the restoration of the roof and coffered ceiling of the Chapel of the Santa Clara Convent in 1993-94. The new pieces of wood should be protected with resins or tar where they are embedded in the walls.
- In humid and salt-air climates such as ours, nails and metalwork tend to rust, rotting the wood, and in that case the nail or fixture should be replaced using the same materials and techniques as the original. It should be borne in mind that the historic metalwork was hand-forged —electric welding was unknown— and the system was completely manual; the tools used by the master blacksmith historically were the forge, the anvil, tongs, hammers and punches; the metal was welded red-hot and hammered on the anvil. Present day nails made with recycled metal constantly create problems due to being short-lasting.

On one occasion I was to prepare some carriages to mount several seventeenth and eighteenth century artillery pieces, and I was fortunate to find an old master blacksmith in the *barrio* or run-down district of Getsemani who knew the old forging techniques. Other metals used with wood are copper, and more frequently, bronze, especially in the hinges and pivots of the massive doors of Hispano-Arabic origin. Bronze has the important advantage that it does not affect the wood and it is resistant to the effects of our torrid an salty climate. Before beginning a wood restoration project, detailed photographs should be taken of its condition as well as sketches and scale drawings. The inventory sheet should be completed, and then one can proceed with great care to carry out the intervention.

All works of art such as sculpture, paintings, drawings and murals should have an inventory sheet and be entrusted to the hands of an expert restorationist experienced in this kind of work. It is the architect's sacred duty to protect these works and store then in a safe place until they are to put in the hands of a restorationist. The guilded wood used quite frequently in Baroque altarpieces should be duly protected while repairs are being done nearby.

We should always bear in mind that work on historic structures should be done by a team of competent professionals and honest and experienced craftsmen.

The colors in the original plaster, found by taking borings through the layers are white, yellow ochre, pink and red ochre, always applied with lime wash and vegetable or animal resin. The colors found on the woodwork, doors, windows and balconies showed the first coat as a white prime of eggs and oil followed by coats of oil-based paint, red-ochre, green, blue, and so forth.

It is wise to continue using mineral washes on the walls, in colors ranging from white to the variety of ochres and pinks and reds; the lime will always tone down the pure mineral color while allowing the humidity of the wall to "breathe", lessening and in many cases, eliminating, the problem of efflorescence. Natural water-soluble resins should be used as binding agents, allowing the wall to breath; vinyl or other kinds of paints that seal in the humidity are not considered for obvious reasons.

Paints for woodwork should be prepared preferably with double-cooked linseed oil, which on being mixed with the mineral colors will provide a rich palette that has always been present in our architecture. By grinding the colors in a container, adding the oil little by little we can obtain an excellent paint that will protect the wood that is exposed to our climate; I have found that synthetic varnishes available on the market are inefficient, since they are soon affected by the sun and the rain which turn them "milky", ruining the color and eliminating the protective varnish. The recommended colors are red ochre, dark green, ultramarine and French blue, and others.

Every house, every landmark, every architectural complex, is a special case and therefore the proposed color should be carefully studied to avoid the whims of taste. The respective authorities should be alert to this and offer advice in the best interest of the work being done, thereby ensuring that the city may slowly but surely come to be given what it truly deserves.

Table of Materials and Uses in the Conservation of Historic Structures

MATERIAL	USES	OBSERVATIONS
River sand	Foundations - mortar	
Land sand	Foundations - mortar	
Sea sand	Foundations - plastering	Wash well before using, may be used in contact with sea-water.
Limestone	Foundations, walls, stonework, columns.	
Coral stone	Rough stonework, walls, foundation.	
Air-slaked lime	Walls, plastering, stucco	
Hydraulic lime	No longer produced	Replaced by gray or white portland cement .
Common brick	Consolidation of walls, construction.	
Military brick	Restoration of floors and walls in fortifications, in cornices	For new work to change color, proportions or texture.
Portland cement	New works, consolidation of submarine foundations, consolidation of structures; Consolidation and restoration of _original structures showing this material as an original material	Not advisable for use in historic plastering-it is better to use lime.
Basic lime and sand mortar	Restoration of plaster in general, all masonry structures; formula: 1 Lime; 2 sand.	The formula will vary according to the use and quality of the aggregates.
Lime and river stone mortar	Platform floors in fortifications	The formula will vary according to the use and quality of the aggregates.
Lime, cement, sand mortar	Consolidations	Use with moderation.
Mortar - pitch	Water-proofing flat outer surfaces or roofs, cisterns, pools, and in some cases, wells.	May be replaced with sealant agents added to mortar or concrete.
Ground sea shells	Marine concrete: Lime + Portland cement + Sea sand + Ground shells + _iv__ stones.	In Bocachica in 1982 this yielded excellent results; one can still see the submarine work in perfect condition.

Table of Materials and Uses in the Conservation of Historic Structures

MATERIAL	USES	OBSERVATIONS
WOODS		
Hardwoods		
Guayacán (lignumvitae)	Beams for floor slab.	Cut the wood according to the lunar cycle and cure with insecticides.
Polvillo (yellow poui)		
Carreto (raintree)	Coffered ceiling beams	
Ebano criollo (Wild ebony)	Beams.	
Almendro (almond tree)		
Soft and semi-soft woods		
Red cotton-silk tree	Rafters, structural joints, transoms, planks, paneling, floors, ties, doors, windows, mouldings, etc.	This wood has practically disappeared from the market.
Mahogany	Idem	
Spanish-cedar	Idem	
METALS		
Bronze	Hinges for military doors, washers, ornamental nail heads, latches, door ornamentation etc.	
Iron	Locks, hasps doorknockers, latches, iron flaps nails for framework, carriages	Hand forge when restoring.
WALL PAINT		
Lime wash	For lime and sand or cement and sand plasterwork.	Mineral colors; use natural resins, sizing, casein, in walls with efflorescence. Do not mix with synthetic resins.
Wash with synthetic resins	For new walls not showing efflorescence.	
WOOD PAINT		
Red ochre	Military doors and woodwork	Prepared with linseed oil and mineral red.
Any color	All woodwork	
Wood wash	Ceilings; interior woodwork.	Linseed oil and any mineral color

The System of Measures in Spanish Colonial Architecture: the *vara real* or Royal Rod

Carlos Baztán Lacasa and Francisco Castrillo Mazeres, Spain

The Roman Measurement System

The Romans consolidated their conquest of the Iberian peninsula in 197 B.C., and thus their system of weights, measures, and currency was imposed, substituting the Iberian system.

The Roman system, which offered a great simplicity and perfect rationality in its measures, was disseminated in comprehensive written legislation. The units are anthropometric. Thus the inch, *pulgada*, is from *pulgar* or thumb; *pie* means foot; *paso*, a pace, measures five feet, and *decempeda*, two *pasos*, measures ten feet. The mile or *milla*, equivalent to one thousand *pasos*, was a road measure.

From the approximately ten surviving foot measures, we have deduced the value of the Roman foot to be 29.63 cm., the generally accepted length.

The Castilian *vara*

During the Visigothic period, various measures were in use, and to put an end to the variety and confusion this produced, in the thirteenth century King James the Conqueror and Alfonso X the Wise ordered that the *vara* measuring three Roman feet (whose modern metric equivalence is 88.89 cm.) be used as the common measure for all of the populace. The city of Toledo received from Alfonso X the first Castilian *vara*, which measured three Roman feet. James the Conqueror likewise presented the city of Valencia with a *vara* of the same length.

Later Alfonso XI and Henry II substituted this *vara* with the Burgos *vara*, known since then as the Castilian *vara*.

The Burgos foot is shorter than the Roman foot, with a metric equivalence of 27.8635 cm. The Castilian *vara* was three feet long, and each foot measured twelve inches: it was the Burgos *vara*, of which the standard is kept at the Burgos archives, with a metric equivalence of 83.5905 cm.

The first attempt at legal standardization of weights and measures occurred under Philip II with "The New Compilation of the Laws of Spain," which took many years to prepare, and was completed on March 14, 1567. In Volume V (there are nine volumes) there is a "Study of Currency, Weights, Measures, Assay, and a Public Standard."

The Edict of Philip II

On June 24, 1568, Philip II issued an Edict and Royal Decree at El Escorial, "so that all measuring rods would be the same throughout the Kingdom, like the Castilian *vara* at the City of Burgos." This decree was disseminated by the town criers of Madrid, on the Plaza Mayor, the 6th of July of that year:

"The town criers of this court did cry out this royal decree of His Majesty in the presence of numerous persons."

The tendency towards standardization continued. Ferdinand VI (1746-1759) issued a Royal Edict directing that the War and Navy branches should use the Burgos *vara*. In the early nineteenth century standardization of measures was further consolidated and the Burgos *vara* was delivered to all provinces (1801).

The Newest Compilation

The "Novísima Recopilación", promulgated by Royal edict on July 15, 1605 provided in Volume V, Title Thirteen, "Of the weights and measures for buying and selling merchandise and supplies, and hardware...we declare that the Castilian *vara*, which is the one to be used in all of these kingdoms is the one had and held by the City of Burgos."

The Construction of El Escorial

One might well wonder why it was that Philip II issued his edict of June 24, 1568 at El Escorial.

The Monastery had been founded in a ceremony five years earlier, on April 23, 1563. On the 28th of that month, Philip II himself ordered the initial groundbreaking for the construction of the "San Lorenzo el Real de la Victoria Monastery," along with the Duke of Feria, the Prince of Eboli, and the Prior of León.

The architect and master builder during the first phase of construction (1563-1567) was Juan Bautista de Toledo, but he died in 1567, "just as the stonework of this famous building began to rise." The shaded area of the engraving had been built by this time. From 1567 on, Juan Bautista's assistants, principally Juan de Herrera, continued to direct the construction.

By February 1568 there were 300 craftsmen engaged in the work; the records show for March that there were French and Burgundian stonemasons present. Flemish carpenters were building the roof frame; there were Flemish slate cutters, Italian masons, skilled marble workers, also Italian, and Dutch craftsmen for the ponds and fountains. At the height of construction activities there were 3,000 workers.

We can only imagine the confusion that arose in the colossal construction project of the Monastery, with workmen from various Spanish provinces and several countries. In spite of previous attempts at achieving uniformity in 24 Spanish provinces, the royal *vara* was not yet the standard. In the various countries of origin we have mentioned there were different measurement systems: the project was a true Babel of measures.

In 1568, Philip II was present at El Escorial in the glory of the first years of his reign, when fate was to deal him some harsh blows. The monarch intervened directly in the construction of the monastery, and issued instructions bearing his own signature. It would seem unquestionable that Don Felipe's decision was born there, at El Escorial. It was a necessity, and the issue had come to the fore, to standardize measures, because of the difficulties encountered in coordinating the construction work. A monumental project like this had never been undertaken, and the difficulties that had arisen appeared to be insurmountable obstacles.

In any case, the unit of measurement used in the construction of El Escorial was the Castilian pie or *vara* as defined by Father Siguenza in Discourse I, Volume 2: "...the *pie* is one third of the Castilian *vara*, which consists of four *palmos* (palms of the hand), and each *palmo*, four fingers, each finger, four grains of common barley.

Pedro Martínez Gómez, states in his work "La evolución y los sistemas en la obra de El Escorial", with regard to this unit of measure, that it is more useful than decimal measures for laying out construction lines and marking the ground plan, as it has even and odd divisions. Juan de Herrera, besides being a great architect, mathematician, and scientist —continues Gomez— must surely have been the inspiration for the standardization and edict of 1568, which mandated the use of a sole unit, the Castilian *vara*, to overcome the difficulties which the diversity of measures had brought to the fore in Juan Bautista's lifetime.

The Application of the Edict

When Philip II issued the Edict of June 14th, he decided for the entire Kingdom. He was the "King of Castile, León, Aragón, the two Sicilies, Jerusalem, Portugal, Navarra, Granada, Toledo, Valencia, Galicia, Mallorca, Seville, Sardinia, Cordoba, Corcega, Murcia, Jaén, the Algarves, Algecira, Gibraltar, the Canary Islands, the East and West Indies, Isles and *Tierra Firme* of the Ocean Sea, Archduke of Austria, Duke of Burgundy, Brabant and Milan, Earl of Hapsburg, Flanders and the Tyrol, Barcelona, Lord of Vizcaya and Molina, etc."

That is to say, he decided for the Iberian Peninsula, the Balearic Islands and the Canaries, for a great part of Europe (the two Sicilies, Sardinia, Corcega, Milan, Austria, Burgundy, Brabant, Flanders, the Tyrol, etc.) for a great part of the Americas (East and West Indies, Isles and *Tierra Firme* of the Ocean Sea), Africa, Asia and Oceania.

This was the first attempt in history to standardize measures, in this case of longitude, affecting the five continents.

The System of Measures in the 18th Century

As a consequence of this attempt at legal standardization, during the eighteenth century the Castilian system for longitudinal measures on land was as follows:

Legua legal (Legal league)	8 1/3*varas*	6.96587 m.
Cuerda (cord)	8 1/4 *vara*	6.89 m.
Estadal	8 2/3 *varas*	3.06 m.
Estado, braza (fathom) or *toesa* (toise)	2 *varas*	1.67 m.
Castilian *paso*	1 2/3 *varas*	1.39 ,.
Castilian *vara*	3 *pies*	83.905
Codo or *media*	1/2 *vara*	41.86 cm.
Pie or*tercia*	1/3 *vara*	27.86 cm.
Palmo mayor	1/4 *vara*	20.89 cm.
Geme or *sexta*	1/6 *vara*	13.93 cm.
Coto or *octavo*	1.8 *vara*	10.44 cm.
Palmo menor or *doceava*	1/12 *vara*	6.96
Pulgada	1/12 *pie*	2.32 cm.
Dedo (finger)	1/16 *pie*	1.74 cm.
Grano (grain)	1/16 *pulgada*	4.35 mm.
Línea (line)		1.93mm.

Note: Only two decimal places have been shown except in the basic measure: the *vara*. Source: Mario Rodriguez Aragón.

The system has the*vara* and its fraction, the *pie*, as the common denominator.

In the "Proporción de Escalas", an address delivered by the Count of Aranda on January 31, 1757, scales were given for city maps, scales for coasts and frontiers, and for fortifications, with cross sections, and also for civilian structures, according to the Burgos *pie*, divided into twelve pulgadas, and besides using only multiples of this "Burgos or large *pie*," 27.86 centimeters, the land league, 5,572.7 meters, and the Castilian *vara*, 89.5 centimeters. These measures, as we will see below, persisted even after 1849, when the decimal metric system was established.

The New Unit, the Meter

In 1849, Queen Isabella II promulgated an act dated July 19, and later the Royal Decree of December 12, 1860, and the Royal Order of November 22, 1866, implementing the act, in which once again Spanish legislation purported to standardize weights and measures based on the meter.

The International Metric Convention was signed on April 19, 1875, during the Presidency of the Spanish General, Ibañez de Ibero, the guiding light of the Convention. A law enacted on July 9, 1892 finally established the metric system.

The Royal *vara* in Spanish America

The Burgos (or royal) *vara* for Spanish America was in general use between the latter part of the seventeenth century to the late nineteenth century. Hundreds of cities and thousands of buildings in the Americas were laid out and measured using this system, as confirmed by a comparison of the structures, written documents, and, above all, the plans and drawings that have remained.

The standard *varas* were brought from the Peninsula to the various administrative centers in the Americas to be reproduced exactly in the presence of a notary (the "fiel de *varas* y medidas" or "rods and measures standard"). For example, in the Mexico City Archives there is a reference dated 1774 to "A model of cast bronze with points marked for a half, third, fourth, *vesna*, eighth (*ochavo*), tenth and 1/2 ochavo, for the city."

These *varas* were used on construction sites to measure the construction lines that were laid out, and in marking out floor plans or public works. The system was not only used in construction, but also for architectural and urban planning.

The graduated scale used in construction was called a *pitipié* (a term derived from French sixteenth century engineering, the "petit pie" or small foot), the graphic scale, usually in pulgadas, that was used for establishing the scale in the drawing to be transposed to the project.

Cassani said, "When the architect wishes to prepare a drawing, the first thing he must do, before doing anything else, is to prepare a *pitipié*."

Long before this, Cristóbal de Rojas, the great sixteenth century engineer of the Madrid Academy, warned that "if the pitipié were too small, the layout of the construction lines will be too small, and if too large, the layout will be too large, for which reason, the Engineer, before laying out the construction lines, will verify how large a building he wishes to construct, and adjust the pitipié accordingly."

The thousands of drawings for cities and buildings in the Americas that are preserved in Spanish and American archives document the systematic use of the *vara* as a unit of measure, and the pitipié as the graduated scale. The use of the graphic scale in drawings was quite generalized, in some cases executed with considerable skill.

But standardization was not limited to this use. The Spanish military engineers codified the *pitipié* to be used according to the nature of the project to be designed. Thus, in a late eighteenth century manuscript from the Barcelona Academy of Mathematics, where a significant number of the military engineers who worked in the Americas were trained, the following ratios are recommended:

- To represent a large "City ward" 1 *pulgada* to 1000 *varas.*
- For a town or city, 1 *pulgada* to 150 *varas*
- For a master plan of a town or city, 1 *pulgada* to 50 *varas.*
- For fortifications, 1 *pulgada* to 20 *varas.*
- For architectural drawings, 1 *pulgada* to 3 *varas.*
- For construction details, 1 pulgada to a *pié.*

If we transpose the above to a metric scale we would have the following:

- For wards or areas within a city: 1:36,000
- For urban maps: 1:1,800
- For architecture: 1:108
- For details: 1:12

These are the scales that were recommended for regional and city plans and architectural drawings.

The Spanish used the *vara real* with its multiples and sub-multiples to erect their cities and buildings; it would seem logical to use the same measurement system with which they were created to study and measure them.

Translator's note: The translator decided to conserve the word *vara*, rather than use the English rod, since rod is defined in the English dictionary as measuring 16 feet. Some terms whose equivalents exist in English, e.g., *pie* (foot), *paso* (pace), were left untranslated, and equivalents were not sought for terms such as *estadal* or *coto*, because the text offers modern metric equivalents for them. On researching the terms, some etymological information was found for the following in the *Léxico de Alarifes de los Siglos de Oro*:

Braza - Latin braccia, two arms.

Codo - Literally "elbow", equivalent to two "*palmos mayores*".

Coto - Four closed fingers held tight with the thumb; *coto* means limit.

Estadal - Latin stadialis; the height from head to toe of an erect man or the breadth of his reach from fingertip to fingertip with arms outstretched.

Geme - Latin semi or half; the distance between the index finger and the thumb when the hand is open.

The translator was not able to find the divison of the *vara* mentioned in the Mexico City Archives, the *vesna*. The texts consulted, including the first edition of the Royal Academy Dictionary show the word *sesma* for the equivalent of one sixth, and this article in the list of metric equivalents shows *geme* or *sexta.*

Bibliography

Andrés, Gregorio de, *Inventario de documentos sobre la construcción y ornato del Monasterio de El Escorial, existentes en el Archivo de su Real Biblioteca*. Anales del Instituto de Estudios Madrileños. Madrid (1970), 55-79.

Cadarso Montalvo, Manuel, *La metrología en España hasta la Convención del Metro. I Asamblea Nacional de Metrología*. Madrid, December. 1975.

Carrera Stampa, Manuel. El sistema de pesos y medidas colonial Supplement to No. 1, Volume XXVI of the Memoranda of the Academy of History of Mexico. Mexico, 1967.

El San Juan Español. 1519-1818. Mapas y planos en los Archivos de España. State Historic Preservation Office, Puerto Rico. Ministry of Culture, Spain.

Fábricas y Orden Constructivo (La Construcción). IV Centenario del Monasterio de El Escorial. 1986.

Herrera, Juan de, *Sumario y breve declaración de los diseños y estampas de la Fábrica de San Lorenzo el Real del Escorial*. Vda. De Alonso Gomez, Impresor del Rey, 1589.

Portabala, Pichel, *Maestros mayores, arquitectos y aparejadores de El Escorial*. Madrid 1952.

Sigüenza, Fray José de., *Tercera parte de La Historia de la Orden de San Gerónimo, Doctor de la Iglesia Madrid*, Imprenta Real, 1605.

Zapatero, Juan Manuel., *La fortificación abaluartada en América*. Instituto de Cultura Puertorriqueña. San Juan, Puerto Rico, 1978.

Works consulted for translation:

García Salinero, Fernando, *Léxico de Alarifes de los Siglos de Oro*, Real Academia Española, Madrid, 1968.

Martín, Melitón, *El nuevo sistema legal de Pesas y Medidas*, Imprenta de J. Martín Alegría, Madrid, 1852.

Real Academia Española, *Diccionario de Autoridades*, 1727 (edición facsímil).

Historic Preservation and the Community: the Conde de Mirasol Fort on Vieques

Robert L. Rabin, Historian, Puerto Rico

The Conde de Mirasol Fort on Vieques Island is one of Puerto Rico's most important historic landmarks outside of the San Juan metropolitan area. Having been included in the National Register of Historic Places and restored and managed by the Institute of Puerto Rican Culture (IPC), the Fort has become a focal point of the cultural and educational life on Vieques. Since the opening of the restoration project in August 1991, tens of thousands of persons have visited the Fort.

On behalf of the people of Vieques, I would like to take this opportunity to thank our dear friend Ignacio Olazagasti, General Coordinator of the restoration project for the IPC. His love and devotion to the project ensured that it was carried out with a high level of architectural and museographic professionalism.

In this presentation, we will touch on some aspects of the Fort, its history, its restoration and the role it plays at present in the life of the people of Vieques, who are also Puerto Rican and Caribbean.

The Fort is a small defense complex consisting of a main building and a system of masonry walls. The height of the walls varies according to the contours of the hill on which they are built. The walls are from 20 and 36 inches wide at the top and from 6 to 8 at feet wide at their foundation. The system as a whole is 150 feet long and 70 feet wide. It has two cisterns which were used to gather rainwater. Due to budgetary issues, the wall system was never finished, leaving the star shaped side on the north unbuilt.

The Governor of Puerto Rico, Don Rafael Aristegui and Vélez, better known as Conde de Mirasol, in October of 1845 advised the inspector of Engineers, Don Diego Gálvez, that "...he considered an absolute necessity to establish a fort on Vieques with 4 pieces of artillery and space for 50 men and 2 small pieces..."

Don Juan Prim, successor to Mirasol in 1847, sent a memorandum to Madrid regarding Vieques in which he stated his opinion that "...Vieques is not only sempiternally an integral part of the Island of Puerto Rico but no sacrifice should be spared, however costly they may seem, to outfit her defenses fully..."

The concerns of these military men, also government officials, regarding Vieques were based on historic events. From their footholds in Anguilla, Tortola, St. Kitts, Nevis and Virgin Gorda, the English threatened to take over Crab Island, as they called Vieques. In 1688 and later, in 1717, English subjects occupied Vieques and on both occasions were repelled by Spanish naval forces. The Danish were also interested in Vieques. Diplomatic communiqués sent from Copenhagen to Madrid, argued that Krabben Eyland, because of its proximity to the Danish possessions of St. Thomas and Saint Croix belonged to its Virgin Islands.

There were other fears that motivated the fortification of Vieques. During the first half of the nineteenth century, the struggle for independence in the Spanish colonies in America and the abolition movement were of great concern to Spanish military officers in Puerto Rico. Vieques is the only point where Simón Bolívar, The Great Liberator of the Americas, touched Puerto Rican soil. In honor of that event, the government of Venezuela gave the people of Vieques the bust that adorns our main Plaza.

The Fort never saw action. Shortly after it was built, both the Danish and the British formally recognized Spanish right to Vieques. For almost a century, the building was used as a jail. Historic research done during the restoration process helped to show the important role this historic landmark played in the repressive judicial system that prevailed in nineteenth century Vieques. Slaves, *jornaleros**, Puerto Ricans who were struggling for autonomy and independence, exiled to Vieques from the Big Island, were jailed in the Fort during the latter part of the last

**Jornaleros* were required to carry a notebook to prove they were working.

century. In 1864 and later, in 1874, foreign workers from the sugar plantations Resolution and Playa Grande, respectively, protested the subhuman conditions in which they worked and lived. These groups of "Tortolans", workers from the English-speaking islands of Tortola, St. Kitts, St. Thomas and Saint Croix, were an important part of the work force on Vieques.

The Fort was also used to repress Dominicans during the War of Restoration on the sister Antillean island, in the early 1860's. In the City Records of Vieques dated September 23, 1879, there is a mention of "prisoners from Santo Domingo" who were forced to do work on the island's roads. We find further information on this group, imprisoned in the Fort, among the death certificates of the Parish of the Immaculate Conception on Vieques. The deaths appear in the Register of Deaths in intervals of two or three days, beginning with Juan Berros de la Cruz, about 50, died on December 5, 1864 and ending with the twenty-fifth, Matías Durán, born in Monte Plata, Santo Domingo, 60 years of age, married to Antonia Abad Cayetana and the son of Juan de Dios and María Francisca Hernándes, died on March 22, 1865.

Shortly after the American invasion of Puerto Rico in 1898, the firs magnetic and seismologic observatory in the Caribbean was established at the Fort. (February, 1903) The 1910 census in Vieques shows the names of more than one hundred prisoners in the Fort, presumably part of a work gang that engaged in considerable work on the Island's roads. In 1915, more than seventy workers from the Vieques sugar mills were jailed here during the massive strike that occurred that year. The Fort was the municipal jail on Vieques until the mid- 1940's, when it was abandoned and closed up. For the following decades the structure fell victim to termites of different sorts, leaky roofs and the pilferage of removable historic material.

In the 50's, 60's and 70's the ICP performed several minimal repairs, preventing the loss of this historic landmark belonging to the people of Vieques. After years of pleas from the public and promises made by the ICP, finally, in 1989, a full restoration project was begun with an assigned budget of $700,000.00. Mr. Ignacio Olazagasti directed the project with the cooperation of Architect Armando Morales and Mr. Ángel Tirado. It fell to me to carry out historical research on the Fort as well as the museographic aspects. A team of Puerto Rican craftsmen worked for a year and a half on the building itself. We opened the doors of the Museum of the Conde de Mirasol to the public on August 30, 1991.

To encourage community involvement in the project, people were invited to see the work in progress, to make comments an offer suggestions. The Yaureibo Cultural Center, the main cultural organization on Vieques, was assigned a space in the building for its office and special activities along with the Conde de Mirasol Fort Trust which was organized to aid in the management of the Museum. The Vieques Historic Archives were also located in the building, to function as a research center on the past and contemporary reality of this island-town.

The exhibition halls: Indigenous Cultures, Historic Processes and Historic Architecture, were filled with materials from the houses and backyards of the towns people. Old coins, photographs, tools, archeological material and other artifacts were gathered in the Vieques community, which showed its enthusiasm and desire to participate in the creation of a museum that honored its culture.

The themes were developed addressing particularly the rescue of the history of a people "without a voice", the humble people whose voices rarely appear in official histories.

Besides researching documents on Vieques in the Puerto Rico General Archives, materials from Spanish archives available at the Center for Historical Research at the University of Puerto Rico, parish records and the City Records and the Vieques City Hall, we made use of the rich source of information provided by the protagonists of the historic processes of our century. Through an extensive oral history program involving high school students, we gathered hundreds of years of experiences, the endless struggle of women, fishermen, carpenters, blacksmiths from the "olden days" and the struggle of a whole people for its very existence.

In our museum we proudly acknowledge the contribution and struggles to defend the heritage of Vieques by our indigenous ancestors, hundreds of African slaves, thousands of *jornaleros* and salaried sugar-cane workers, whose sacrifice and struggles contributed the spirit of struggle to defend their rights and their dignity which is part of the collective spirit of the people of Vieques of

today.

A consistent program of cultural and educational activities, with the active involvement of the different sectors of the community, helps us to ensure a positive dynamic of spreading information of the rich cultural heritage of Vieques. The constant visits of groups of school children, from Vieques and from Puerto Rico (the "Big Island") in search of their roots, force us to fulfill our obligations. The guides at the Museum of the Conde de Mirasol Fort are students that belong to the History Club.

There are many architecturally significant sites in Vieques. The old cemetery at Isabel Segunda; the private burial complex of the first Military and Political Governor of Vieques, Teófilo J.J. María Le Guillou; the Frenchman's Hous, built early this century by the wealthy landowner Victor Mourraille, a native of Marie Galante, Guadaloupe; the lighthouse at Punta Mulas in the town, which was recently restored by the Municipal Government and the ICP.

One of the main obstacles to the study and preservation of historic places on the Islands is the control exercised by the United States Nave on two thirds of the land. More than two hundred historically important sites lie behind the military fences. In January and February, hundreds of residents of Vieques visited the ruins of the Playa Grande sugar cane mill and the Puerto Ferro lighthouse, both on Navy lands.

We fraternally suggest that the restoration of historic landmarks should involve the people of the community in the process, so that they may receive the necessary support of the community; they should contribute to rescuing the history of the majority, the humble folk and the workers who are generally left out of museums and text books.

There is an African proverb that tells us that "...a people that does not know its history is like a tree without roots."

The mission of the Museum of the Conde de Mirasol is to rescue the history of the people of Vieques as Puerto Ricans and Caribbeans. We are certain that knowledge of a glorious past of struggle and sacrifice, will be of significant support to historic preservation projects and enable future generations to enter the approaching new millenium with strong cultural roots.

Problems and Possibilities: the Restoration and Interpretation of the Brimstone Hill Fortress, St. Kitts

Victor T.C. Smith, B.A., Brimstone Hill Fortress National Park Society
Presented by Larry Armony, General Manager, Brimstone Hill Fortress, National Park Society

Introduction: Location

Brimstone Hill is an extrusion of volcanic rock just inland from the western coast of St.Kitts and about one mile south of the town of Sandy Point. On its upper slopes and top are the structures of one of the largest and most magnificent British fortresses in the Caribbean. This is the subject of a major programme of conservation, restoration and interpretation by the Brimstone Hill Fortress National Park Society.

Raison d'etre for the Fortress

The main worth of St.Kitts to the British and the reason for its being held and defended was the high value of its sugar, extracted from sugar cane extensively cultivated on the island.

St.Kitts existed within the context of the wider power-play of the other European powers in the region. Its possession was part of a larger problem of securing the miscellany of British territories in the Caribbean. This, in turn, has left a large and important heritage of historical fortifications amounting to hundreds of sites across the region. Besides demanding adequate academic study and deserving to be better-known, these also contain their own imperatives for conservation.

Guns were first mounted by the British on Brimstone Hill in 1690, during the War of the Grand Alliance. This was to bombard and help recapture the nearby coastal Fort Charles which had been seized by the French. Gun positions were then made permanent to give rear fire-support to the fort in the event of a further French attack. Soon after that the value of the Hill as a "Deodand" or final retreat for the richer free inhabitants of the island was recognized and its top was converted into a refuge fortress. Severely damaged and captured in a major siege in 1782, the fortress was extensively rebuilt as a purely military position. This was a process which continued into the Napoleonic Wars when, in 1806, Brimstone Hill again saw action in firing at a French squadron offshore. The fortress was garrisoned until 1853. After this it was abandoned as part of the wider defence cuts in the Caribbean, gradually being robbed of masonry for building material needed elsewhere on the island and disappearing under a mass of invasive brush.

The Heritage Legacy

One and a half centuries of development on Brimstone Hill have left a vast legacy of more than 80 structures, such as bastions, curtain walls, batteries, barracks and store buildings, upon this 40 acre site. This is a conservation challenge on a grand scale. Yet, as well as posing problems, these buildings also offer great possibilities for presentation and interpretation of the fortress.

The fortress is important not just as a major example of military engineering but because it was also a complete military community, consisting of an infantry garrison, gunners, technical specialists, medical and administrative staff, families, as well as, for much of the period, a resident slave population. From a distance the fortress appeared to be a small hill-top town.

The citadel, Fort George, is one of the earliest surviving examples of polygonal fortification in the British service. Such is the international importance of the site that an application has been made for its inclusion in UNESCO's World Heritage List.

Organisation and Strategic Objectives

Brimstone Hill is owned by the Government of St.Christopher and Nevis, and managed by the Brimstone Hill Fortress National Park Society, a voluntary non-governmental organization

*Ed. Note: Deodand: Late Latin. Deo dandum, a thing to be given to God. In English law, any personal chattel which was the immediate occasion of the death of any reasonable creature, and which was forfeited to the crown to be applied to pious uses, and distributed in alms by the high almoner. *Black's Law Dicitionary*. St. Paul, Minn., West Publishing Co. 1979

founded in 1965 which operates with a full-time management team and maintenance staff.

The National Park Society has three main objectives:

First, to secure the present and future integrity of the fortress and its buildings as well as the Hill itself as a cultural resource for St.Kitts, the Caribbean and the World.

Second, to enhance the accessibility of the fortress and the Hill to visitors.

Third, to present the site including its flora and fauna for the education, understanding and enjoyment of visitors: local and foreign.

Within these objectives the National Park Society is careful that it does not celebrate a monument to British imperialism. It remains committed to historical truth which gives emphasis and weight to the skill and labour of African slaves who built and maintained the fortress as well as to the ingenuity of its British designers and planners. The fortress provides a focus for interpreting the history of the island and its peoples. Its presentation is therefore relevant to the people who live in St.Kitts and the wider Caribbean today, as well as to those interested in purely military history, and to tourists from abroad.

Practical Issues

With a project of this kind, involving the care of a large area and over 80 buildings, there is an inevitable competition for resources between, on the one hand, the need to preserve structures against gradual destruction by invasive organic growth, erosion and weathering and, on the other hand, to also present to the visitor in a creative way the many aspects of the history of the fortress: not just guns and soldiers, but its existence as a living community which interacted with the country and the economy around it, the building techniques used in construction, and the slave society which built it. It was clearly not desirable or possible to wait for every last piece of masonry to be stabilised before devoting resources to interpretation work. A balance has had to be found between these twin objectives, and sometimes difficult decisions have had to be made.

The National Park is evolving a strategy for a rolling programme of gradual stabilisation of the most vulnerable areas of masonry combined with occasional complete rebuilding and reconstruction projects. However, its planning resists the temptation to make reconstruction for effect an end in itself. It reconstructs only where a crucial re-use purpose is served or where it fulfills a key interpretation aim.

Reconstruction

The responsibilities upon the National Park in reconstruction projects is considerable. Reconstruction must be informed, accurate and based only upon evidence. Indeed all the tools of evidence must be brought to bear: whether that of (a) the extant remains, (b) original documents or pictorial record, (c) where necessary archaeological investigation and (d) comparison with similar extant structures in other locations.

Access to original documentation for defence heritage sites is often a problem of distance and convenience for those living and working in the region. Depending upon the nationality of the builders of the site, this can mean the need to visit archives in Britain, France, Spain or elsewhere for source material. Fortunately, the Society has a member in Britain with close and easy access to the relevant archives. Archaeological and historical-architectural investigations require professional inputs. These are more immediately accessible in some parts of the region than in others. The National Park has had to import these but hopes to build up its own ancillary skills in these areas.

A key example of reconstruction for crucial re-use is that of the Commissariat Store for use as a Visitor Centre. In this building, information about, and interpretation of the fortress is provided in one half, and the National Park shop is located in the other. A Visitor Centre had to be close to the unloading point for buses and cars on the Parade of the fortress so that initial interpretation could be carried out when most effective. Instead of providing this facility in a new structure, we decided to rebuild the early 19th century Commissariat Store for this purpose. This was conveniently close and more compatible with the visual and historical integrity of the fortress. This undertaking has been successful and important in improving visitors' understanding of the fortress.

Within the Commissariat Yard which enclosed the Visitor Centre, we also built the Warrant Officers Quarters. This was for an interpretive purpose to present images of a living quarters within the fortress by refurnishing its interior. Outside this an archaeological excavation was undertaken which has provided new information about the stratigraphy of the ground which made up the Commissariat Yard.

Refreshment and restroom facilities are important on any site but are not necessarily always provided in a visually acceptable way. In this instance too, a reconstruction option was chosen. This took the form of a self-contained element of the Infantry Officers Quarters, also at Parade level. Sufficient original and documentary evidence existed to allow an authentic reconstruction.

The first project for re-use of a building at Brimstone Hill was that of the Citadel, known as Fort George. This did not involve complete rebuilding, but extensive repairs. It was prompted by the decision to create a museum collection within the fortress, primarily to present the history of the fortress through display of artifacts and pictorial matter. This was and still is the only museum in St.Kitts. It was this purpose which gave momentum to the repair of the building. Its use on a continuing basis has also ensured its maintenance. Without this, the building might have remained a lifeless shell.

Barrack No. 4 - a Case Study

Appropriate re-use can indeed offer a future for a decayed building. A current case in point is a project for No. 4 Barrack in the north-east part of the fortress. Reconstruction is being considered to provide a sheltered area for the increasing numbers of large organised parties to the fortress who need a place which is sheltered from sun and rain in which to eat their food and picnic. Without the need for finding a suitable place for this facility it is doubtful that the National Park Society would have considered the building for anything other than stabilisation at this stage.

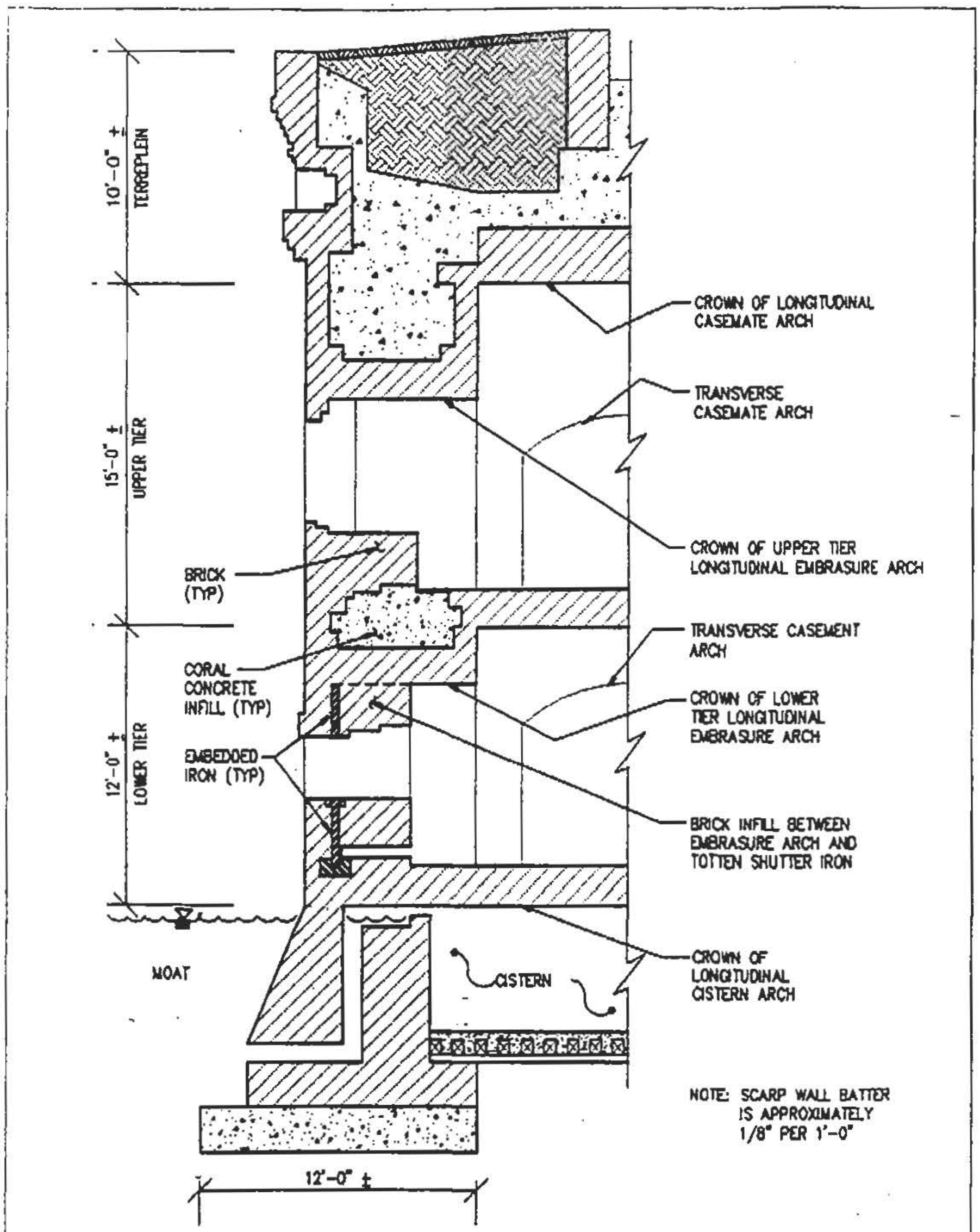
This is a case study of how a process of academic and technical investigation is having to be applied in order to ensure the achievement of an historically and aesthetically acceptable reconstruction.

Firstly, a fundamental question to be asked was, given its incomplete state, "What did the building look like - inside and outside"? Secondly, we have to decide how much of the structure to rebuild.

The surviving elements of the structure gave clear evidence as to the overall form - a two storey building, divided in two by a central internal arched wall supporting a double ridge and furrow roof. What was not evident from the visible remains of the building until clearance operations on the site was the existence of a stone-paved verandah on either side. This find confirmed an impressionistic sketch of the barrack in 1810. Clearance and archaeological excavation within the interior of the building revealed the layout of pier supports for the wooden floor. Mr. Frederik Gjessing, an architect whose specialty is historical restoration visited the site, utilised all the architectural, archaeological, documentary and available comparative evidence to produce a reconstruction drawing for the walls and roof.

The interior arrangements of the barracks, including furniture, fixtures and fittings, are more difficult to work out. The spaces within the arches were almost certainly infilled with timber panels to complete the division of the building into two halves. Those halves seem to have had a central aisle flanked by sleeping spaces along either long wall. The aisle would have been encumbered by mess tables and benches. The sleeping arrangements were hammocks, fixed into wooden frames whose design is at present uncertain. The barrack had 238 designated sleeping places and the hammocks must have been fitted double-tiered, in bunk style. The upper storey was a roof-space only.

How to rebuild the barrack and how much of the structure should be rebuilt has yet to be settled. To complete the whole of the structure would be expensive but would result in a desirable visual and interpretive asset to the fortress. However, engineering advice was that it would need to be completely sealed to make it hurricane resistant as it is sited on the windiest part of Brimstone Hill. It was several times badly damaged by hurricanes in the early 19th century. An alternative we are considering is to rebuild the side walls and roof rafters only. Easily removable roofing would



SCHEMATIC SECTION THROUGH SCARP WALL @ EMBRASURES

4 0 4 8

SCALE: 1/4"=1'-0"

DESIGNED: M.E. DRAWN: V.D:T. TECH. REVIEW: R.S.,M.E. DATE: 2/17/94	SUB SHEET NO SK-1	TITLE OF SHEET FORT JEFFERSON N. P. TYPICAL SECTION THROUGH CASEMATES AND SCARP WALL AS-BUILT CONDITIONS TITLE 1 SERVICES REPORT	DRAWING NO. 364 / 20005 PKG. NO. ___ SHEET 1 OF 5

then be placed on the rafters when needed as a shelter. The result would be sufficient to become an historical and a visual asset but would have plenty of space for hurricane force winds to pass through without causing damage to the structure.

There is a shortage of available cut facing stones on the site for the walls and it will be beyond our financial reach to have fresh stones cut and textured. In some parts of the Caribbean there has been a tendency to rob one historical building for materials in favour of another. This is unacceptable. In our case, we have been fortunate to obtain the promise of suitable materials from a demolished building of no historical significance.

More generally, this project will act as a focus for the opening up of an adjacent part of the fortress which has hitherto been invisible to visitors by being overgrown. This includes bastions from the original refuge fortress, another barrack, a cistern and a kitchen.

In the case of the Artillery Officers Quarters, we have an imperative of a different nature. This was a grand and imposing structure when built in the 1790's. However, it is gradually collapsing, the casualty over the years of initial stone robbing and general deterioration, worsened by occasional earth tremors. Careful stabilisation is to be carried out and this will be devised in such a way as to keep the options open for a complete rebuild later, in the event of a suitable re-use purpose emerging.

Accommodation of the Ecological with the Historical Heritage

On some defence heritage sites a conflict of interests can emerge between an ecological concern and the historical heritage. This may be a difficult issue to resolve but the ecological dimension must be respected within a wider conservation framework.

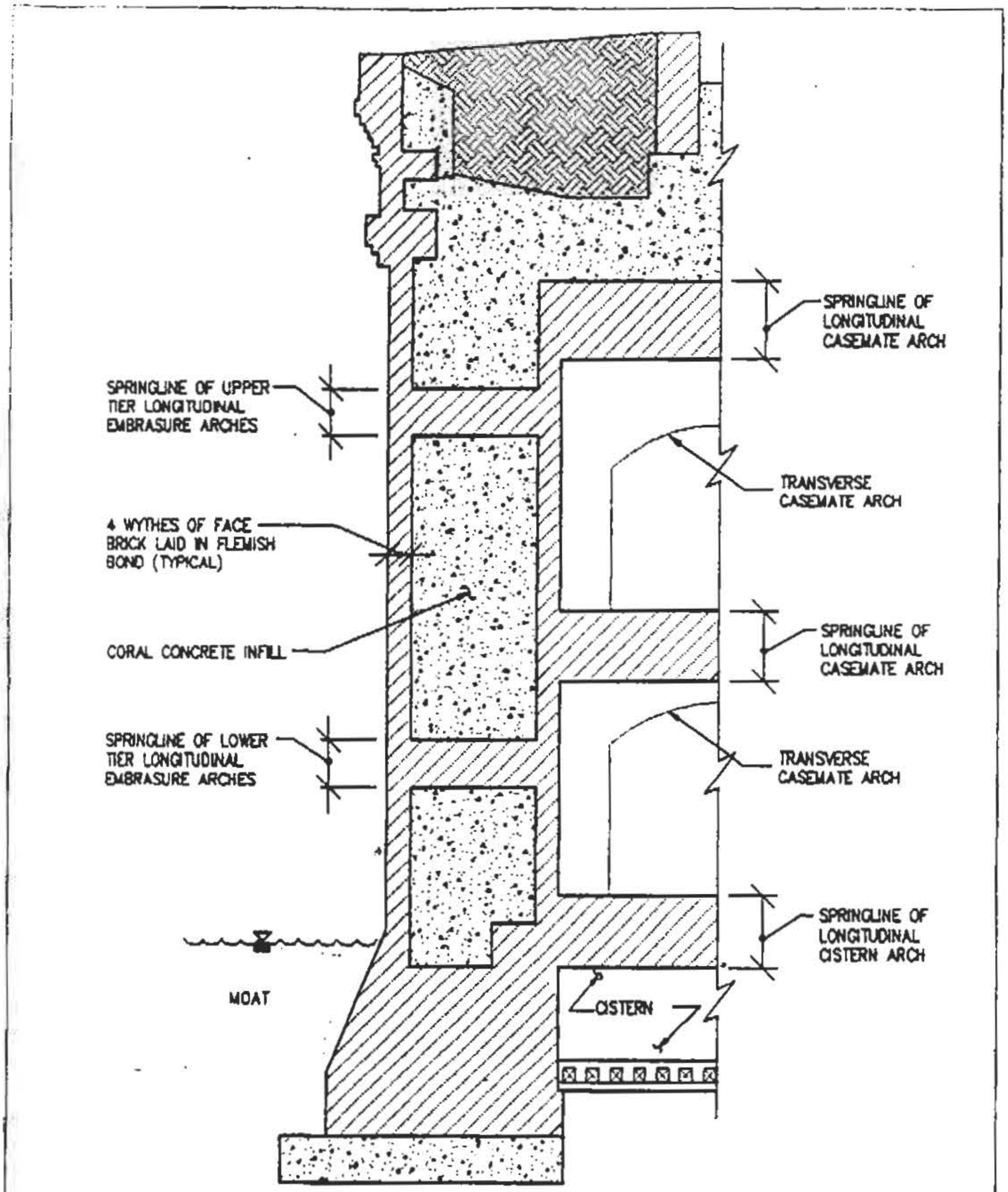
Brimstone Hill has a rich ecological resource in the form of its plant life (and the animals it supports) which survived the earlier deforestation of surrounding lands to make way for sugar cane. Although minor destruction of some vegetation and plant life is going to be inevitable in clearing around buildings, there will remain a large part of the Hill, mostly below the level of the fortifications in which nature will be little disturbed, other than through giving a degree of public access by means of nature trails so that plant life and habitats can be interpreted.

The Future

Provided that the National Park maintains its visitor levels and the income this brings and that it can secure occasional assistance from grant-aiding bodies for special projects, the future for Brimstone Hill looks bright. We shall continue with the wall stabilisation and rebuilding activity we have started. The ecological dimension will be given greater emphasis and so will the interpretation effort for the fortress in general. This will include the placement of open-air panels in key places containing interacting perspective reconstruction drawings and explanatory text to bring the fortress back to life in the minds of visitors. Some further refurnishing of exteriors and interiors will also be a feature. There will be a teachers' educational pack for schools and colleges. Even living history presentations may be a possibility in the longer term. Certainly, new areas of the fortress will be opened up.

One of the most exciting areas for future development will be to exploit the plentiful archaeological evidence of the site in addressing and answering questions about the development of the fortress. The process will be to match documentary evidence with the results of focused archaeological investigation. This will, for example, be a key way in which to learn about slave activity on the site.

Finally, it is represented that there is a need for a standing special interest group or organisation dedicated to the research, conservation and promotion of defence heritage sites of all nationalities within the Caribbean. A number of people throughout the Caribbean are involved in the research or conservation of defence heritage sites but do not necessarily all know of each other or of each other's resources of information and experience. The Caribbean experience justifies such an organization, which can provide an opportunity for researchers to see their sites and their work within a wider, international context.

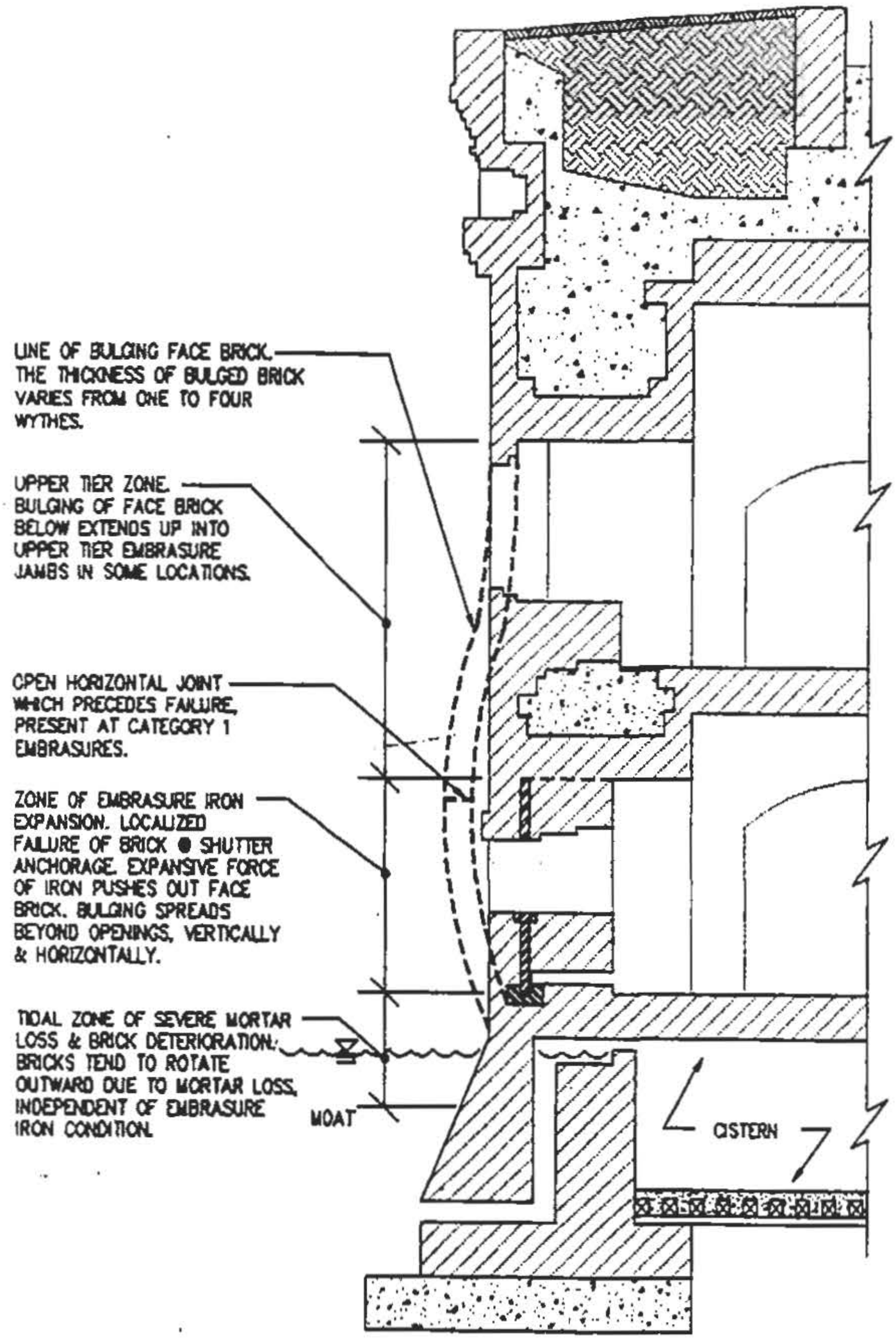


SCHEMATIC SECTION THROUGH SCARP WALL BETWEEN EMBRASURES

4 0 4 8

SCALE: 1/4"=1'-0"

DESIGNED: M.E.	SUB SHEET NO	TITLE OF SHEET	DRAWING NO.
DRAWN: V.D.T.	SK-2	FORT JEFFERSON N. P. TYPICAL SECTION THROUGH CASEMATES AND SCARP WALL AS-BUILT CONDITIONS TITLE 1 SERVICES REPORT	364 20005
TECH. REVIEW: R.S.,M.E.			PKG. NO. — SHEET 2 OF 5
DATE: 2/17/94			

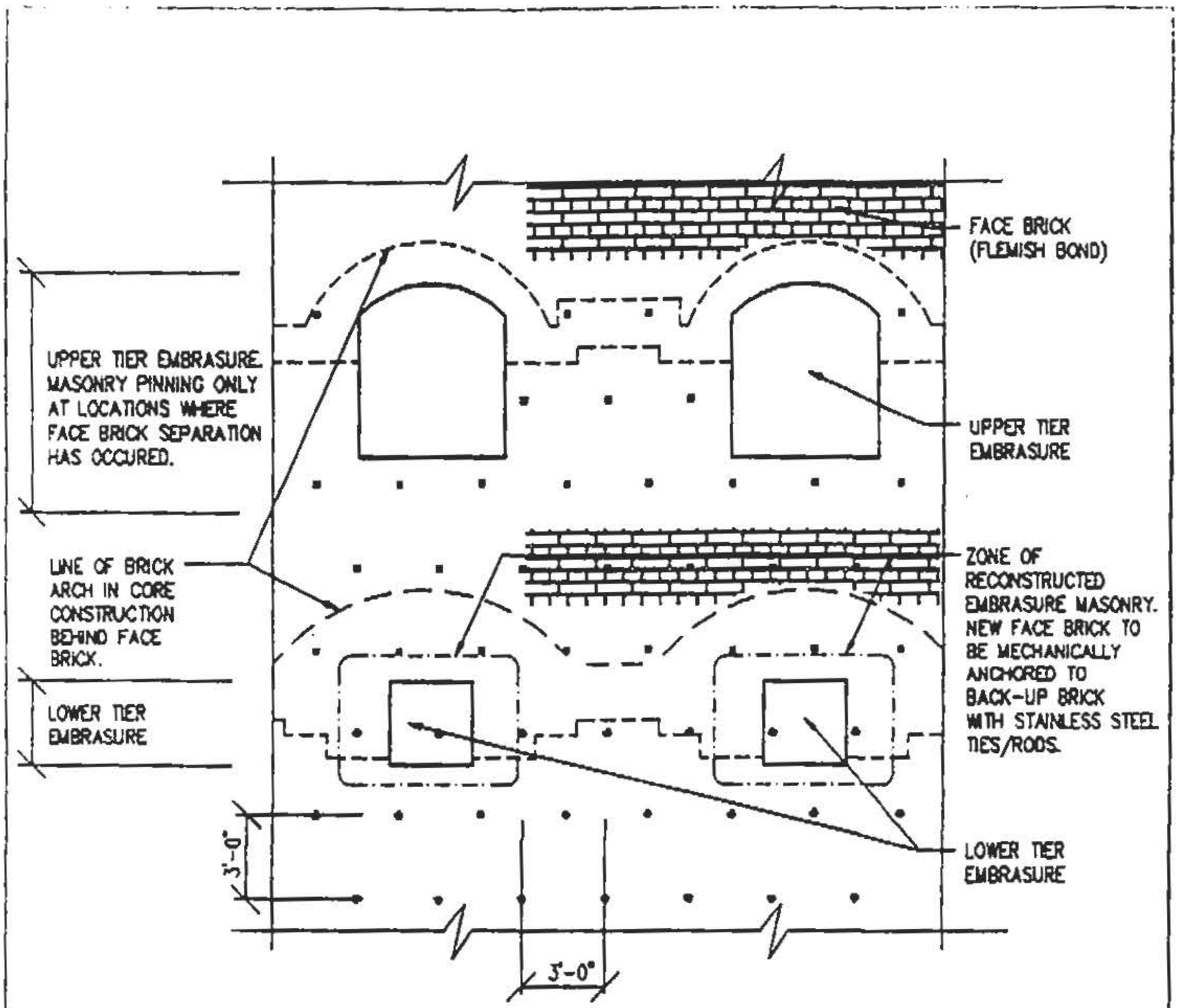


SCHEMATIC SECTION THROUGH SCARP WALL @ EMBRASURE OPENING CATEGORIES 1 TO 3

4 0 4 8

SCALE: 1/4"=1'-0"

DESIGNED: M.E. DRAWN: V.D.T. TECH. REVIEW: R.S.,M.E. DATE: 2/17/94	SUB SHEET NO SK-3	TITLE OF SHEET FORT JEFFERSON N. P. TYPICAL SECTION THROUGH CASEMATES AND SCARP WALL EXISTING CONDITIONS TITLE 1 SERVICES REPORT	DRAWING NO. 364 20005 PKG. NO. ___ SHEET 3 OF 5



ELEVATION SHOWING EXTENT OF PINNING REPAIRS

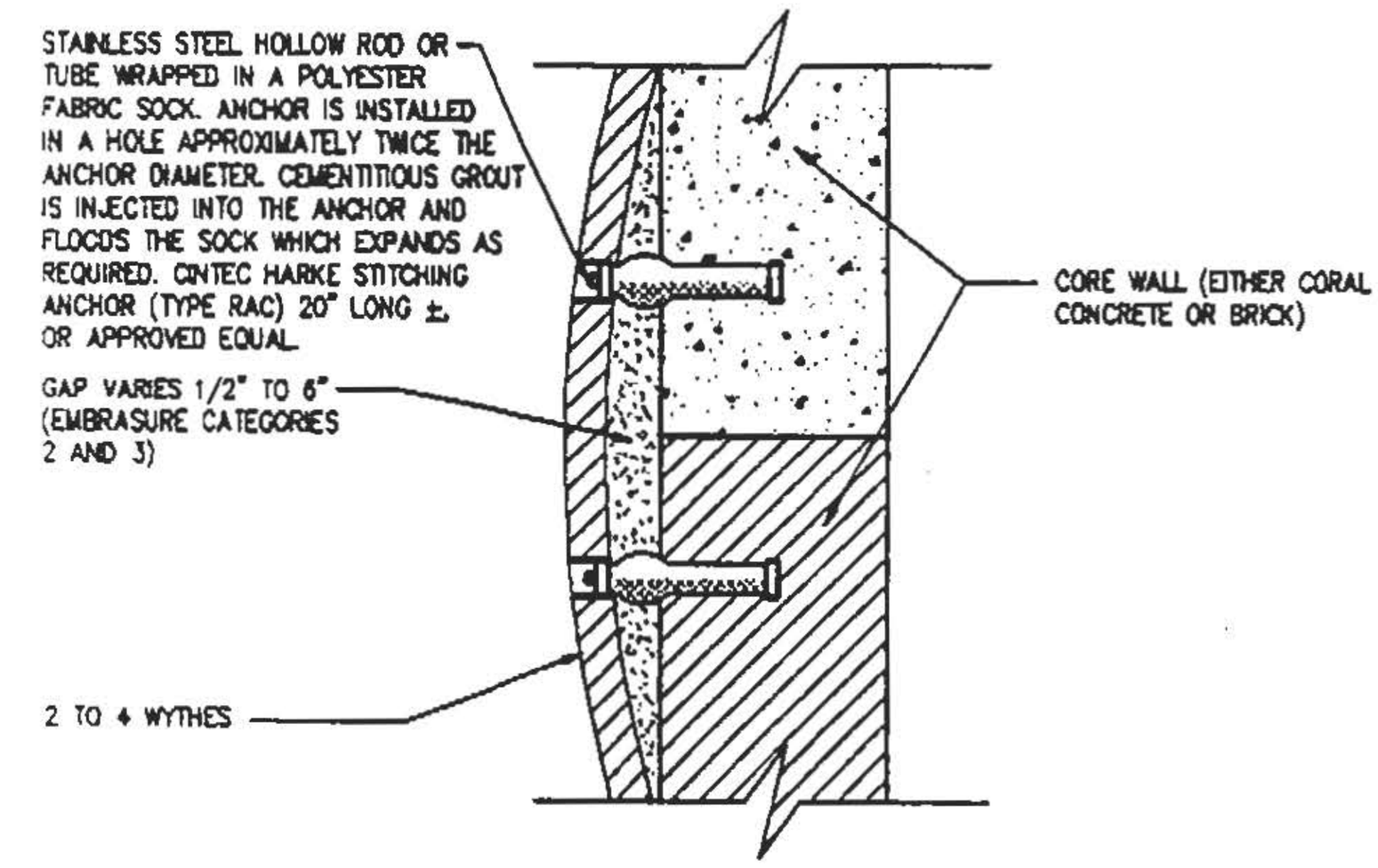
4 0 4 8

SCALE: 1/4"=1'-0"

NOTES FOR TEST INSTALLATION

1. LOCAL REBUILDING OF BRICK WILL BE REQUIRED AT EMBRASURE OPENINGS AFTER REMOVAL OF TOTTEN SHUTTER IRON.
2. REINSTALLATION OF SALVAGED OR REPLACEMENT SHUTTERS WILL SIMULATE THE HISTORIC APPEARANCE WITHOUT MASSIVE EMBEDDED STEEL. REBUILDING OF BRICK AT EMBRASURES CAN PRECEDE SHUTTER REINSTALLATION.
3. PINNING ANCHORS ARE SHOWN ON A 3'-0" BY 3'-0" STAGGERED GRID TO REATTACH EXISTING FACE BRICK TO BACKUP MATERIAL. THIS IS A PRELIMINARY ESTIMATE WHICH WILL BE CLARIFIED DURING SUBSEQUENT FIELD WORK. THE SPACING FOR ANCHORING TO BRICK BACKUP MAY BE DIFFERENT THAN THE SPACING FOR ANCHORING TO CORAL AGGREGATE CONCRETE.
4. FOR THE PURPOSES OF THE TEST PROGRAM, TWO ADJACENT EMBRASURES, ONE CATEGORY 2 AND ONE CATEGORY 3 SHOULD BE SELECTED.

DESIGNED:	SUB SHEET NO	TITLE OF SHEET	DRAWING NO.
M.E.		FORT JEFFERSON N. P.	364
DRAWN: V.D.T.	SK-4	TYPICAL SECTION THROUGH CASEMATES AND SCARP WALL	20005
TECH. REVIEW: R.S., M.E.		PROPOSED REPAIRS TITLE 1 SERVICES REPORT	PKG. NO. — SHEET 4 OF 5
DATE: 2/17/94			



SCHEMATIC SECTION @ FACE BRICK STABILIZATION REPAIR

4 0 4 8

SCALE: 1/4"=1'-0"

NOTES

SEQUENCE FOR TEST INSTALLATION:

1. REMOVE OUTER WYTHES OF BRICK @ ANCHOR LOCATIONS.
2. DRILL THROUGH CORE MATERIAL TO DESIRED DEPTH.
3. INSTALL ANCHORS ON 3' x 3' (APPROXIMATELY) GRID, STAGGERED.
4. REPOINT MASONRY IN REPAIR ZONE, FROM FOUNDATION TO CORNICE.
5. GRAVITY FEED OR LOW PRESSURE INJECT GROUT INTO CAVITY.
6. CONCEAL HEADS OF ANCHORS WITH SALVAGED OR REPLACEMENT BRICK.

DESIGNED: M.E.	SUB SHEET NO	TITLE OF SHEET	DRAWING NO. 364 20005
DRAWN: V.D.T.	SK-5	FORT JEFFERSON N. P. TYPICAL SECTION THROUGH CASEMATES AND SCARP WALL	PKG. NO. — SHEET 5
TECH. REVIEW: R.S.,M.E.		PROPOSED REPAIRS TITLE 1 SERVICES REPORT	OF 5
DATE: 2/17/94			

Masonry and Iron in a Marine Environment: Structural Stabilization and Preservation at Fort Jefferson, Dry Tortugas National Park, Florida

Sarah J. Boykin, AIA and Marie Ennis, P.E.

Introduction

This paper describes investigations undertaken by the Historic Architecture Division of the Southeast Region of the National Park Service to address the structural stabilization of the exterior walls, specifically, the lower tier embrasure openings, at Fort Jefferson in the Dry Tortugas National Park. The Southeast Region was very fortunate to have David Wright, AIA, project architect (Grieves Worrall Wright & O'Hatnick, Baltimore, MD and Marie Ennis, P.E., structural preservation engineer (Robert Silman Associates, New York, NY) lend their expertise to this effort. Sarah Boykin, AIA, is the historical architect that served as project manager for the Historic Architecture Division. The fieldwork was done in December, 1993, and the report was completed in March, 1994.

In 1846 the United States Army began construction of Fort Jefferson as the largest and last of the third system of fortifications, constructed to provide coastal defense for the U.S. mainland. It is situated seventy miles west of Key West, Florida, on a seventeen acre island, or key, known as Garden Key, that is part of a small cluster of islands in the Gulf of Mexico. In the sixteenth century, the explorer Ponce de Leon named these islands the Dry Tortugas : dry because there is no fresh water, and *tortugas* (the Spanish word for turtle) for the hundreds of sea turtles that are native to these islands.

Fort Jefferson has been considered a significant cultural resource since the beginning of this century when it was designated Fort Jefferson National Monument. Over the years, its remote location has contributed to its reputation as one of the most pristine marine environments in the western hemisphere, and in 1992, this reputation was instrumental in changing Fort Jefferson National Monument (which includes the surrounding one hundred square mile area) to the Dry Tortugas National Park.

In addition to the diverse species of aquatic life, the Dry Tortugas National Park is also an important habitat for hundreds of native and migrating bird populations. Because many of these marine animals and birds are endangered species, the preservation of the natural environment is a critical concern that has influenced the management objectives of the Park. The complexity of issues related to preserving an important historic structure within this very unique natural environment has presented opportunities and challenges for both the scientist and the preservationist.

The primary preservation issue at Fort Jefferson is the stabilization of the exterior walls which are experiencing massive structural problems due to corrosion of the iron shutters. Originally, the fort was constructed using exclusively masonry arch and vault construction. The core structure is unreinforced coral aggregate concrete faced with brick. (Illustration SK-2). The terreplein (roof) was designed as an elaborate water collection system that drains into the fort cistern below the slate floor on the first level to provide fresh water for the island's inhabitants. A moat wall, or counterscarp, approximately six feet wide was built seventy feet out from the scarp wall and surrounds the fort on all six sides.

On the lower tier of the exterior walls there are approximately 163 iron embrasure openings that were designed for the "Totten shutter." This iron shutter represents the latest in nineteenth-century military engineering technology and was designed specifically for Fort Jefferson by General Totten, a military engineer, for whom it is named. When the guns were fired, the shutter automatically closed, sealing off the embrasure opening. When constructed, the iron components were coated with asphaltum before being concealed within the masonry wall (Illustration SK-1). Historically, the exposed iron shutters were oiled routinely to prevent corrosion and deterioration.

As the fort neared completion in the 1870's construction was stopped and never resumed. For the past hundred years or more, the fort has not been active as a military defense outpost, and

maintenance of the iron shutters has not been done on a regular basis. Over time, the protective coatings on the iron shutters have worn away, and the iron has begun to deteriorate. The presence of salt water, moisture, and air have contributed to the deterioration process, causing the metal to swell gradually and expand as much as ten times its original mass. This expansion of the corroded iron causes exfoliation, or flaking of the iron, eventually results in structural (or fabric) failure, which has occurred at several embrasure openings at Fort Jefferson.

The purpose of this investigation was to document the condition of the embrasure openings and to develop a program that addressed the iron and brick deterioration in a cost-effective manner, allowing for the stabilization of as much historic fabric as possible. The following is a summary of the methodology that was used and the conclusions and recommendations made as a result of the investigation.

What is Known: Fabric Deterioration, Iron

We knew when we began this project that the primary cause of wall failure at Fort Jefferson is deterioration of the wrought iron shutters. As the iron became exposed to the elements, particularly moisture, it began to corrode. The environmental conditions of the Dry Tortugas, including the high humidity levels, wind, and saltwater have contributed to the iron deterioration. In addition, galvanic corrosion may be occurring due to the presence of more noble metals in the sea water.

The oxidation of iron and the formation of corrosion causes the iron to expand, significantly increasing the original volume of the metal elements. For example, a shutter element which was originally 2 inches thick could expand to 20 inches or ten times its original size. At Fort Jefferson the iron shutters embedded in the masonry walls push the face brick outward, producing tensile and shearing stresses in the masonry. (Illustration SK-3) These corrosion-induced forces result in the shattering of brick units and in the separation of the face wythes from the back-up material. Visual evidence told us that a contributing secondary cause of wall failure is masonry deterioration—the erosion of mortar joints—again, as a result of environmental factors, specifically, wind and water erosion.

Masonry: Scarp Wall Construction

The original construction of the fort walls has had a major influence on the failure mechanism of the masonry. The face brick, which varies from four to six wythes thick, is keyed to the main (or core) structure at the longitudinal arches using header bricks. Between the arches, the back-up, or infill material, is an unreinforced coral aggregate concrete. There are no brick or iron ties connecting the face brick and the concrete, since the outer wythe was intended to be a sacrificial layer in the event of attack. This construction method has allowed the brick to peel away from the concrete mass as the iron swells, creating cracks and voids that then have become vehicles for water to reach the concealed iron.

Also as the wall loses mortar on the outer face, the brick becomes unstable, and there is a loss of structure integrity. Over time, deterioration of the masonry and iron progresses to the point of wall failure, and the fort begins to look like a structure under attack. When this occurs, the core construction is exposed to the elements, and it then becomes subjected to deterioration from wind and weather.

Field Survey Methodology

This is what we knew before conducting a visual survey and assessment of the exterior walls. Because of the variety of existing wall conditions, the project team conducted a field survey to assess the condition of each embrasure opening. Each of the 154 openings (the total number remaining with iron shutters) was ranked according to this assessment, in relative categories of 0-5). The ranking and corresponding conditions designated) as the most severe condition and 5 as the least deteriorated opening:

0. Significant loss of brick adjacent to the embrasure opening has already occurred; 17 embrasures (11%) are in this category.
1. Significant loss of brick adjacent to embrasure opening is imminent. Voids behind the

face brick are detectable and bulging of the masonry is severe; 50 embrasures (32%) fall into this category.
2. Condition of the brick adjacent to embrasure is deteriorating. Bulging is present, accompanied by some local brick loss; 47 embrasures (31%) are in this category.
3. Beginning signs of deterioration and bulging of brick adjacent to embrasure openings are evident; 21 embrasures (14%) are in this category.
4. Embrasure openings originally designed without metal shutters. The condition of the adjacent brick is sound and without evidence of localized bulging; 8 embrasures (5%) fall into this category.
5. Brick rebuilding has already occurred at the embrasure opening with complete removal of the Totten Shutters and anchorages; 11 embrasures (7%) fall into this category.

These categories allowed the team to establish priorities and to develop a scenario for each recommended treatment.

Overall Assessment

The condition of the masonry varies considerably throughout the fort with the north-facing Front 5 experiencing the least deterioration. A possible explanation for this phenomenon is the differences in thermal movement of the masonry and iron, as well as the temperature variations during the course of a day, which are a function of exposure, or orientation. Temperature variations can cause both the brick and iron to expand and contract, with the face brick and iron subjected to much higher temperature variations than the core materials. These thermal factors could contribute to the failure or shearing of header bricks at openings on all fronts (behind the face brick).

Front 5 has less thermally induced stresses resulting from heat loss and gain since it receives less direct sunlight exposure than the other fronts. In this regard, its orientation may be a factor in explaining why it is in better condition than the other sides. The thermal influence may also explain why the north-facing sides of several bastion embrasures are in better condition than the south facing sides.

Intervention Recommendations

The following interventions in order of priority are recommended as part of a full-scale restoration of the scarp walls:

1. Removal of Iron Shutters. Includes al components currently buried behind or within the masonry.

The iron embedded within the masonry has undergone significant expansion causing cracks and separations in adjacent masonry from small hairline cracks (Category 3) to gaps of 8 inches or more in width (Categories 1 and 2). No technology or rational methodology exists which will allow the retention of the metal in-situ while addressing permanent stabilization of the adjacent masonry walls. Cathodic protection of the metal in-situ was investigated as a possible option for those shutter assemblies which have not experienced significant exfoliation (Category 3). However, in order for cathodic protection to work, all corrosion products would first have to be removed. This means that all embedded iron would have to be exposed, thereby necessitating the removal of masonry. In addition, this process requires that the iron be surrounded by an electrolyte, e.g., water, rendering the exposed shutter elements suitable for cathodic protection.

Reinstallation of the embedded (concealed) pieces of the original shutter assembly within the masonry reconstruction is not recommended since its inaccessibility would reintroduce the possibility of future deterioration.

2. Embrasure Masonry Repairs. These repairs fall into three levels of intervention based on the condition categories:

A. In-situ stabilization of masonry around embrasures classified Category 3.
B. In-situ stabilization and rebuilding of masonry around embrasures classified as Category 2.
C. Rebuild masonry around embrasures classified Category 0 and portions of Category 1.

3. Full Scale Repointing of Masonry.

All scarp walls require repointing in order to stabilize the outer brick courses. To perform other repairs without repointing is not recommended since loss of masonry wall fabric will continue to occur until all eroded mortar joints are repointed. The repointing effort could be done when embrasure repairs are scheduled for a particular area of the wall.

Prioritized Recommendations

The following prioritized recommendations are based on December 1993 conditions. These priorities will allow for phasing of contract work as funding is available, with the ultimate goal to restore all the scarp walls. With the passing of time, the deterioration will progress, destroying original fabric. The ranking of each opening will change and, potentially more aggressive interventions will be required to stabilize the walls. For example, embrasures in Condition Category 1 eventually will become Category 0 in the near future, in some cases within weeks or months. Category 3 embrasures are in the best condition and will progress, over a longer time period, to Category 2.

It is important to emphasize that the expedient repairing of Category 3 embrasures offers the greatest opportunity to save original fabric than the repairing of any other single category. And, obviously, the sooner that all embrasures are repaired, the more original fabric can be saved in-situ at each location, due to the progressive nature of the masonry and iron deterioration.

1. Field Testing. Ideally, masonry repair options should be tested on representative embrasure categories prior to full-scale repairs and stabilization. In this way, procedures can be tested on a limited scope, allowing for adjustments, improvements, and confirmation of recommended methodologies before contract documents are executed for the full scope of work.

Testing alternatives also allows for refinement of appropriate methods, and identifies needed materials and skills that might not be considered otherwise. These project parameters are critical in developing an accurate cost estimate for securing the necessary funds for the work.

2. Full Scale Masonry Repairs.

For face brick stabilization, a test installation of stainless steel hollow rods wrapped in a polyester fabric sock is recommended in order to mechanically fasten the bulging masonry to the core structure. Illustrations SK-4 and SK-5 show the extent of this technique in greater detail. This repair method has been successful on similar preservation projects, and it is potentially an effective method for stabilizing Fort Jefferson's masonry walls.

The following priorities have been identified to preserve the most masonry in-situ. As with other phases of work, the order of priority for masonry stabilization work is subject to change contingent on field testing as well as progressive deterioration that occurs before the actual execution of the repairs.

First Priority: Category 3 Embrasures: Stabilize the surrounding masonry in-situ, via pinning and low pressure grouting. Remove the embrasure iron and reconstruct the wall.

Second Priority: Category 2 Embrasures: Same as Category 3 above, with more extensive pinning, grouting and reconstruction.

Third: Category 1 Embrasures: Removal of unstable wall sections to avoid "uncontrolled failure"; stabilization of masonry around the openings; removal of embrasure iron; rebuilding scarp and embrasure openings.

Fourth: Category 0 Embrasures: Removal of embrasure iron and reconstruction of walls and openings; new masonry to be anchored to core construction using stainless steel ties/anchors.

3. Non-Corrosive Shutter Installation. The long-term goal of this preservation effort is to remove all the iron shutter components from the exterior walls and replace them with non-corrosive replicas. Duplicate shutters could be fabricated using a non-corrosive material such as

inert glass fiber reinforced plastic resins or A-316 stainless steel. The reinstallation of duplicate shutters is critical to the interpretation of the Fort's history since they represent a major nineteenth-century military engineering development and were designed specifically for Fort Jefferson. Rather than a full replication of the original shutter, it is recommended that the new shutter be surface-mounted instead of embedded in the structure as the original shutter. This modification to the original design would allow easier maintenance and less damage should deterioration reoccur.

One alternative for achieving this goal in a phased sequence of work is to install stainless steel inserts during the local masonry reconstruction effort described above. These inserts would provide structural support fore the new shutters to be installed at a later date.

4. Recoating Existing Shutters

Some of the existing shutters are salvageable and can be cleaned down to base metal and coated to prevent further corrosion (and until they can be replaced by non-corrosive replicas). A two-coating system could be developed with a permanent base coat and a top coat that is reapplied periodically, ideally, no more than every fifteen to twenty years. The coating for the shutters could be a specially formulated system utilizing a two or three part epoxy coating, with an ultraviolet resistant top coat.

Related work

As was noted previously, secondary factors also have contributed to the deterioration of the shuttered embrasure openings and surrounding masonry. The project team recommends that two independent projects be undertaken as separate contracts as part of this restoration effort: the full scale repointing of the scarp walls and the waterproofing of the terreplein. (The long-term effectiveness of the embrasure repairs is contingent upon these related stabilization projects being completed, since they are related components whose conditions directly affect the performance and overall stabilization of the scarp walls.)

Provisions for Access during Stabilization

The utilization of a small barge within the moat is recommended for accessing the exterior walls during testing and reconstruction. This approach would have minimal impact on the marine environment, unlike traditional scaffolding that would damage the moat floor at each installation. The barge could remain in the moat with the necessary scaffolding erected at each embrasure opening as required until all preservation/repair/reconstruction work has been completed.

Interpretation

For interpretation, a free-standing shutter installation complete with original embedded components could be installed as an exhibit in one of the casemates. An interpretive panel could describe the original construction, as well as the defensive function of the shutters. In addition, an educational display of a severely corroded shutter could illustrate the significant iron corrosion that had occurred. And, using photographs of the embrasure deterioration present in 1993, an exhibit could describe the factors that contributed to both the masonry and the iron deterioration.

Summary

It is feasible to undertake the stabilization, preservation, and restoration of Fort Jefferson in a sequential process that coincides with available funding. As preservationists, it is important to keep in mind that every intervention intended to address a specific need also creates new issues or conditions that must also be addressed. The unique field conditions and construction of Fort Jefferson, like many other historic structures, require proposed alternatives that are field-tested, rather than textbook solutions.

These proposed alternatives are based on what is known, conditions identified at a particular time. They synthesize available information, preservation technology, and project parameters such as function, use, and interpretation. As new conditions are revealed or new information is discovered, they, too, will become factors in the decision-making process.

As with other preservation projects, the effectiveness and relevance of the proposed alternatives depend on the timely execution of the work as well as periodic monitoring and evaluation of their efficacy. The appropriate solutions will be those recommendations that are executed in a timely manner and proven successful in the context of responsible cultural resource management. We look forward to the day when we are able to identify and report to you just exactly what those solutions are.

Bibliography

Anderson, Louis, "Fort Jefferson National Monument Historic Structures Report: Architectural Data Section", National Park Service, April, 1988.

Bears, Edwin C. , "Fort Jefferson National Monument Historic Structures Report: Historical Data Section 1846-1898." National Park Service, 1982.

Grieves Worrall Wright & O'Hatnick, Inc.. and Robert Silm and Associates, P.C., "Fort Jefferson Lower Tier Embrasure Openings: Fabric Analysis and Treatment Recommendations", February, 1994.

Manucy, Albert C., " Constructional History of Fort Jefferson, 1846-1942", National Park Service, May, 1942.

Comparative Study of the Works of the Antonellis: The El Morro Castles of San Juan, Puerto Rico, and Havana and Santiago, Cuba

Tamara Blanes Martín
National Center for Conservation, Restoration and Museology, Republic o f Cuba

Abstract

The Tres Reyes del Morro, San Pedro de la del Morro, and San Felipe del Morro castles, constructed between the sixteenth and seventeenth centuries, were built in response to a particular need: to protect the respective Cuban and Puerto Rican cities from privateer and pirate attacks.

These military constructions, which are of great historical and architectural value, share a common identity in the two aspects of form and function. The original drawings of the forts were designed and executed by the Antonellis, based on contemporary models which were typical of the Renaissance and which reflected the stage of development of firearms.

During the eighteenth century, these structures became increasingly vulnerable and insufficient, as arms technology developed along with a stronger navy, transforming poliorcetics, the science of attack and defense.

In the 1800's, Spain, on being left with Cuba and Puerto Rico as its sole colonies, concentrated all its forces on these two Caribbean islands, creating a line of defense consisting of redoubts, batteries, trenches, and underground fortifications, consistent with the new defense needs. The Morro fortifications remained as auxiliary bastions in this modern system.

Today, these landmarks are an integral part of their national and universal cultural heritage, a symbol of past Spanish rule of the Caribbean.

Background

The Antonellis were the most distinguished members of Philip II's sixteenth century corps of engineers. A family of military and hydraulic architects and engineers, of Italian origin, their renowned works, executed four centuries ago, are unequaled in the colonial history of the Americas.

The Castillo de Santiago de Araya in Cumaná, Venezuela; the Castillo de San Juan de Ulúa in Veracruz, Mexico; the Morro Castles of Cuba and Puerto Rico; the walls of Cartagena de Indias, and other works, are still standing in the Caribbean. They defy time, mute witnesses to hard, dangerous and prolonged labor, and to the wisdom and insight of the engineers who erected a monumental military architecture under the most adverse circumstances, without the benefit of the advanced technology or our twentieth century society.

It was their studies, plans and direction that produced the colossal castles of San Felipe del Morro in Puerto Rico, Los Tres Reyes del Morro in Havana and the San Pedro de la del Morro in Santiago de Cuba, built between the sixteenth and seventeenth centuries. These structures addressed the particular need of protecting these major Spanish colonial cities from privateer and pirate attack.

To keep her overseas territories, Spain had to create adequate communications, allowing for commercial exploitation as well as protection. The favorable winds and sea currents of the Caribbean, the Gulf of Mexico and the Atlantic, facilitated circulation along the trade route between the Iberian peninsula and the overseas colonies. The fleet navigated along the route that began in Seville, entered the Caribbean Basin, passed by the Lesser Antilles, and from there went on to the commercial hubs of Santo Domingo, Puerto Rico, Cartagena de Indias, Portobelo, Veracruz, and Havana, among the main ports. These cities acquired commercial importance as ports because they were tied to the exploitation of gold, silver, and other riches of the kingdoms of Tierra Firme, New Spain, and other faraway lands. From the sixteenth century on, Cuba and Puerto Rico were a part of this enormous enterprise.

The natural conditions of some of these bays, such as those with narrow passageways and wide harbors, were favorable for development as commercial ports. This particular characteristic was especially suitable for fortifying both sides of the channel entrance, closing the main access, as

at Havana, Portobelo and Cartagena de Indias In other cases, a large fort was erected at the mouth of the port, and a network of minor fortifications and walls were erected along the bay as at Santiago de Cuba and Puerto Rico.

At the entrance of some of these channels there are elevated and rock areas jutting out from the coast, called *morros* or promontories, which are useful in guiding ships due to their elevation. The Morro Castles in Puerto Rico, Havana and Santiago de Cuba were erected on these formations as principal fortifications for their respective cities.

These fortifications, which all adopted the name of Morro, were ideally located for their tactical and strategic uses. They were built in response to the compelling need of the time: to ward off, face, and defend the cities from privateer and pirate attacks, and from powers that were Spain's enemies such as France, Holland, and England.

The three Morro castles became a part of the first line of defense for the overseas colonies, begun in 1586 by Felipe II. The military engineer Bautista Antonelli, was a prominent figure in these early works, leaving his mark on all fortifications built since then.

The majority of the defenses were designed by Antonelli under the general direction of the Italian Tiburcio Spanoqui, Chief Engineer to the King. This great work was continued by the Antonelli family: Cristóbal de Roda and Juan Bautista Antonellli. Besides them, there were other prominent Spanish engineers who made their respective contributions at a later date.

The initial defense plan provided for a thorough study of the specific characteristics of each region with a view to creating a system capable of providing protection by land and by sea. The financial and material resources employed, while insufficient for immediately undertaking a major project, were nevertheless sufficient to lay the groundwork for construction in the following centuries.

Historical Significance of the Fortifications at Havana, Santiago de Cuba and Puerto Rico. First Stages and Construction of Projects

There is no question that geography is a determining factor in the development of settlements. The Central American region, with its shallow and rocky coast, lacked, among other things, adequate harbors for large vessels, and lagged behind the Caribbean and the Gulf of Mexico. The only prominent exceptions were Portobelo, the link between the Caribbean and the Pacific, and Trujillo, in Honduras, where part of the Fleet passed on its way to Veracruz or Havana.

In contrast, the privileged location of the city of Havana and its ample harbor allowed access to the Fleet, which loaded with riches, sailed out of this port towards the metropolis through the Florida Straits. This trade facilitated sufficient commercial activity to make Havana one of the major cities of the Americas in colonial times, and one of the best fortified.

In her book, Historia Documentada de San Cristobal de Havana en el Siglo XVI, Irene A. Wright mentions a contemporary document alluding to the existence of a masonry tower dating from 1563 and located at the point of the *morro*. The tower was 9 meters tall and the viewing distance extended for 8 *lenguas* or leagues.

In 1589, at this same site, work was begun on the Castillo de los Tres Reyes del Morro, and on the opposite side, on the Castillo de San Salvador de la Punta, part of the first defense plan for the port of Havana, undertaken by the *maestre de campo* Juan de Tejeda and Bautista Antonelli.

In speaking of the fort's chapel, completed in 1614, Irene A. Wright states in her book that the religious title for the Morro castle is in honor of the three magi: the altar where there was an "altarpiece of the adoration of the magi, the castle's divine protectors." The castle was completed around 1630. Martín Felix de Arrate in *La llave del Nuevo Mundo, antemural de las Indias Occidentales*, describes the completion of the fort in detail.

Santiago de Cuba, on the southeast coast of Cuba, also had a favorable position in the Caribbean, due to its proximity to the island of Santo Domingo, the seat of the Spanish colonial government, the government of *Las Indias*, throughout the sixteenth century. Sea currents facilitated navigation towards its coast, propitiating communications with this early city. It was from here that many expeditions set forth to inspect and conquer the new continent, such as those led by Juan de Grijalva and Hernán Cortés.

In addition, the spaciousness of the Santiago harbor, which was entered through two narrow channels, and various peninsulas, inlets, and keys, allowed access to some of the Fleet/s vessels on their way to Veracruz or Havana. The ships were exposed to great risk, because this barely protected location was frequently the object of privateer and pirate sacking and pillage, above all because of its proximity to the copper mines, which were initially exploited, according to Irene Wright, in 1599.

Unlike Havana, various natural factors contributed to making Santiago's prosperity short-lived. From its early years, Santiago was severely affected by violent earthquakes, hurricanes, sacking, and fires.

A letter dated 1622, from the Academia de Historia collection, states that at the time a ravelin, or small fort, had been erected at the entrance of the Santiago bay on the *morro*, and had "3 or 4 iron pieces", and a garrison of twelve soldiers.

In 1639, thanks to the efforts of several governors, work was begun on the San Pedro de la del Morro, on the *morro* where the small fort had been erected years before. It was named for its patron, Pedro de la de Borja, governor of Santiago de Cuba from 1633 to 1643. According to Jacobo de la Pezuela It had been completed by 1643.

Juan Bautista Antonelli had arrived in Santiago with orders to inspect strategic sites and draw up plans for a defense system. Antonelli, the engineer, envisioned the port entrance as the focal point of the defense, along with a chain of minor fortifications lined up along the complex topography of the port.

The port of the island of San Juan de Puerto Rico was not of the same rank as the port of Havana, although it dominated the Caribbean, due to its location at the entrance to the Basin, on the commercial traffic route between the Peninsula and the main colonies in the Americas.

San Juan was an inevitable stopover for part of the Fleet, where it took on supplies and engaged in some commerce, before continuing on to Havana or other commercial ports.

During the seventeenth century the systematic takeover of the Lesser Antilles by European powers that were Spain's enemies constituted an imminent danger for Puerto Rico, since the Europeans used these islands as a base from which to set out and harass the Spanish colonies.

In 1540 the protection of this coveted prize was initiated with a stone and brick barrel-vaulted tower with a barbette or open battery, and a semicircular parapet at the foot of the promontory located at the port's mouth, the northwest corner of the islet on which San Juan stands.

In 1587, Governor Menéndez Valdés, considering Puerto Rico's position with respect to the other Antilles, the accessibility of its port, and other circumstances that affected navigation in the Caribbean Sea, organized a plan of defense implemented by Captain Pedro de Salazar.

In 1591, construction was begun on the San Felipe del Morro castle at the grounds of the *morro*, its name being bestowed by Philip II, ruler of Spain from 1556 until his death in 1598.

It is evident that years before the construction of the Morro castles, these sites had been protected by lesser fortifications, although these structures should not be underestimated. Until the mid-sixteenth century all fortifications had been built using less-advanced techniques, which in fact corresponded to the antiquated type of armaments still in use at the time.

Conceptual and Formal Unity of the Three Morro Castles

The initial construction drawings for the San Felipe and Los Tres Reyes are attributed to Bautista Antonelli, and those of the Castillo de San Pedro de la, to his son, Juan Bautista Antonelli. These engineers worked with and promoted the modern drawing and building techniques that were being used in Italy and France.

We may describe the Morro castles in their formal and functional aspects: they are built on an irregular topography and their structure is adapted to the configuration of the land. Symmetry is only preserved on the bastioned front facing the land, a long scarp wall connecting two semi-bastions, from which the land was defended by direct, flanking and cross-fire. An open moat served as an obstacle to the enemy and a drawbridge was constructed over it to communicate the castle with its surroundings. The covered way extends to the exterior, juxtaposed to the moat counterscarp, some 5 meters wide, with a parapet along its full length, high enough to protect the

soldiers lined up behind it; a ravelin was the outerwork and there is a glasis, whose slope provides a protective trench for the fortification.

The walls of the bastions and the curtains were crowned by embrasures or gun ports, for cannon, and wide merlons that offered cover for the troops within.

Antonelli, in order to further emphasize the similarity he was able to achieve in the bastions and semi-bastion at the Morro castles of Havana and Puerto Rico, gave them the same names: Tejeda and Austria.

The remainder of the structures is a polygon, whose wall form open angles providing defense on the sea side. The fortification was laid out so that the angles extended the visual scope, opening the defense in various directions, so that there could be cross-fire. This solution is markedly different from the compact and enclosed structure of medieval castles. The battered massive walls were a technical device designed to repel cannon fire an to withstand the destructive force of firearms.

On the outer walls, there were batteries to strengthen the defenses, and traverses against enfilading fire.

The layout inside the castle was an innovation in keeping the contemporary typology of the sixteenth century. Artillery and infantry were deployed in a system of ramps, stairways, and narrow halls, leading to the different levels provided by the promontory. There were watchtowers, sentry boxes, batteries, platforms, and casemates, some of which were carved out of the rock as at the Morro Castle at Santiago de Cuba.

The drainage and conduit system within the castles is worthy of note: barely discernible narrow channels between the walls, uneven floors to provide drainage, water boxes, and a variety of gargoyles. In addition, several cisterns were built on bastion roof, on the curtain or on the platform, accompanied in some cases by smaller cisterns with filters for purifying the water in the larger cistern.

Bastions such as the Estrella in Havana, Smo. Sacramento in Santiago de Cuba, and La Fortaleza in Puerto Rico, were built at the point of the morro and a few meters above sea level. As time passed, they became ineffective because of their exposure to the pounding sea waves, and their cannon were easily destroyed.

There were other structures erected inside the polygon for barracks and storage, a chapel, living quarters for the chaplain, the commander, officers, and the garrison, usually near the parade square. The structures became permanent in the eighteenth century.

Fundamental Modifications in the Eighteenth Century

The eighteenth century was characterized by Spain's struggle against the expansionist policies of Great Britain, the rationale for fortifying the Spanish colonies in the Caribbean, and the significant financial resources employed in this grand enterprise were directed at securing Spanish dominance. Charles III (1759-1788), and his policy of enlightened despotism, favored the colonies economically, liberalizing trade regulations between the Americas and Europe. Other parallel events that favored the colonies were the American War for Independence and the industrial revolution in England.

New and ambitious fortification projects were undertaken during the second half of the eighteenth century. The development of firearms and poliorcetics affected the layout of the fortifications, where trenches predominated with protective outerwoks.

The fortification systems of Cuba and Puerto Rico were enlarged and modernized, along with the technological development of armaments, and the castles became insufficient and vulnerable. The English occupation of Havana was clear proof of the situation, and that of the other fortifications that defended the city. The Morro castles were transformed, and reinforced, to conform to the new defense requirements of the times. They were notably improved in terms of construction, functional use of space, and defense tactics.

In 1762, the English attacked and occupied Havana. Eleven months later the city was returned to Spain, and the Earl of Ricla was appointed Captain General of the island, arriving with the mission of stabilizing Cuba politically and economically, and implementing an excellent defense

plan. He was accompanied by prestigious engineer such as Silvestre Abarca and Agustín Crame, who had extensive career in military construction in the Caribbean throughout the eighteenth century. These engineers designed, and directed, the construction of the second defense system of the city and were responsible for the reconstruction of the military facilities. Alejandro O'Reilly, who later was sent on another mission to Puerto Rico, arrived in Cuba with the objective of organizing and inspecting the military situation of the island, and organizing a militia as a high priority action.

The Tres Reyes del Morro castle was partially destroyed during the English attack. Two powerful mines exploded in the salient angle of the Tejeda semi-bastion and in the counterscarp, on the north side, towards the coast, opening a gap that allowed the enemy to penetrate and occupy the fort.

From 1763 to 1766 the Morro was rebuilt, and it is during this brief period in which its formal and functional aspects were established. The original structure was altered by the changes made at this time.

Before the English occupation of Havana, the Morro was protected by land by a moat from which there rose a curtain connecting the Tejeda semi-bastion with the Austria bastion. ON the bayside, another curtain to the principal entrance, connecting the Austria bastion with the Santiago semi-bastion; the Estrella platform (later substituted by the Doce Apóstoles), just a few meters from the sea; and the Morrillo promontory, which was years ago called the "Lengua del Agua" or tongue of the sea, where the tower stood. Along the coast there were a series of salient curtains, the main cistern and the Santo Tomás point. In the interior, there were independent structures devoted to various functions.

During the reconstruction, in order to augment its functional capacity, the castle floors were leveled at the Santo Tomás point and the Tejeda semi-bastion were reinforced with flaking walls: the former was converted into a platform for a battery, conserving its name, and the latter became a bastion.

The Austria bastion was altered: a flanking wall was eliminated and a curtain was extended towards the Santiago semi-bastion. A vaulted covered way was added to the curtain and a main entrance was opened: the original entrance was thus left between the new and old covered ways.

The citadel, on the parade ground, comprised of independent structures, was replaced with a stronger, bomb-proof building, whose long hallways had more than twelve vaults. The building was enlarged to accommodate quarters for the chaplain, the commander, and the officers of the fort. Two spiral staircases, located at both ends at the front of the building lead to a wide terrace on the roof.

Notes on the Restoration of the Lighthouse at San Felipe del Morro Fort

Milagros Flores Román, Historian, San Juan National Historic Site, Puerto Rico

The great military, as well as economic, value the possession of Puerto Rico represented for Spain once more was confirmed in several studies carried out by the Spanish government with a view to provide the island with a maritime illumination system, which would offer sea-going vessels greater security around its coasts, as well as protect the flourishing island commerce of the nineteenth century.[1]

The Spanish government carried out its first studies on the island between 1835 and 1845, a period in which the Puerto Rican Chamber of Commerce proposed the construction of a rotating lamp on the San Felipe del Morro Fort at the entrance of the port of San Juan, based on two considerations: the commercial activity of the port and its importance as a supply stop for ships on route from Europe to the Americas. The 1840 inventory showed the following among the most important ports:

- On the north, the San Juan Harbor, the most important and secure, and the Arecibo Harbor, an excellent harbor, although not well-protected from the northern winds and six secondary ports.
- On the west, the three important ports of Aguadilla, Mayagüez and Cabo Rojo, where there was international commercial activity with products such as coffee, sugar and cotton.
- On the south, a highly active commercial region, the ports of Guánica, Ponce-Jobos and Guayama.
- On the east there were the ports of Humacao, Naguabo, Ensenada Honda and Fajardo.[2]

In November of 1845 a construction order for a brick tower that could support a lamp was published in the *Boletín Mercantil* (*Commercial Bulletin*), and in that same month, the HR Dunham Co. of New York sent a cast iron light to San Juan. In January 1846 the island's first light was installed at the San Felipe del Morro Fort in an octagonal iron tower with an eight second light that beamed every two minutes.[3] This was the only light in the system whose design did not include living quarters for the lighthouse keepers, who were provided with rented houses near the Morro Fort.[4]

Due to the rapid deterioration of this first structure, in 1876 the Spanish authorities erected a second tower at the Ochoa Bastion at the El Morro Fort.

According to the document "Memoria Justificativa de la Liquidación de las obras de nueva construcción del faro del Morro y Torrecilla del Vigía" (Explanatory Memorandum regarding the demolition of new construction at the Morro Lighthouse and Torrecilla del Vigía)[5] the project was approved under a Royal Order dated October 6, 1876 and included demolition of the original structure and construction of a new foundation.

An octagonal iron tower, painted grey and white, was placed on the brick foundation, as well as an octagonal light with a copper cupola. In 1885, a semaphore signal was built on the foundation of the former light at the Austria Bastion, and it was demolished in 1940 by the United States Army.

According to the document,[6] there was a significant increase in the budget, for two main reasons: first of all, because the foundation originally was to have been 32 cubic meters, and constructed with materials obtained from the demolition of the Vigía structure, of which only 16 cubic feet were used, since the rest had been reduced to small-size rubble. The second reason was that it was necessary to construct a deeper foundation or base in the upper battery of the fort, for a total of 79 cubic meters of foundation work.

Since the reconstruction work on the lighthouse was carried out significantly later than the date they for which it was approved, October 15, 1867, a memorandum regarding the proposal by the then Chief of Engineers, Evaristo Churruca,[7] explains all the changes in the budget and in the execution of the work:

1. Cutting and placing a keystone in the arch of the foundation for greater stability.
2. Construction of a double iron sill and rowlock placed so as to prevent the flow of water from the battery floor and wear from use.
3. Placement of a lead drain pipe from the crown of the foundation to the battery floor.
4. Repair of damage done to the battery floor during the construction work.
5. Construction of a hydraulic cement floor not included in the budget; the crown of the foundation and staircase.
6. Substitution of interior plastering with ordinary mortar with hydraulic mortar painted with oil-based paint to prevent penetration of humidity.
7. Construction of a trap leading to the lower vault.
8. Paving the lower floor with Canarian tile.
9. Placement of a drainage pipe to the tank beneath the foundation.
10. All plastering done with hydraulic mortar to prevent rapid deterioration caused by humidity and salt air.[8]

The originally proposed construction was a small brick tower, whose diameter would be smaller than that of the existing base, the wood floor of the walkway to be covered with zinc panels, leaving an open space around the tower and taking advantage of the pre-existing ironwood balustrade of the old lighthouse. But eight years later, when the work was carried out, it was in such bad condition that it was then decided to widen the wood tower covering the full base, eliminate the walkway and substitute the zinc with brick. This enlarged the structure, facilitating the installation of a stairway and eliminating the need to reconstruct the exterior balustrade, and above all, eliminated all those parts that could be easily destroyed by the wind.

According to the survey done in 1861 by the Central Lighthouse Board of the Ministry of Overseas Territories[9] with a view to gathering all the information needed for developing a comprehensive system of maritime illumination for the island, the factors that should be considered in establishing a system of lighthouses would be the relationship with the port to trade and local agriculture, the geological, hydrographic, and atmospheric conditions of those ports, to guarantee free access and safe navigation. After that, between 1876 y 1885, the Lighthouse System project was affected by several budget cuts. Nevertheless, the colonial government with Spain's consent, and pressured by the large landowners, the public works department, and the Naval Command, the seven most important lighthouses in Puerto Rico were begun: Puerto de San Juan, Cabezas de San Juan (Fajardo), Isla Culebrita, Punta Borinquen, Caja de Muertos and Isla Cardona. The plan was later revised in 1890 and 1892.

During the events of the Spanish-American War, the Castillo del Morro lighthouse suffered serious damage from bombardment, for which reason between 1899 and 1900, the Untied States Navy demolished the previous tower and built a 56-foot high reinforced concrete octagonal structure, thus becoming the first lighthouse built by the U.S. on the island.

Later a new structure was built on the octagonal brick base of the former tower, a three-level square masonry structures. On the first level there was a vestibule, a fuel room and a storage room. On the second level, there was a watchroom, a small bedroom and a corridor and on the third level, the light with hits cast iron and bronze lamp, covered with plates of wrought iron. There was a parapeted gallery overhanging its exterior, with three ornamental Spanish colonial-style sentry boxes. The doors and windows are in a "pseudo-Spanish" style. It was a third order light, whose lens came from the French company Sautter, Lemonnier & Cie; this is the structure that still stands today.

In 1932 it was electrified and in 1937 its colors were changed to beige and brown. The light was fully automated in 1962.

Restoration of the Lighthouse at El Morro by the National Park Service

In 1991, the United States National Park Service published the Historic Structure Report for the National Historic Site of San Juan. The El Morro Lighthouse was one of the structures recommended for restoration.

The study was divided in two phases:

Phase I Research and preparation of plans for work to be carried out.

Phase II Restoration carried out in a joint effort between the Atlanta Regional Office of the NPS and the preservation team of the San Juan National Historic Site.

The study was carried out along with the North Atlantic Historic Preservation Center of the NPS, mainly directed at identifying structural deterioration, analyzing its causes and submitting recommendations for restoration and preservation

The study shows that the rapid and growing deterioration of the El Morro lighthouse is due to two principal factors:

1. Its walls were not painted, allow a greater penetration of water, accelerating erosion.
2. The internal supports have corroded due to the humidity causing cracks in the structure which in turn produce leaks.

The study emphasizes the urgent need to correct these two situations or causes of the deterioration, which otherwise will continue to accelerate the process and there was a risk that in the near future the structure would collapse. A plan was developed covering the following:

a) treatment of existing structural materials.
b) reconstruction of unsalvageable material.
c) restoration of affected material.

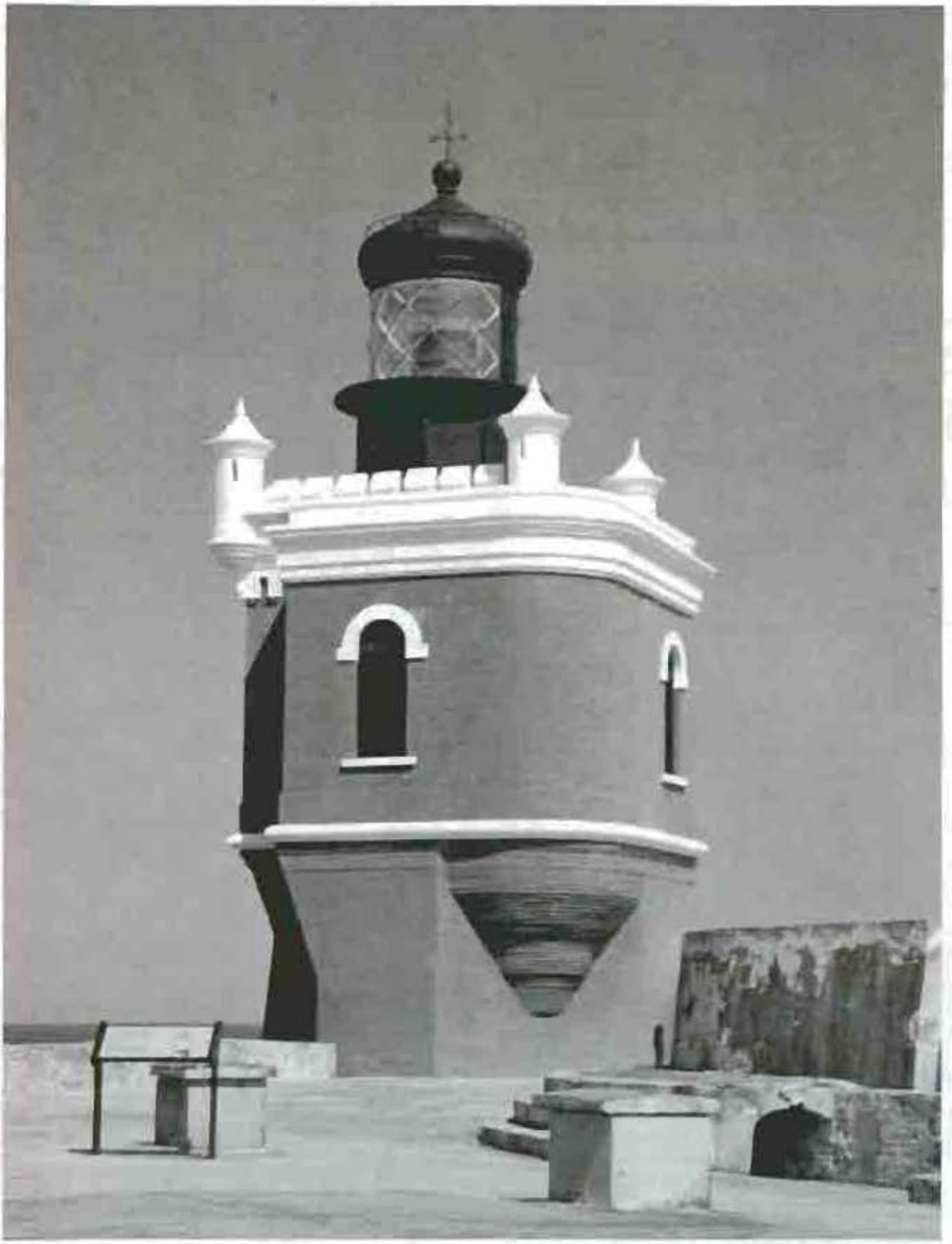
Basically the preservation work done at the El Morro Lighthouse included three main elements:

1. Masonry: removal and replacement of al brick showing a surface loss of one inch or more.
2. Iron and steel: reconstruction and repair of a good part of the elements of the light, which were in very bad condition.
3. Glass: all the glass at the Castillo de San Felipe del Morro was replaced.

The total cost was $150,000 and the lighthouse was re-opened to the public in 1992.

Notes:

1. Miyares González, Fernando, *Noticias Particulares de la Isla y Plaza de San Juan de Puerto Rico*
2. Nistal Moret, Benjamín, *The Lighthouse System of Puerto Rico, 1846-1979, National Register of Historic Places Inventory*, August, 1979. (Unpublished form).
3. Bearss, Edwin C. *Brief Chronological History of the San Juan Point (El Morro) Lighthouses*, National Park Service, official document, November 20, 1979 (unpublished).
4. General Archives of Puerto Rico, *Puertos y Muelles, Faros, Asuntos Varios, Documentos, 1867, Gratificación para alquiler de casas a los torreros del Faro del Morro; 1871, Alquiler de casas que ocupan los torreros de El Morro; 1898, Petición de los torreros suplentes, Don José Duchesny y Don Fulgencio Sifredo de una gratificación para pago de alquiler de casa.*
5. General Archives of Puerto Rico, *Puertos y Muelles, Faros-Liquidación y Construcción, 1897. Documento número 1, Memoria Justificativa, Liquidación de las obras de nueva construcción del Faro de El Morro y Torrecilla del Vigía.*
6. Ibid.
7. Ibid.
8. Ibid.
9. Op cit. Nistal Moret, Benjamín.



Bibliography

Alvarez, Maritza. "Faros de Puerto Rico." *Patrimonio* (San Juan de Puerto Rico: October-December 1989), Vol. 1, No 4.

Anon. La Invasión de Fajardo, *El Hijo del Torrero Cuenta la Historia, (The Invasion of Fajardo-the Keeper's Son Tells his Story)* "El Mundo", Sunday, May 6, 1951, page 5 (article).

Bearss,Edwin C., *Brief Chronological History of the San Juan Point (El Morro) Lighthouses*, National Park Service Documents, 1979.

General Archives of Puerto Rico. Various Sources.

General Archives of the Indies, Seville. Various Sources.

Geographic Service of the Army, Madrid. Various Sources.

Military History Service, Madrid. Various Sources.

Military Architecture Archives of Puerto Rico, National Park Service, San Juan de Puerto Rico. Various Sources.

Miyares González, Fernando, *Noticias Particulares de la Isla y Plaza de San Juan Bautista de Puerto Rico* (Personal Report of the Island and Military Outpost of San Juan Bautista de Puerto Rico), Universidad de Puerto Rico, San Juan, 1957.

National Historic Archives of Madrid, Ministry of Culture of the Government of Spain. Various Sources.

National Park Service, Department of the Interior. *The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings.* 1983.

National Park Service, Department of the Interior. "The National Register of Historic Places." 1989.

Nistal-Moret, Benjamín. "National Register of Historic Places Nomination Form: The Lighthouse System of Puerto Rico, 1846-1979." 1979.

Puerto Rico Public Works Department. *Instrucción para la mejor inteligencia y cumplimiento en los dispuesto en el Reglamento de Faros.*(Instructions for the Correct Interpretation and Implementation of the Lighthouse Regulations). San Juan, Puerto Rico: Tipografía dc la Viuda González. 1893.

_____*Reglamento para la Instrucción Práctica de los Alumnos de Torreros de Puerto Rico.* (Regulations for Practial Instruction of Apprantice Lighthouse Keepers of Puerto Rico). Tipografía de la Viuda González. 1851.

U.S. Coast Guard, La Puntilla, San Juan Offices, Documents of Puerto San Juan Light (El Morro), Cabo San Juan Light; Punta Mulas Light; Puerto Ferro Light; Arecibo Light; Guanica Light; Cabo Rojo Light; Punta Tuna Light; Culebrita Light; Isla de Muertos Light; Cayo Cardona Light; Punta Figueras Light; Punta Higuero Light; Punta Borinquen Light; Isla de Mona Light; Mona Island (unpublished)

Financial and Administrative Aspects of a Historic Restoration Project: The Experience at Casa Aboy

Luz Celeste Monge Rodriguez

Introduction

Any project involving expenditures should be based on a study of the factors that will ensure its viability. Historic restoration, as may of you are aware, and many of us are beginning to learn, is not exempt from this critical activity of organizing and planning the human and financial resources required to carry out a restoration project on a historic structures. It is extremely difficult, and we might add, painful, to undertake a venture of this scope, without previous planning and organization, especially when the work is being done on a volunteer basis.

The Casa Aboy restoration project may be useful as a model for a self-critical analysis of errors committed in good faith as well as of support that a project of a similar nature might obtain from public and private sources, the need to delegate tasks among all volunteers; the significant economic and social impact these projects can have on the community, the appropriate and efficient technical management of a project of this nature, and the necessary financial management, among other factors. To undertake this analysis we must address our contemporary context, our reality, in keeping with current processes of political and socio-economic change.

We have been hearing a lot about the globalization of the economy or the creation of new economic models, the integration of the countries that constitute the European Economic Community, and the disintegration of the socialist block countries, the effects of the Free Trade Agreement, and GATT. However, the news media, intentional manipulators of information, make no mention of the role of cultural conservation, and consequently, of our national historic heritage, in all these events, which are seen as purely economic and political in nature.

We wonder whether the values and traditions of our peoples are not important in the design of the so-called new economic models of the world economy. Must we renounce and sacrifice our cultural identity and our cultural heritage to fit into the directives established by multinational corporations? I want to make it clear that I am not only talking about American companies, but also about representatives of current economic blocks: the European block and the Asian bloc.

I would go as far as proposing the following thesis: to the degree that we can integrate ourselves in those inevitable and undeferrable processes of change, we will be able to develop new cultural policies that are consistent with international and globalizing interests; thus a country could have parallel economic and cultural development. To the degree a country is able to achieve cultural enrichment, it will be a country rich in information, and, therefore, an economically developed country. We could digress with regard to the economic value of information in the technological era, but that is a subject for another paper.

I will limit myself to indicating that the purpose of this paper is to create and awareness and to collaborate with others interested in an almost untouched area in Puerto Rico: the importance of restoration from an economic and administrative point of view.

Background of the Corporación Casa Aboy

In order to talk to you about the Casa Aboy Restoration Project and how it came to be, I should like to give you a brief history, especially for the benefit of those who are not familiar with this historic structure. I think that some paragraphs from the magnificent description of the Casa Aboy written by our friend Marisa Rosado, who has committed herself whole-heartedly to this Project, will summarize quite well the importance of preserving the Casa Aboy:

> " This structure, located in Miramar, was built between 1910 and 1912 by Ramón Aboy Benitez, as a wedding gift for his son, Ramón Aboy Lompré. The exact dates cannot be determined because the drawings were destroyed by termites during the time the house was abandoned. Casa Aboy is one of the few structures of its time still standing, representative of the early years of modern architecture in Puerto Rico. Its design was a collaborative effort of

several architects. One of them, Antonin Nechodoma, a native of Chicago, and a student under Frank Lloyd Wright, arrived in Puerto Rico around 1905. His tropical architecture was quite popular among San Juan society, and his work included elegant residential mansions built early in this century, one of which, the Georgetti Mansion, was demolished in the late '70's.

Puerto Rican architect Miguel Ferrer, a bother-in-law of Aboy Lompré, and engineer Francisco Pons, designed the house facing north, so that it would benefit from the refreshing Atlantic winds and natural light, without exposing it to the hot tropical sun. Tropical trees and ornamental plants enhance the beauty of this structure in the once-exclusive sector of Miramar. Pons and Ferrer had been partners to Antonin Nechodoma, and they contracted Frank B. Hatch, who had been construction foreman for many of the houses designed by Nechodoma.

For several years, Casa Aboy was the venue for social activities attended by prominent members of San Juan society. as the children grew up, the family spent less time in the grand house, until finally it was closed up. Their lack of interest in the house is shown by the poor maintenance it was given over the years. Meanwhile, land values in the area continued to grow as modern high-rises were built around it, and commercial activity expanded in the area.

The house was rebuilt in 1919, and was later rented to the "Gift Box" store and the Jewish Synagogue."*

In 1975, when Ramón (Moncho) Aboy Miranda found out that the house that had belonged to his grand-parents, his childhood home, was to be demolished, he decided to devote himself to its reconstruction. With the support of his friends, among them the distinguished Puerto Rican, Ricardo E. Alegría, Aboy Miranda opened the first Caribbean photography gallery, Galería Fotográfica PL 900. But Casa Aboy was not just a Gallery. In the 1980's it became a bastion for the defense of Puerto Rican culture in answer to what many Puerto Ricans called the "Leticiado", a reference to the then Director of the Institute of Puerto Rican Culture, the infamous Leticia del Rosario.

Casa Aboy became headquarters for more than 30 Puerto Rican cultural organizations: the Children's Program, Friends of Casa Aboy, etc. In short, Casa Aboy was a unique space for the celebration of a diversity of cultural events.

But as the saying goes, it was too good to be true. There were financial and family crises. The heirs of Aboy demanded that the structure be closed and sold. There were no legislative funds assigned for the continued operation of the, and, finally, in the wake of all the uncertainty, Casa Aboy closed its doors in 1986. Nevertheless, the Casa Aboy Board of Directors continued to struggle in favor of its cause. The Board turned to the Legislature, to the Courts, and even to the Governor, clamoring for the rescue of this architectural and cultural treasure. In 1989, thanks to the efforts of the Board of Directors, the Institute of Puerto Rican Culture declared Casa Aboy a national historic landmark, as did the National Trust for Historic Preservation. In that same year, the Board succeeded in getting the Land Administration to acquire the Casa Aboy and hence prevent its demolition. The restoration of the, however, was not a priority for that government agency, and thus, in 1990, the Board of Directors was forced to go to battle once again, this time with a concrete proposal for leasing the in order to restore it and reinstate it as a space of community expression for the people of Puerto Rico.

A story with a moral: How not to choke when you have bitten off more than you can chew

Most of the members of the present Casa Aboy,Inc. Board have no idea of how it was that we got caught up in this fine entanglement, but we do know why we are here now. To begin to point out some of the problems we have faced in the project, it is important to note that with the exception of our esteemed Carmen Gontán, a member of the Board until 1992, none of the other members had any experience in this kind of project. This lack of experience led us to make mistakes, along with what we were able to accomplish.

*Marisa Rosado, "Breve recuento de la Casa Aboy", San Juan, Puerto Rico, 1993, pp. 1-3.

First of all, the lease agreement with the Land Administration stipulated as a condition that a cultural center be established at the Casa Aboy. This clause was very important, since it helped us to compete with proposals from other entities such as Comisión 2004, the Architects' Association, etc., who were interested in acquiring the structure. In July, 1991, the Ramón Aboy Miranda Cultural Center was established formally, in honor of the founder of Casa Aboy, Inc.; the applications for construction and use permits turned into another trial, a *via crucis*, because of the time it took for the Permits Authority, the Electric Company, and others to authorize the permits. Marisa Rosado and I visited these agencies on countless occasions. Meanwhile, we were encountering problems with the construction itself, and it was decided to hire an independent administrator for the Project. An accountant was recruited to serve on a volunteer basis. On self-analysis, the Board realized that we should have done this at the outset of the restoration work.

On the other hand, we had to address another aspect: how to obtain the funds to carry out the work. We identified several sources, in the public as well as in the private sectors. We sent proposals to the Puerto Rico Legislature, the Institute of Puerto Rican Culture, the State Historic Preservation Office, the National Trust for Historic Preservation, the Quincentennial Commission, the Telephone Company, and the San Juan municipal government. In the private sector, we turned to the Puerto Rico Foundation for the Humanities, "Dale la Mano a Puerto Rico", and more recently, to the Banco Popular, AT&T, and RJ Reynolds. We received full support from the government agencies. However, in the private sector, only the Puerto Rico Foundation for the Humanities accepted our proposals. The other private agencies have acknowledged the quality of our proposal by their response has been that they do not have any funds.

In spite of the support we have received, we have once again had to face the monster of bureaucracy. Our proposals have been accepted, but we have not received the funds necessary to finish the restoration from at least two of the agencies, forcing us to take out loans based on government promises of funds.

"Operation Bootstrap": Administrative and Financial Considerations for Survival

During the Board of Directors' meetings, we not only discuss the problems faced in the Project, but also the contradiction between the approval of a substantial body of cultural legislation in Puerto Rico designed to protect our national heritage, and how that legislation is virtually defunct in terms of our immediate reality

If we add to this the withdrawal or cutbacks of government financial support of many cultural or non-profit organizations, the picture is certainly not very .* In our desperation, we decided to be more assertive, if not outright aggressive. For example, after going through all the traditional channels of communication, letters, telephone calls, faxes, and so forth, we decided to "lay siege" on the offices to which we had applied. We arrived at an early hour, asked to see the director, and inquired about the status of our application. Until we received a satisfactory reply, we did no "withdraw" from our "objective". Another tactic has been to call every day until we obtained a response. You can imagine what a continuos vexation this was. Yet, incredibly enough, the tactics yielded results.

But the results are not sufficient. We are trying to develop an administrative and financial plan based on modern marketing practices as well as changes in public and private economic policies regarding funding of cultural programs. To put it simply, I am talking about the urgent need to apply traditional business management concepts to projects such as historic restoration. I am also referring to "selling" or "marketing" our projects as quality products, of adopting the management philosophy known as Total Quality Management, that will allow for the continuous reevaluation, creativity, change, and flexibility necessary for quality work. This will be the way to achieve the preservation of our identity as a people. We will contribute to the future of our country and other nations, creating programs designed to integrate the family and the community at large, stressing our fundamental human values.

---

* Laws such as those for the restoration and preservation of La Fortaleza; for the creation of the State Historic Preservation Office; for the conservation and study of submarine and land archeological treasures; for the conservation of the caves and sinkholes of Puerto Rico, and so forth. For a more detailed study, see Edwin R. Harvey, "Legislación Cultural: Legislación Cultural Puertorriqueña y Comparada". San Juan, Puerto Rico. Instituto de Cultura Puertorriqueña, 1988.

Sustainable Design Concepts and its Appropriateness in the Field of Cultural Resources Preservation of Colonial Masonry Structures

Michael R. Taylor, Ruins Preservation Specialist,Division of Conservation, National Park Service, Southwest Region; Barry Sulam; Architect, Chief, Division of Conservation, National Park Service, Southwest Region

Introduction

Sustainability is the ability of a system to support itself. Sustainable design is the philosophy that human development should exemplify the principles of conservation, and encourage the application of those principles in our daily lives. It is a concept that recognizes that human civilization is an integral part of the natural world and that nature must be preserved and perpetuated if the human community is to sustain itself indefinitely. Sustainability promotes less consumptive lifestyles. This paper will present 1)a review of sustainable design initiatives by the National Park Service, 2)sustainable design in regards to cultural resources, 3)and recommendations on ways that the concepts of sustainable design can be applied to masonry structures in the Caribbean.

Review of the Sustainable Design Initiatives by the National Park Service

The National Park Service plays a key role in promoting the concepts of sustainable design. In the 1991 Vail Symposium, working groups studied the "state of the parks" as part of organizational renewal activities associated with the 75th Anniversary of the National Park Service. The groups presented the following factors as stressing the National Park Service capabilities: population increases, park visitation increases, demographic changes, increased number and types of sites to manage, environmental degradation, lack of capable leadership, and the need to protect whole ecosystems.

As a result of the Vail Symposium, the sustainable design initiative was officially launched in November 1991 with a workshop in Maho Bay, Virgin Islands National Park. The participants represented a variety of agencies, organizations and private sectors. The outcome of the workshop was a set of guiding principles for the application of sustainablity to the management of natural and cultural resource areas. As presented in a publication titled Guiding Principles of Sustainable Design, the principles to be used in the design and management of park and other visitor facilities emphasize environmental sensitivity in planning, design, construction, operation, and maintenance; the use of nontoxic materials, resource conservation, recycling; and the integration of visitors with natural and cultural settings. The principles were developed for nine topics: interpretation, natural resources, cultural resources, site design, building design, energy management, water supply, water prevention, and facility maintenance and operations.

Sustainable Design in Regards to Cultural Resources

In large part, the historic events and cultural values that are commemorated in today's societies were shaped by humankind's response to the environment. It is just not nostalgia that draws people to historic developments. Much of what is valued in these developments is their response to the climate, natural setting, and local available building materials. Their usefulness as models for new buildings only adds to their value. Many preserved buildings, districts, and landscapes consist of vernacular design - architecture without architects - built with onsite or locally available materials.

Traditional Building Practices

Since humans began constructing structures over 10,000 years ago, the traditions used have been based on tried and true methods of design, workmanship, and maintenance. Locally available materials were used in construction by local craftsmen familiar with the materials and techniques. Buildings were fitted together so that when a part would come to the end of its service life, it could be easily replaced. Maintenance was as much a part of the building's history as was the initial construction.

As an example, a symbiotic relationship of human activities within their host environment is evident in the Anasazi cliff dwellings at Canyon de Chelly National Monument in Arizona. There, the natural sandstone, local earth, and timber were used to shelter communities in the cliff. The occupants' structures were their direct response to the environment. They built them with what they had, and built them in such a way as to be cool in the summer and easily warmed in the winter. This is just one of innumerable examples of how man has responded to his environment in ways that was beneficial to both. Certainly this has been the case in the Caribbean area where vernacular responses to climate, setting, and materials provides opportunities for presenting positive lessons in ecologically sound design.

"Square Peg in a Round Hole" period, 1940's - 1990's

With the advent of easily obtained, mass produced building components and a false impression that transportation costs were of no concern for delivering materials to the work site, structures in the industrialized world began to be constructed after World War II with a "factory" type mentality. Building materials that were not local to the region were shipped in, many times from across great distances at considerable expense of energy. Many of these materials are harmful to the environment to produce or extract, are difficult to adapt to local technologies of construction, and are not compatible with local building traditions or craftsmanship values. Since the 1950's, the industrialized countries have erected disposable buildings which are difficult to dispose of after they outlive their short-lived service life. Since the buildings were constructed to be disposable, little thought has been put into maintenance. And replacing them is even more costly. The industrialized countries have also gotten in the habit of importing "new technologies" to developing countries, such as concrete prefabricated units, corrugated tin, and metal frames. Persons living in these incompatible structures are now faced with high maintenance costs and difficulty in obtaining replacement parts. An example are the thousands of concrete structures built with steel rebar, that now, 50 years later, are beginning to deteriorate at alarming rates because of the steel oxidation that causes cracking and bulging.

Preserving Cultural Resources in the 21st Century

We are starting to rethink the feasibility of the building practices of the past 50 years, and realizing that local materials and traditions are the soundest avenue to pursue for new building construction. The structures erected by developed countries from the 1940's through the 1990's will hopefully be looked upon as an anomaly, an aberration, when they are considered from a historic perspective one hundred years from now.

As in the old days when structures were designed and built with limited resources and minimal transportation involved, today, many of us are looking at similar circumstances that are essential to sustain the natural resources in the world.

The process of preserving cultural resources inherently is not sustainable. All materials deteriorate over time, and with cultural resources efforts are made to prevent their natural progression. There are ways, however, to minimize the amount of effort needed to retard the deteriorative rates of cultural resources.

When repairing or replacing parts of a building, materials of known physical and chemical makeup are the most appropriate to use. This is why we have always heard that like materials should be used in the repairs, since we know the characteristics of these materials, how they will interact with the existing, and any side effects through time. There are, however, materials and techniques that are new innovations on the market that have been specified in preservation work. These can effectively be used in preservation work if the properties of the replacement material are known. New materials that have not been tested over time in contact with historic materials may alter the balance of an entire structure, through differential coefficients in expansion/contraction, toxicity, adverse chemical reaction through time, etc.

Additionally, technical efforts to preserve cultural resources must not contribute to the degradation of the environment. The use of pesticides, fungicides, and other toxins, has damaged the earth, so any preservation efforts should consider non-hazardous alternatives.

In some instances toxic materials, such as lead-based paint and asbestos, are inherited. Toxic materials that exist in many historic buildings must be removed and properly disposed of. The problem of inherited toxins will need to be addressed in all proposed management and development projects in the future.

The reuse potential of historic buildings should include an assessment of the original resources it took to construct the building as well as an assessment of the building's potential for economical heating and cooling. Often older buildings were designed to take advantage of natural light, non-mechanical ventilation, passive solar heating and the ability of native materials to hold heat or cold when assembled in certain fashions. Conversely, more recent structures may rely on energy-consumptive systems for their continued use. Historic buildings and landscapes can provide opportunities to discuss construction prior to the 20th century, when most structures were built with locally available materials.

Sustainable Design in Regards to Masonry Structures in the Caribbean

Masonry structures in the Caribbean, whether they be extant roofed buildings or ruined structures at archaeological sites, require constant maintenance and attention. In order to better protect these historic structures and at the same time follow the principles of sustainable design, a number of preservation options can be considered.

1) **Repointing:** If a wall was never historically plastered, or if a wall was historically plastered and the masonry coursing is now considered key to interpreting the resource to the public, then repointing the masonry is the preferred option in many cases.

   Most of us are familiar with the deleterious effects hard portland cement has when used in repointing stone masonry. The cement, usually being a much harder and impervious material than the stone, ends up deteriorating the weaker stone at accelerated rates. This deterioration takes place from: 1)differential temperature coefficients, making the weaker stone crumble under the expanding effects of the cement, 2)leaching of damaging salts from the cement into the stone, eventually causing deterioration through efflorescence and sub-florescence, and 3)the diversion of moisture through the generally more porous stone instead of the cement mortar, thus causing deterioration through wet/dry cycles and salt crystallization. When repointing, then it is understood that a material weaker than the stone it is adjacent to should be used. If the wall was originally mortared with lime, then a lime mortar should be used. If a wall was originally mortared with earth, then an earth mortar should be used. There are various amended earth mortar mixes available that are non-toxic and naturally occurring that can retard the maintenance cycle significantly.

2) **Plastered surfaces:** The cyclical maintenance needs of repointing masonry many times results in time consuming work, and the need to repeatedly physically alter the historic fabric. Wall surfaces can be considered to be plastered with a sacrificial rendering such as earth or lime plaster. This not only is a porous, reversible protective surface for the masonry, but also provides for easier and less costly maintenance. If wall surfaces were never historically plastered, this action can be looked upon by some as not appropriate. However, if deterioration of the masonry is taking place at a rapid rate, it can easily be justified. Also, if the walls in question were originally plastered and have lost their protective coating through erosion, plastering the surface is technically one of the best preservation methods available.

3) **Backfill:** Backfilling, or site burial, is a preservation technique that is gaining more and more acceptance among site managers and technicians, especially in light of the recent sustainability efforts. Backfilling is the technique of covering all, or parts of a site or structure with soil. Backfilling is "an attempt to re-instate the original environment of an excavated site, and thereby re-establish a state of equilibrium similar to that which existed prior to its liberation by the spade, or to create anew a more stable environment for ruins that have always been exposed." (Demas) It is common knowledge that archaeological

sites that have not been excavated are usually fairly stable, having reached a chemical and physical equilibrium with the surrounding soil, and that upon excavation the architecture and artifacts quickly begin to be negatively impacted by the environment (ie. changes in temperature, humidity, exposure to the pollutants, etc.). The Southwest Region of the National Park Service in collaboration with the Getty Conservation Institute has recently completed a backfill research project at Chaco Culture National Historical Park, New Mexico in which the effects of backfilling masonry sites were investigated. Even though, moisture content, soil pH, and other variables in the soil are different in the arid Southwest than in Caribbean environments, the same principles can be applied. If proper soils and techniques are used, backfilling can be extremely beneficial for the protection of masonry walls at archaeological sites. Backfilling also essentially negates the need for maintenance of the walls, thus realizing enormous cost savings to site managers. It also cuts down on vandalism.

4) **Benign neglect:** There are many instances in which doing nothing is the best alternative. In preservation terms, benign neglect is the process of intentional neglect and a hands-off attitude towards treating a cultural resource. Documenting the resource is many times the only preservation action justified. This concept is most pertinent to architecture in ruins that has never before been subjected to stabilization or excavation efforts. Experience has shown that a structure in ruins has reached its own level of near entropy through time, being relatively stable with the environment. Once excavations and maintenance efforts disrupt the "equilibrium" by clearing rubble away from the bases of the walls, repointing masonry, regrading the ground surface, etc., the ruin must once again begin to defy the effects of gravity, new exposures, etc.

5) **Cultural landscapes:** The study and integration of cultural landscapes into cultural resources management has deservingly received much attention recently. A building should be looked at, assessed, and interpreted to the extent possible in context with its surroundings, as part of a whole, instead of in isolation as a monument. In considering sustainability, any intervention on the lands in context with the cultural resource should consider methods to least impact the area in terms of visual intrusions, impacts to the surrounding natural resources, traffic congestion, etc. A classic example of unsympathetic treatments to a cultural landscape is the manicured lawn look of a site that never historically had such an appearance. These "golf course" type presentations are not only a false representation of the historic cultural landscape, but are also unsustainable, needing constant maintenance and watering.

6) **Drainage:** Efficient drainage systems are essential components to sustainable designs for historic structures and landscapes. Faulty, inoperable systems can greatly accelerate the deterioration of cultural resources, thus increasing the expense of repair and maintenance. Positive slopes away from structures, working gutter systems with discharge well away from the structures, and the absence of lawns and other vegetation needing water near buildings are essential in the design and management of historic properties.

7) **Carrying capacity:** When cultural resources become visitor attractions, the responsible authority must ensure that providing access to these resources does not create additional environmental deterioration. Getting people to the cultural resources can have major effects on the environment. The process can require the construction of roads, trails, and visitor facilities. The transportation aspect of bringing people to the resources is accompanied by energy consumption and pollution.

In addition, the carrying capacity of a historic building must be closely monitored. Normally, the very act of allowing public access to a significant cultural resource exposes the property to increased risk of deterioration. This must be countered with increased maintenance activity, the energy cost of which should be weighed as part of the decision about how much access will be allowed to that resource.

The foot traffic of thousands of people a year through an historic structure can not only accelerate the deterioration of the floors, but also add additional humidity to a roofed building, and increase vandalism. At archaeological ruins, unsolicited trails can be created too close to walls, thus creating swales at wall bases which collect water and migrate through capillary action up into the walls.

Sustainable Design and the US/ICOMOS Specialized Committee on Earthen Architecture

The US/ICOMOS Specialized Committee on Earthen Architecture, which is chaired by Michael Taylor, one of the authors of this paper, is promoting the principles of sustainable design as it regards earthen architecture preservation and construction. This includes not only the application of sustainable design to preserving historic earthen structures, but also advocating the use of earthen architecture in new construction for visitor centers at parks and in housing projects. Earth is a renewable, abundant resource that has been used for thousands of years to efficiently and comfortably house humanity from all social classes. Throughout history, it has been the building medium of choice in many areas of the world. The rich architectural heritage of building with earth in the Caribbean is apparent to all of us. Today, a renewed awareness of its viability and importance is being fostered not only by preservation advocates, but also by banking institutions, housing authorities, and foundations.

Conclusions

This paper has reviewed but a few of numerous recommendations that could be considered for more sustainable preservation of masonry structures in Caribbean.

We must remind ourselves that we are in the business of preserving our cultural patrimony for future generations. This does not mean only for our children and grandchildren, but for civilization 50, 100, 10,000 years into the future. We must rethink our methods and philosophy for preservation, and plan on a **sustainable** approach to our efforts.

Bibliography

Guiding Principles of Sustainable Design United States Department of the Interior, National Park Service, Denver Service Center, 1993.

Demas, Martha. "Backfilling of Archaeological Sites", unpublished manuscript, Getty Conservation Institute Training Program, Marina del Rey, California, 1992.

Dowdy, Katherine and Michael Romero Taylor. "Investigations into the Benefits of Site Burial in the Preservation of Prehistoric Plasters in Archaeological Ruins", *Terra 93, Communicacoes, 7 Conferencia Internacional Sobre O Estudo e Conservacao da Arquitectura de Terra*, 1993.

Holstrom, Ingmar and Christina Sandstrom. *Maintenance of Old Buildings*, Document D10:1975, research project 272, National Swedish Institute for Building Research

Holstrom, Ingmar. "Buildings to Use or Demolish", Contribution No. II to CIB Congress 1983, "To Build and take care of what we have built, with limited resources" arranged August 15-19 in Stockholm by the National Swedish Institute for Building Research, Gavle, Sweden.

Elmina: Castle and Town

Ir. Arjen K. Joustra and Diederik Six

Background

Elmina is a West African town on the Gulf of Guinea. By the end of the 15th century, the then small fishing village, came, because of its for trade unique situation, in contact with European powers. These contacts determined the development and to a great extend the character of the town. The castle, Sao Jorge de Mina, built near the village by the Portuguese, played a central role here. From 1637 till 1872 the castle formed the Dutch main quarters on the gold coast and the town grew to an important trading place. By the beginning of the 19th century, after the abolition of slavery the building lost its function as a trading-post. Over a century later, in 1921, the town also lost, because of a commercial prohibition, its trade function. The town fell back on its original source of income, fishing. This relapse in development on the one side had the advantage that the valuable character of the town was not touched by new or extended functions. On the other hand this character now is threatened of falling into decay.

The decay can only be stopped if the town receives new economic impulses. Improved fishing techniques could give such an impulse. But stimulating tourism should be considered too. Restoring the culturally and building-historically valuable castle St George, sited in Elmina could be a first important step. Students in restoration techniques from the Delft University of Technology researched the possibilities of reuse of the castle. The problems surfacing when used as a tourist attraction mainly are not tied to the castle itself but its surroundings. On top of this the problems usually are not of a structural nature. The research therefore extended into other disciplines. It is the intention that this interdisciplinary research yields a proposal indicating how the valuable elements and structures of the town can be rehabilitated by new economic impulses.

The history of the Town and Castle Elmina

By the end of the 15th century the trade routes from India to Europe were blocked by the Turks. Looking for new routes, in 1471, the Portuguese discovered the West African coast. The coast of present day Ghana was called 'Mina' (mine) because of the abundance in gold offered here.

Diego d'Azambuja was assigned by king Joao II of Portugal to find a suitable location for a trading post. The choice fell on the trading town of Aldea das Duas Partes, at present called Elmina. The site on the tip of the spit formed by the river Benja and the Atlantic Ocean offered the stronghold a unique strategic position. Not comfortable with the lasting of the friendship with the local population the castle had to be built quickly. To be able to realize this the most essential building elements were prefabricated in Portugal.

The prefabricated castle was built in the late-medieval castle-building tradition. A high walled square with on three corners protruding round towers. The fourth corner was marked by a square tower. The castle built in 1482 soon proved to be too small and was extended on the south-eastern side with a trade square. The town on the spit was protected by the castle and a city wall and received its town privileges as early as 1485. For more then a century the Portuguese knew how to keep the lucrative gold trade a secret for the other European seafaring nations.

Until Barand Erikszoon landed on the coast in 1593. The Dutch threat made the Portuguese modernise their castle. Around the old fort and the trade square a stronghold was built secured with bastions. The double ring of canals on the landside made that the whole complex was surrounded by water. Several attacks on the castle were beaten off.

So too in 1625 an attack in which Piet Heyn was involved. A plan staged in 1637 by Johan Maurits the Brazilian succeeded. His army did not barrage the castle from the seaside but from the hill of St Jago where a Portuguese chapel stood. Now that the castle was in Dutch hands it was altered and extended by building on the lower end of the square on the riverside.

On the hill of St Jago the fort Coenraadsburg was erected to protect the castle from the

landside. Soon not only the Dutch but the English, Swedes, Danish, French and Brandenburgers laid claim on the coast. Despite this competition the Dutch fared well. The trade in gold, elephants teeth and especially slaves, flourished. The castle was decorated and in the town pavilions and gardens were constructed.

Because of the French rule in the Netherlands, around 1800 Elmina was isolated from the motherland. Many Dutchmen were forced to settle permanently in Elmina and thus a large urban expansion developed on the foot of the St. Jago hill. The expanded town was protected from attacks from the inland by a system of redouts [earthenworks].

The abolition of slavery at the beginning of the nineteenth century made the property on the coast uneconomical for The Netherlands. The English, who had far-reaching plans for colonization, were interested in taking over. In 1872 this led to a complicated exchange of Dutch property on the gold coast for rights in northern Sumatra and the possibility of sending labour from India to Surinam.

The important Ashanty tribe, for years the best ally of the Dutch, was not notified of this take-over. Soon the English were at war with the Ashanty In 1873 this led to bombarding of the old town on the spit. Until now the spit remained unbuilt on. The town across the river was extended however. After closing the harbour by the beginning of the 20th century the town fell back on fishery.

In 1957 Ghana was the first African nation south of the Sahara to gain independence. For a while the castle was used as a police academy. At present the building is left desolate.

Research

Even though we leave from a complete picture of the town with her own specific values, we concentrated our research on one element of the town, the castle St George d'Elmina.

The research leading to a proposal for reuse of the castle was started in 1987. First the castle, which stands noted as the first and largest European building in tropical Africa, was thoroughly inventoried and documented. A very precise survey of the castle resulted in a number of plans, cross-sections and faces.

From three investigations, a historical, a technical and an organisational investigation, the boundary conditions for reuse of the castle resulted.

Building historical research is essential to be able to explain and understand the present structure and thus to determine its value. The building historical research led to the conclusion that this is a very special castle. he weaving of the late medieval castle with a fortress secured with bastions make it a unique building. In the proposal for reuse it has therefore been tried to clearly emphasize these structures.

The building technical research not only oriented on the technical state of the building but especially on the question whether interior or exterior spaces can, building physically, be made comfortable. The castle as a fortress always functioned well but as a building to live in was and is extremely uncomfortable. Comfort can be improved structurally by improving the movement of the air and reducing the radiating surface. For the research a wind tunnel and sun simulation tests were used. This resulted in a number of proposals; applying double roofing systems, planting the large square and installing wind grids for movement of the air in the court.

Thirdly we researched how new functions could, from an organisational point of view, be accommodated in the building. The old organisation of the castle as a stronghold corresponds well with the planned museum-hotel function. As boundary condition remains the respect for the found structure of the building. he accessibility of the castle should, considering her historical importance, be as easy as possible. Further a tight social connection with the town is sought. The latter is especially emphasized by the planned technical school on the 'katteplaats' and the study centre on the great square.

All three investigations finally resulted in a proposal for reuse in which the following functions would be incorporated in the castle: museum, hotel, restaurant, study centre, conference room, laundrette and technical centre.

Review

It is clear that Ghana owns a unique heritage of fortresses and castles. That they are truly unique is indicated by their place on the UNESCO World Heritage List. Buildings however, that do not remind us of something beautiful but which are soaked with the suffering of the slaves traded here. None the less Ghana has ample reason to develop plans to conserve what remains.

Not just from a cultural-historical point of view but also from an economic view point. he fortresses and castles can play an important role in stimulating tourism. No doubt a well organised tourism, without degrading culture to severely could be an important contributor to the economy. Ghana is rich in potential tourist attractions; the rich local culture, wild parks, tropical rain forest, the delta of the Volta river, the Akosombo dam, the gold mines, a coast of unparalleled beauty and the old European trade fortresses.

The fortresses and castles are found on those locations on the coast where one has the best views. Often pitched high on a cliff, looking out over the ocean, fishing villages, the sandy beaches and lagoons. The building possesses great touristic appeal from both an educational and from a romantic point of view.

In Ghana preservation of monuments and historical buildings by comparison to western standards is still in a very early stage. Nevertheless it was one of the first African states to develop plans for conservation of historically valuable buildings. In 1952, under British rule the 'Monuments and Relics Commission of the Gold Coast' was founded to devote itself to these historical buildings. At first attention was focused only on fortresses and castles. After Ghana's independence the previously mentioned institute was refounded as the Ghana Museums and Monuments Board (G.M.M.B.) and its territory was extended to important remaining local monuments.

The activities are reduced to conserving the individual monuments. Measures to protect a whole settlement or complete sections of a town do not exist.

Elmina is one of the oldest cities of West Africa and besides the castle and the fort it accommodates various buildings of great cultural and building historical value. The character of the town is not only determined by the individual buildings but by the city-structure as a whole, the lines of observation, the streets and squares, the hills, the beach and the harbour.

Until the end of the nineteenth century Elmina flourished. During the last decennia it remained sealed off of any economic development. This is why the valuable town structure basically remained intact, but it is now threatened by neglect.

As with a building, a town too should have sound economic functions to exist. Except for a few, the buildings are all in a bad state of maintenance. The number of monuments that should be restored is gargantuan, so are the problems that will come forward when executing this task.

About ten years ago the G.M.M.B. received supervision over the castle St. George d'Elmina. They then developed plans to give the building a hotel function. The building is the most frequently visited site by tourists in Ghana. It is well situated at a two hour drive from the capital and from the capital of neighbouring Ivory Coast.

Our research showed that a hotel function is technically as well as organisationally possible without affecting the present valuable structure of the building. When executing these plans the number of tourists in the town will increase so that existing facilities such as shops, and public services will be taxed. To prevent such new economic development from affecting the historical centre of Elmina, protective measures for the town structure should be taken. As mentioned earlier, the Ghanese Monuments Board is not familiar with such measures. The Dutch National Monuments Board, which has the necessary experience, could advise the Ghana Museum & Monuments Board here.

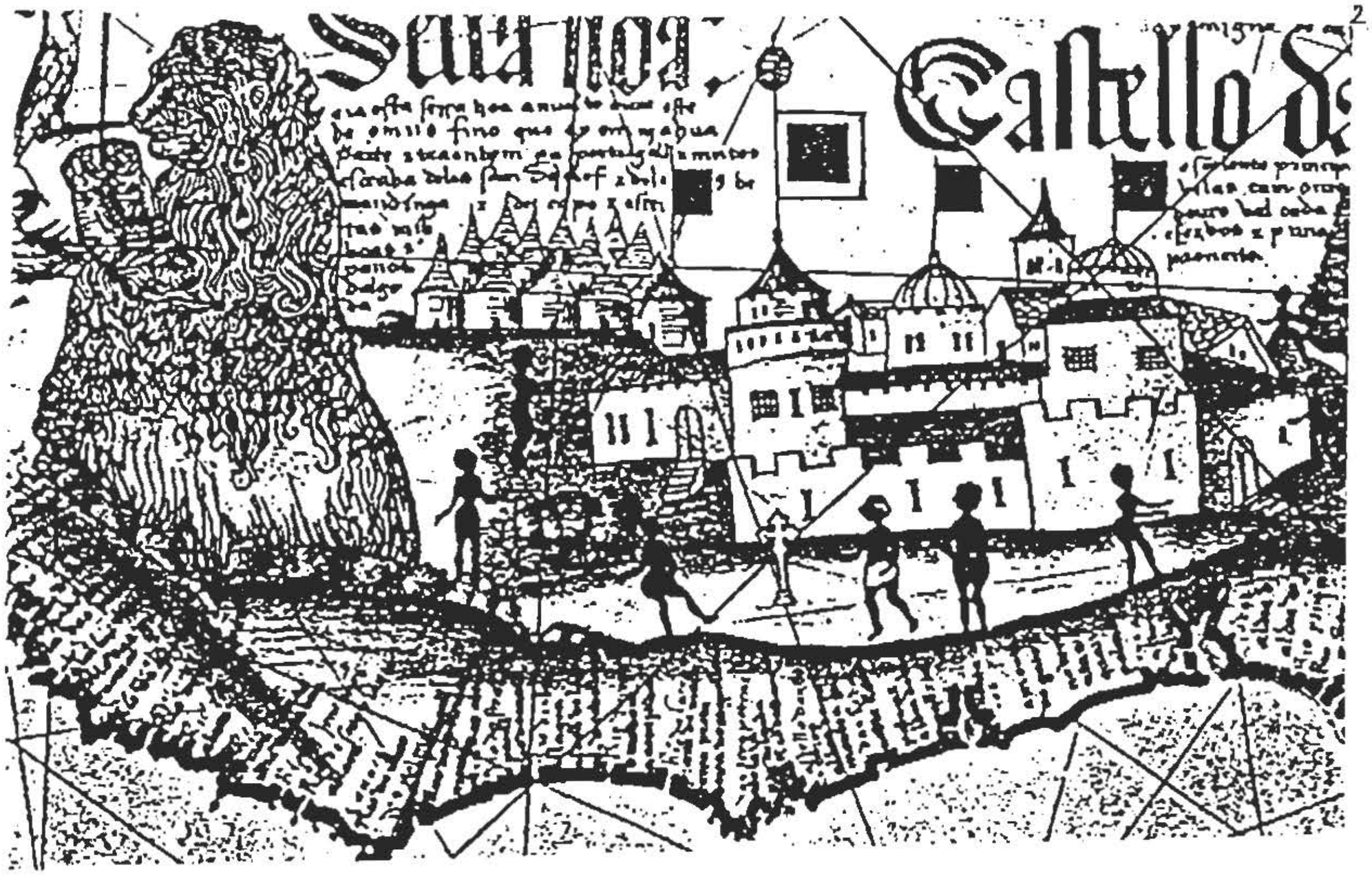
Except for stimulating tourism, by the rehabilitation of the historical centre and the valuable buildings, improvement of fishing techniques could give the town new economic impulses. The Elmina canoes, however beautiful they are, are a crying contrast to the Japanese and Korean fishing factories moored off shore. Related are the problems concerning the processing of the fish and the silted up harbour.

To arrive at a well-considered proposal, research has been started at various Dutch

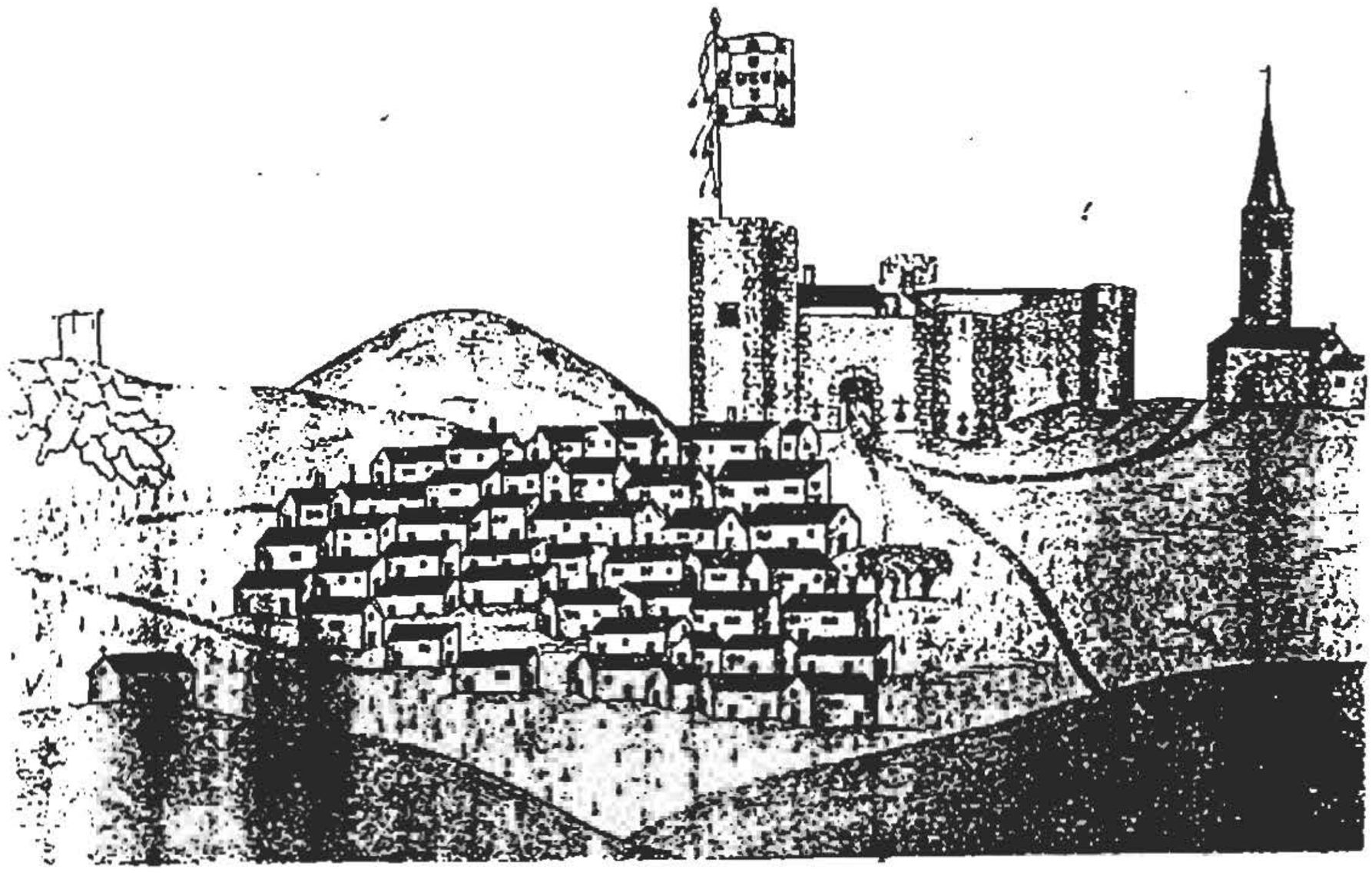
Universities in cooperation with Ghanese Universities. The University of Delft, department of Architecture, did research after a proposal for reuse of the castle St. George. The University of Tilburg is researching the economic aspects of tourism in Ghana. The University of Delft, department of Civil Engineering, will research possible improvement of the infra structure. The University of Eindhoven, department of Architecture, will research the feasibility of preserving the valuable buildings in the town.

Reuse of valuable buildings, rehabilitation of a historical city and improvement of the infra structure are areas in which The Netherlands have experience and a sound reputation. The government should feel obliged to realize the guidelines that come forward from this mutual research. As Mr. Mitterand recently stated, the ever widening gap between the West and the Third World is the biggest threat to humanity.

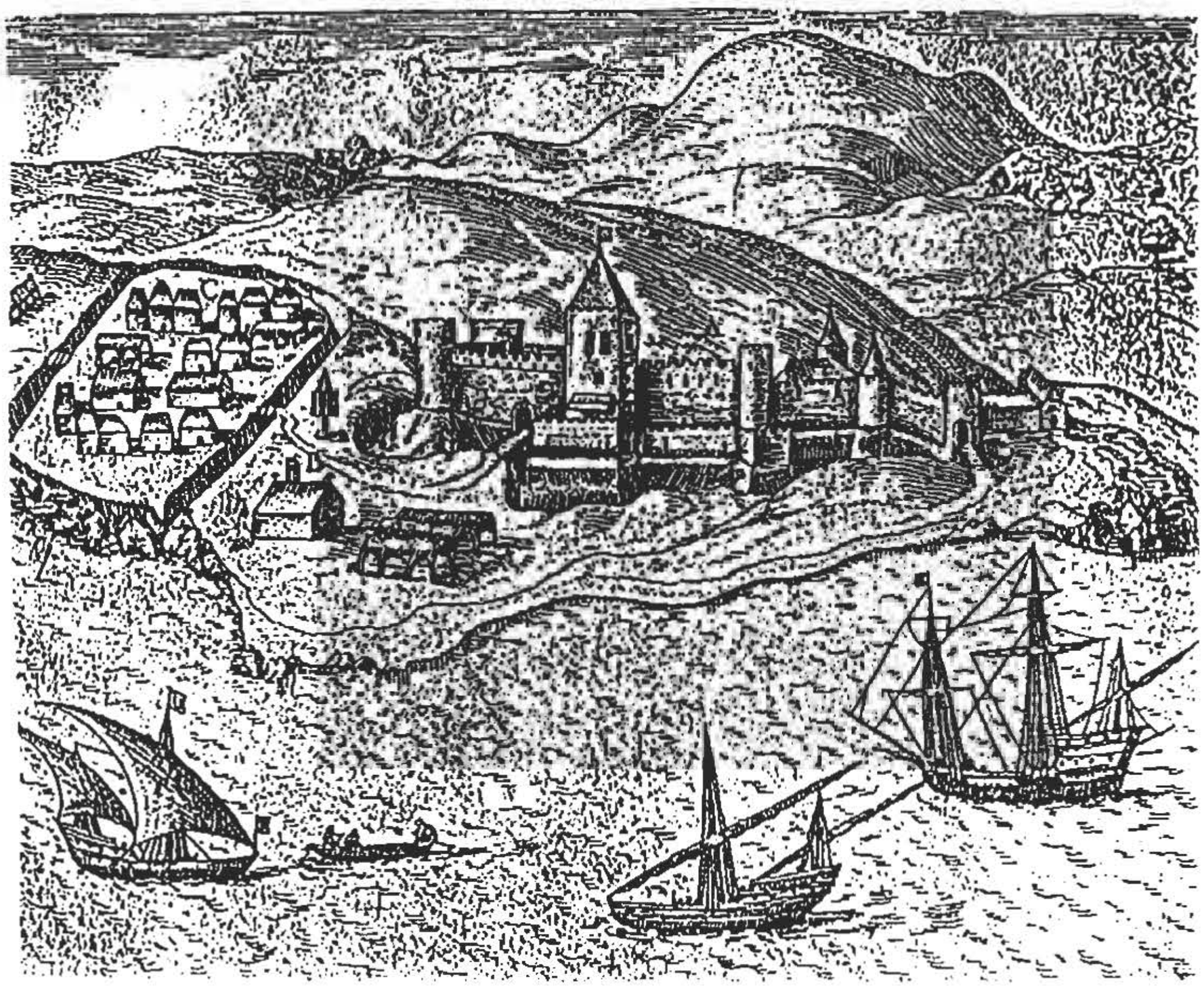
This paper has been made possible by the kind support of the Foundation for the Preservation of Castles and Forts in Ghana. The investigation by the authors was carried out as part of their studies at the University of Technology of Delft.

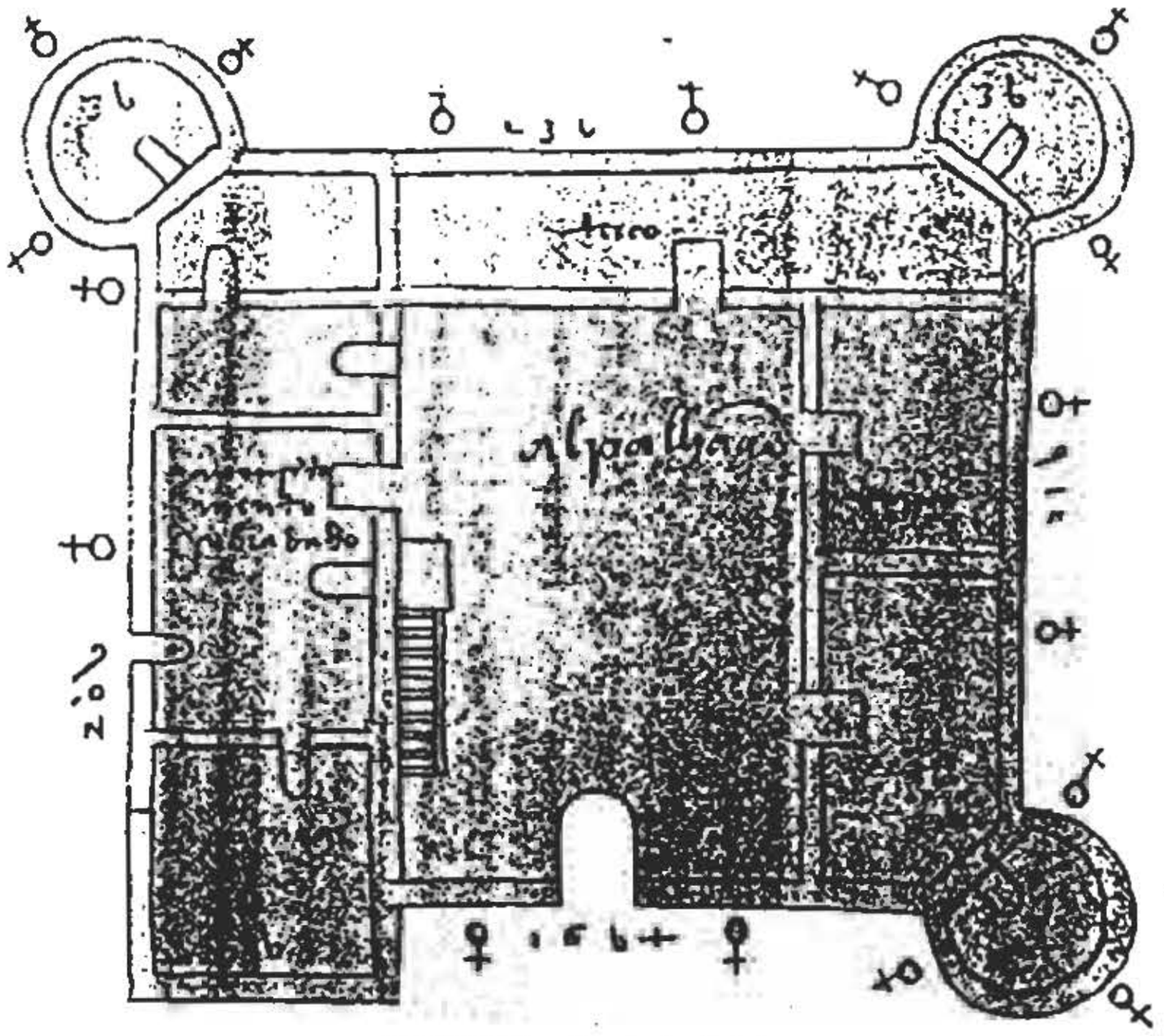


(d.3) De Cantino planosphere, 1502.

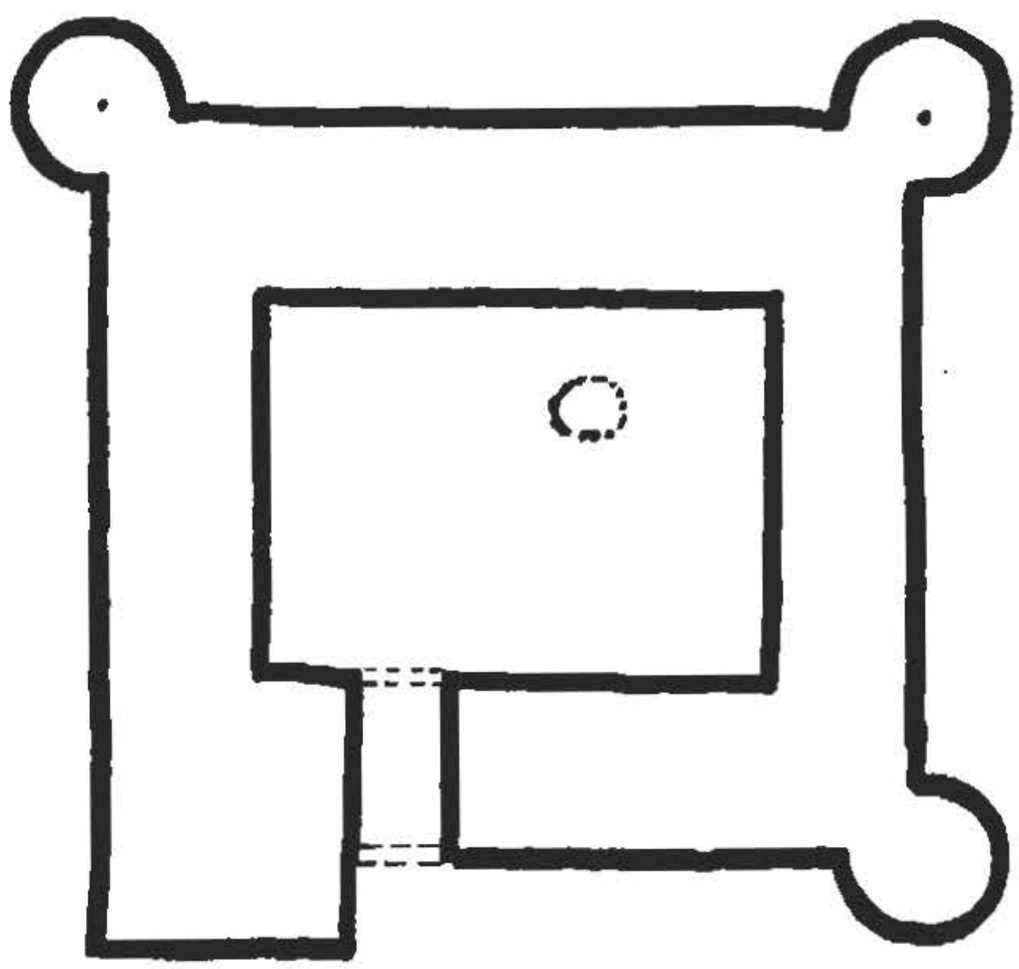


ALPALHÃO — Vista tirada da banda do nordeste

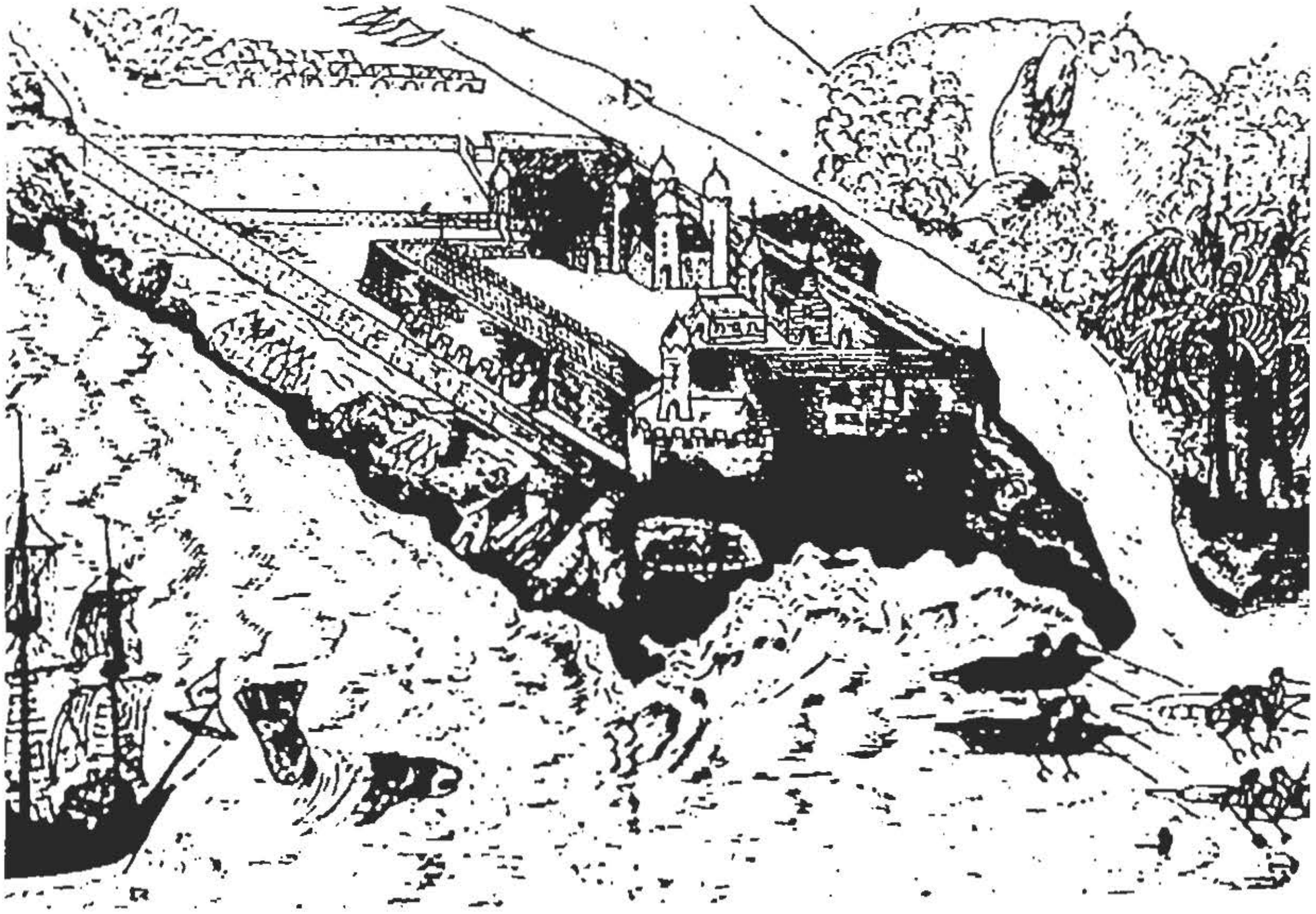




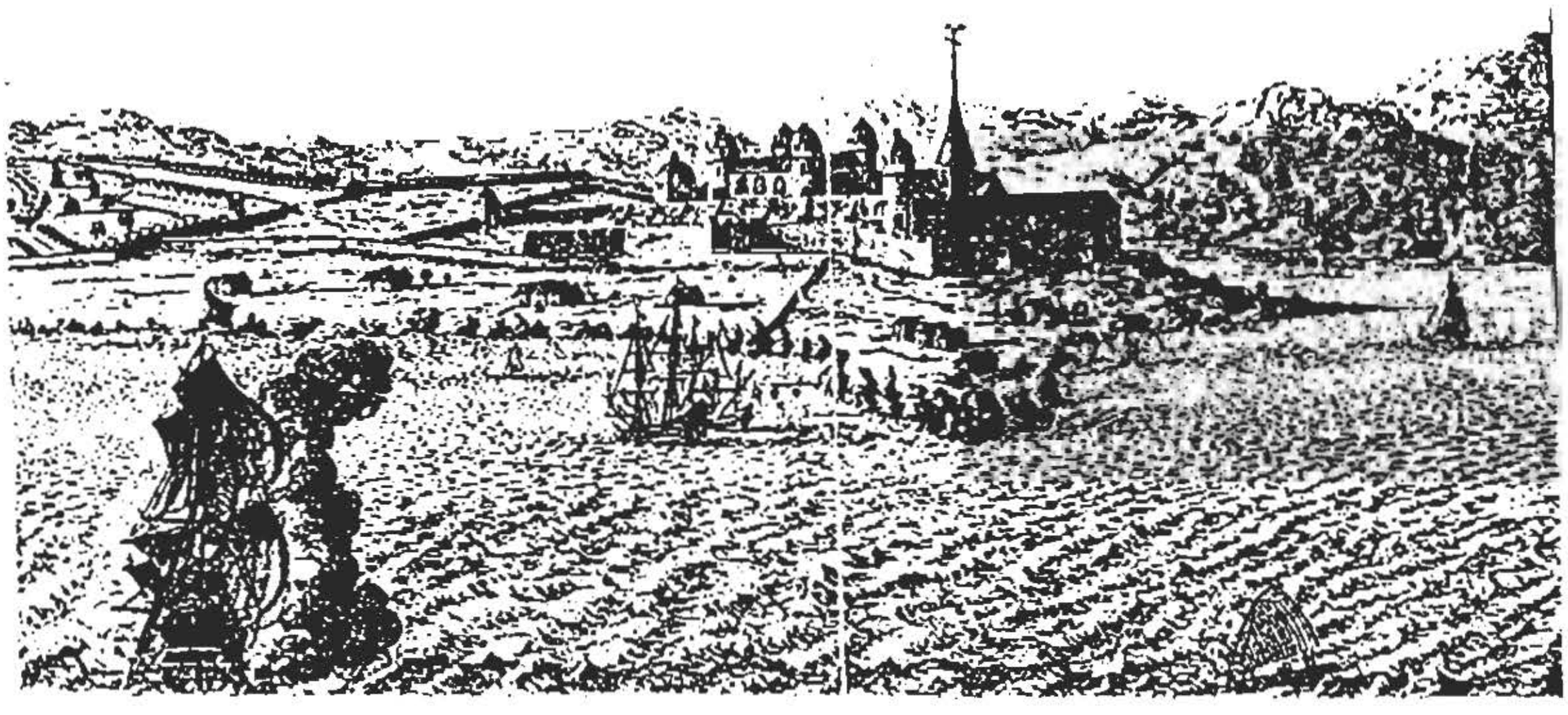
ALPALHAO — Planta da Fortaleza

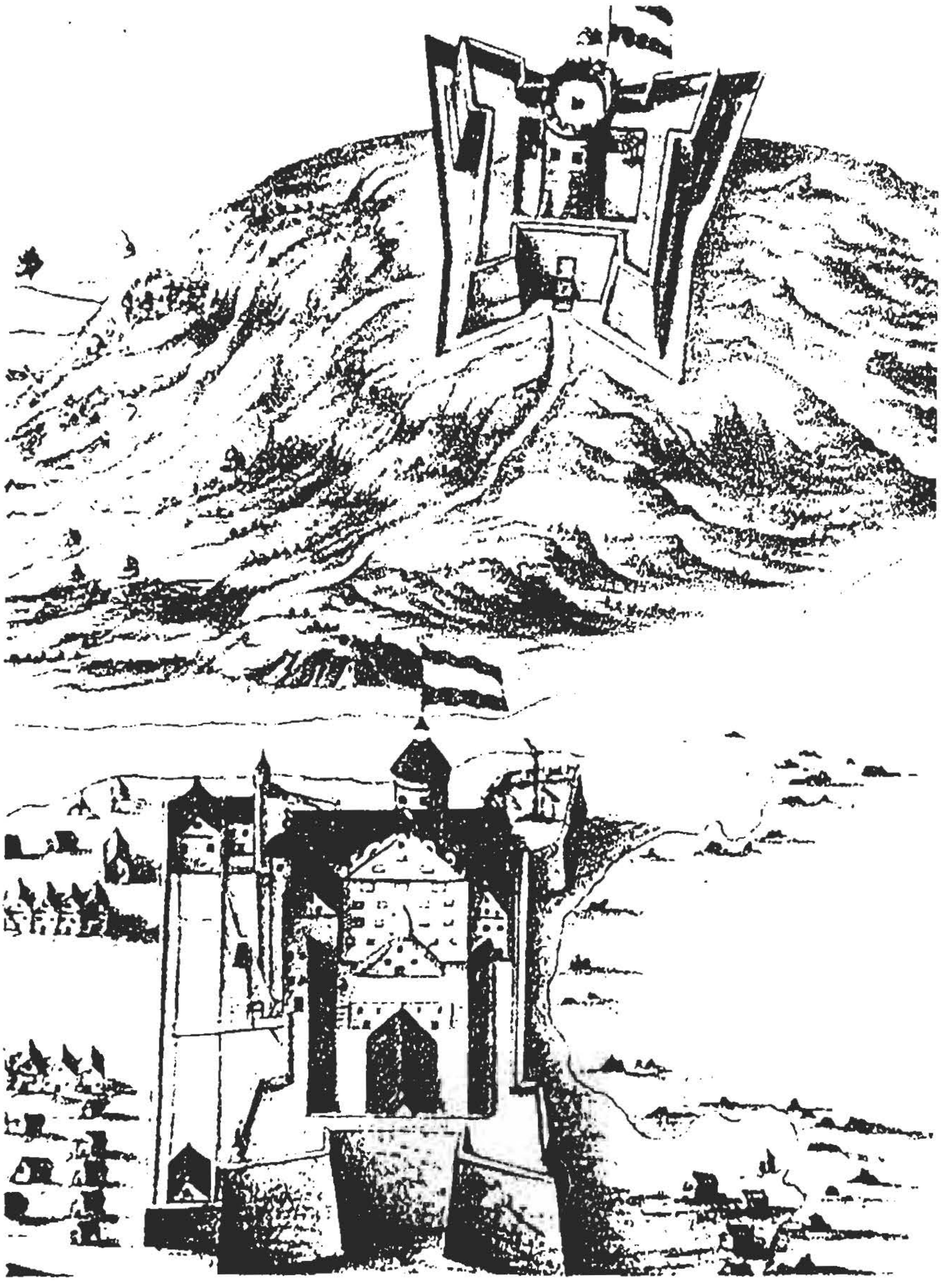


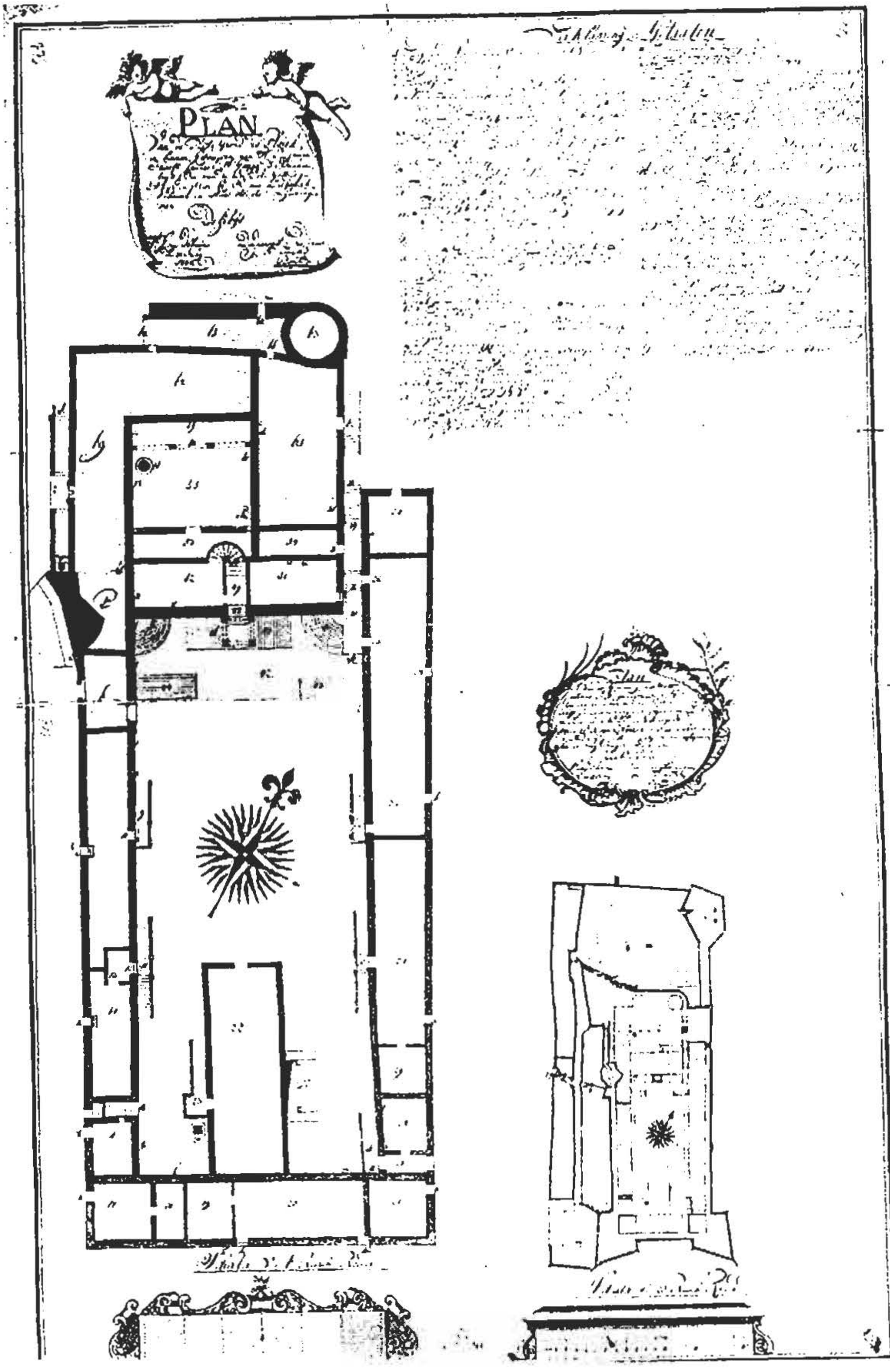
Reconstructie plattegrond van het kasteel St George d'Elmina

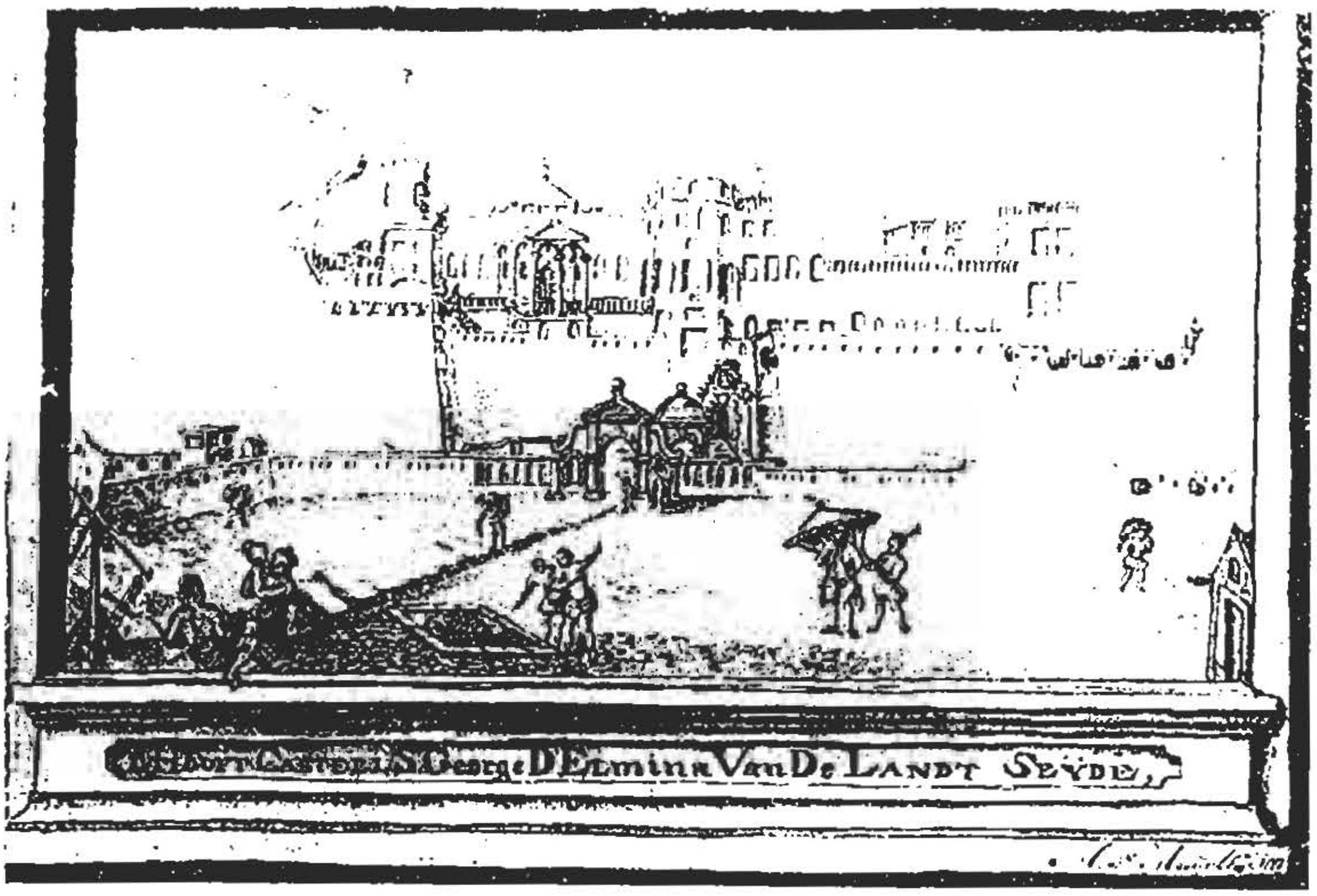


(d.19) Ulsheimer, 1603.

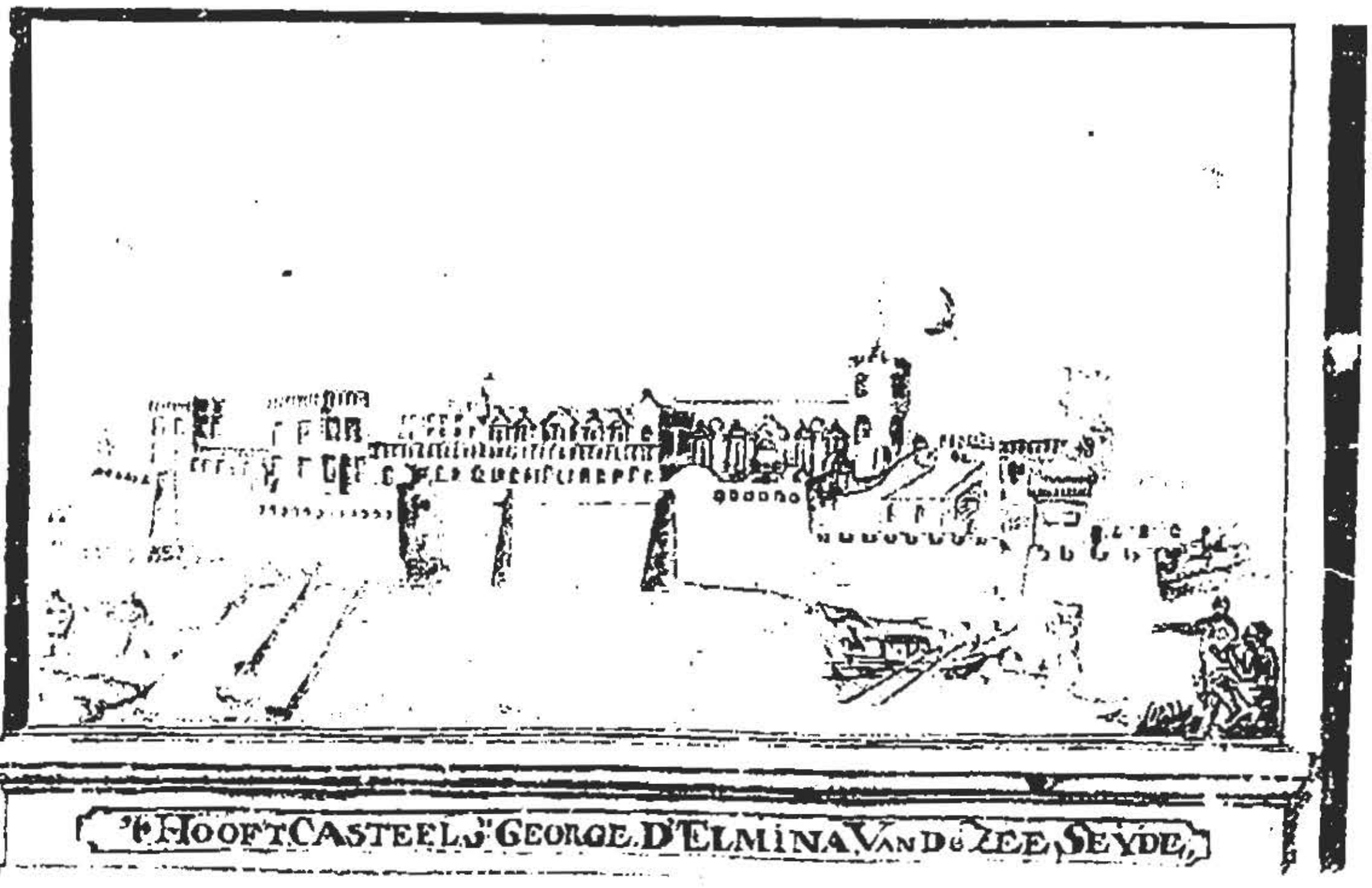





PLAN



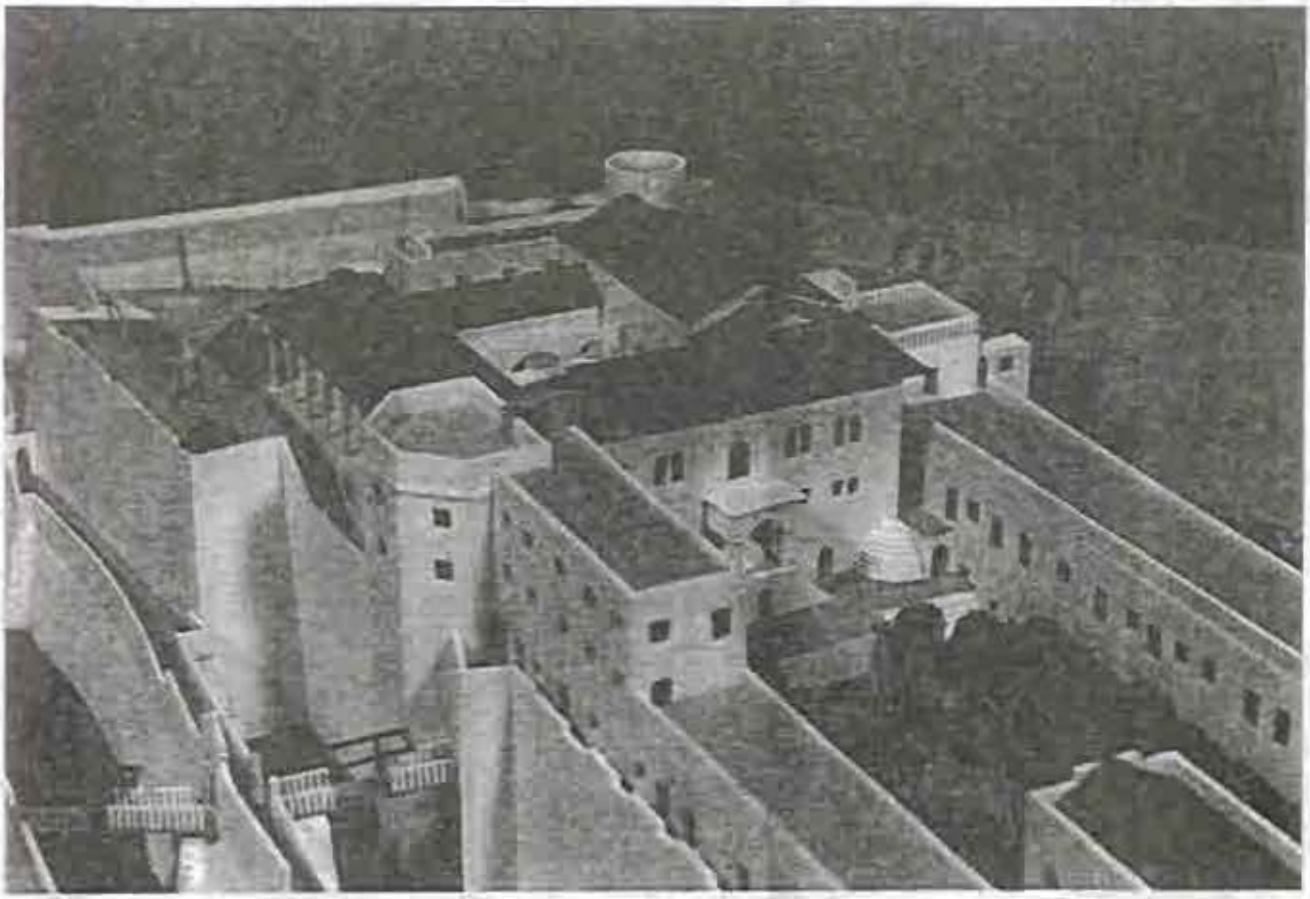
(d.53) Mazijn, 1777

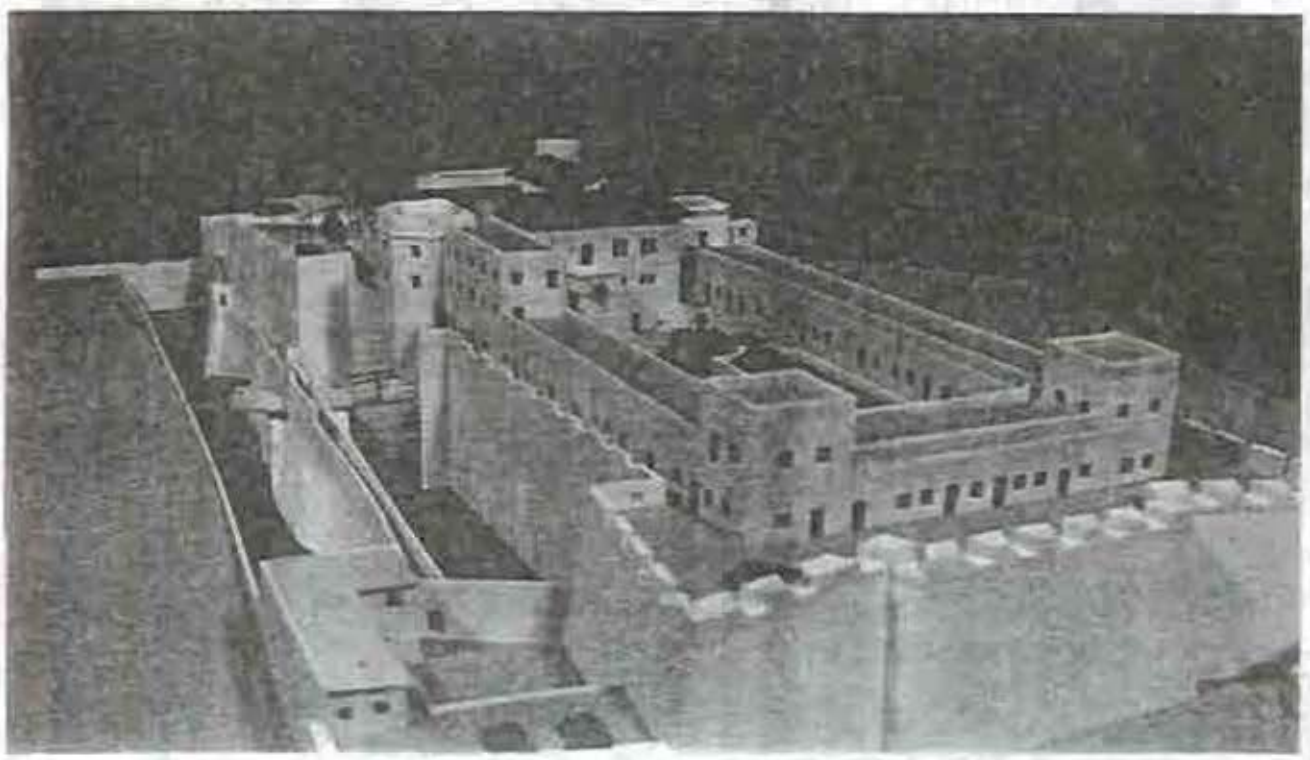


(d.83) Het kasteel van de landzijde. Joustra & Six, 1987.

Castle St George d'Elmina

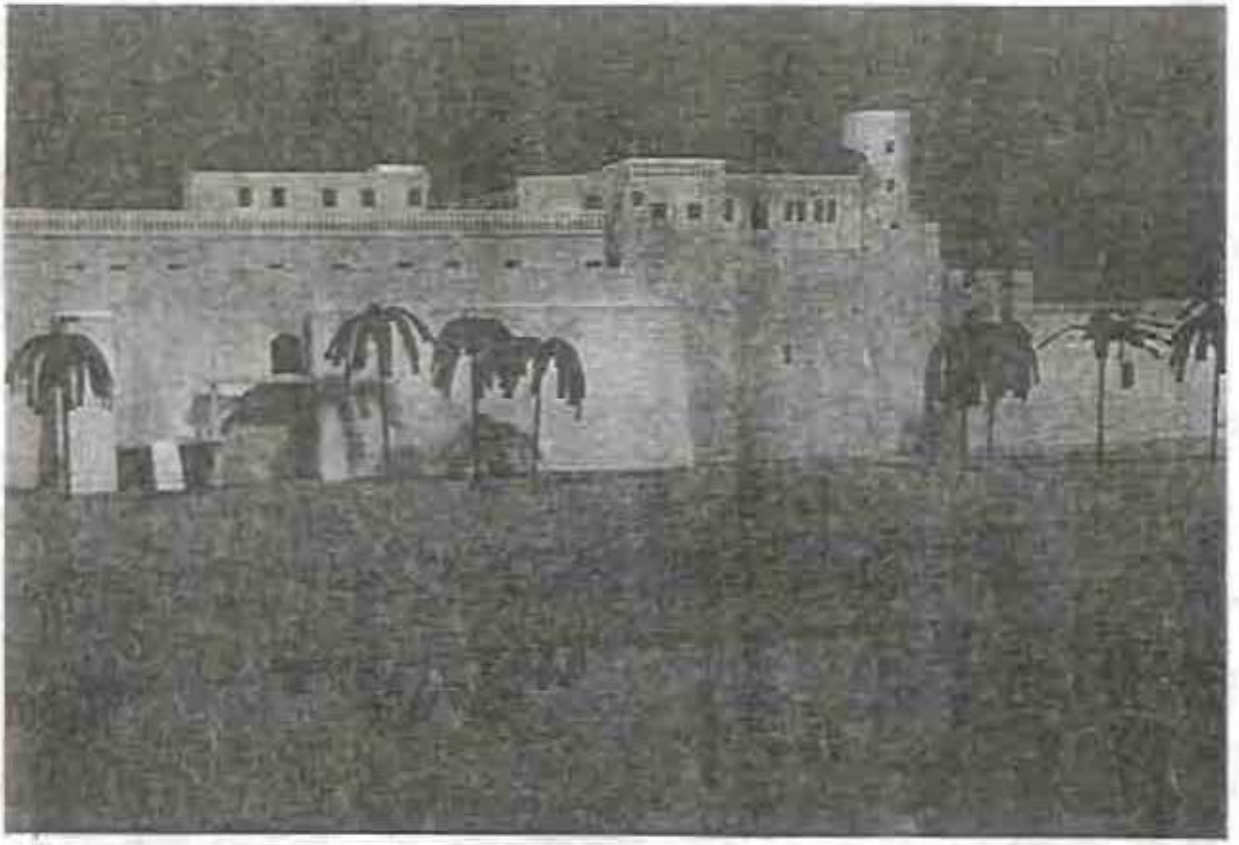
Restauration-proposal by A.K. Joustra & D.L. Six, 1989





Castle St George d'Elmina

Restauration-proposal by A.K. Joustra & D.L. Six, 1989



Archeological Investigations at the Flanking Battery Wall of El Morro

Ken S. Wild, National Park Service, Southeast Archeological Center

The Southeast Archeological Center conducted archeological investigations at the fortress San Felipe del Morro, San Juan, Puerto Rico from May 8 through May 29, 1990. These investigations were designed to provide information about various construction phases of the fortress. This information was needed to complete an overall historic research study aimed at defining and identifying the growth and modifications made to the fortress since its construction by the Spanish in 1539. This paper describes these investigations and their results.

While researching the physical history of San Felipe del Morro for a historic structures report, several hypotheses were developed that required testing through archeological methods. It was felt that an archeological approach could provide information on structural renovations made to the fort during the last quarter of the eighteenth century. A 1742 drawing of the fortress, produced in Spain, depicts a recessed area, (orillon) in the flanking wall of Austria Bastion that is not present today. The orillon would have allowed riflemen to enfilade the curtain wall and entrance to the fort. The orillon was constructed in 1602 and reconstructed in the 1620's from the hornwork remains left by the attack and capture of the fortress by the Earl of Cumberland in 1598.

Drawings of the fort produced after the ca. 1773 refurbishing of El Morro do not depict the orillon suggesting (if the map made in Spain was accurate) that it was filled during this period. It was also hypothesized from the studies and previous archeological research (Smith 1962) that the moat level as well as the walls may have been raised as much as 10 feet or three meters during the ca.1773 reconstruction. If the moat had been filled, as suspected, then the construction seam of the orillon where it was filled, if it existed, would be underground.

While conducting the analysis and study of the ca. 1773 reconstruction of the fort, it was suspected that much of the same materials and techniques were used in both the 17th and 18th centuries making it difficult to date the different periods of construction. Archeological investigations were, therefore, designed to locate evidence of the ca. 1602 orillon, determine the accuracy of the Spanish 1742 drawing, and evaluate the probability that the moat and walls of the fort had been raised during the 18th century reconstruction (Wild 1989). If the investigations located a portion of the original orillon and if the orillon was filled, then it would also be possible to differentiate between the methods and materials utilized in the two construction periods.

The investigations, therefore, were directed towards the location of a specific vertical masonry construction joint in the flanking battery wall of Austria bastion where the suspected filled orillon butted against the ca. 1602 orillon corner. From the research conducted by Blaine Cliver, Historic Architect for the project, the construction joint would be located, in the moat, approximately 34 to 40.5 feet from the junction of the curtain wall and the flanking battery wall.

Investigations conducted by Hale Smith in 1961 indicated that in order to reach the bottom of the fort wall excavations would have to extend to a depth of at least three meters or approximately 10 feet. Also, the soils would be loose, and safety measures such as steeping back the excavation and shoring of walls to prevent wall collapse would be necessary.

Five excavation units were excavated in the study area by a team of four archeologist. Three of these units were established for stepping purposes and were only excavated approximately half the distance (two meters) required to reach the wall footings.

In all five units, the excavation of the first 60, and in some areas, 80 to 170 centimeters below the surface (cmbs), revealed evidence of disturbance relating to the American occupation of the fort in the 20th century. From the surface to 60 cmbs four to five layers of fill were encountered in each unit. This material was deposited for the creation of a golf course that extended into the moat during the 1940s and 50s. Within each of these strata were found materials dating to the golf course construction period (1940s) and artifacts dating back to the 16th, 17th, 18th and 19th centuries attesting to the mixed nature of the deposit. Materials dating to early Spanish occupation included one fragment of montelupo polychrome popular between 1500-1550 and fragments of El

Morro ware dated between 1550-1770 (Deagan 1987). Two coins were recovered that date to between 1516-1550. The coins are 4 maravedies minted in Santo Domingo to honor Carlos and Juana also Carolus at Ioanna (Ortega 1982). Seventeenth century materials included metropolitan slipware (manufactured between 1630-1660) and delftware. Ceramics of the 18th century included creamwares popular between 1765-1820 and Astbury ware used ca. 1725-50. Artifacts representative of the 19th century included: a wide variety of pearlware type ceramics (1780-1840), canton porcelain (1800-1830), ginger beer bottle fragments (1820-1930), and a variety of whiteware type ceramics (1820-1900), (Hume 1982).

A sketch drawing of the fort made in the 1930s depicts a tennis court in the immediate vicinity of the excavation. Evidence of the tennis court was found int the form of concrete curbing and an underlying red clay level. The excavation of these upper strata also revealed, along the flanking battery wall, one course of dressed stone, just below the surface, that the Historic Architect identified as patch work that was undertaken by the U.S. Army during its occupation of the fort. Just below this patch work a deteriorated mortar masonry joint that is approximately ten centimeters thick was noted. Below this masonry joint dressed stone continued.

As the excavations continued below 60-65 cmbs, the soils became somewhat more uniform. Excavation of this loose sandy stratum revealed concentrated deposits of mortar typical of debris deposited during wall construction. The mortar deposits extended out from the flanking battery wall at a downward slope and became thinner away from the wall.

The number and variety of artifacts recovered from this stratum decreased considerably compared to the disturbed levels above. Most of the materials recovered below the golf and tennis court fill were ceramics, of which the majority were non-diagnostic course earthenware. The diagnostic materials recovered demonstrated that these soils were deposited in the later half of the 18th century. All diagnostic artifacts recovered have a beginning manufacturing date before or starting in the 18th century and all but one (Ichtucknee blue on white majolica, ca. 1600-1650) were still being produced in the 18th century. Materials recovered included: faience (ca. 1600-1802), slipware (ca. 1580-1795), unidentified majolica fragments (ca. 1490-1850), olive jars of the early (ca. 1500-1800) and middle style (ca. 1580-1800) and plain creamware (ca. 1762-1820). Pearlware ceramic types were recovered from the upper 20 to 30 centimeters of this deep deposit. The fact that pearlwares were not manufactured until 1780 suggests either the surface of this sandy deposit was exposed for a period of time or construction was not completed in this area until after 1780.

The excavation of the sandy soils revealed, along the flanking battery wall, a change in construction materials from dressed battered stone to a rough irregular rubble stone and a red clayey mortar fill. The change was recorded at 1.95 meters below the surface. This rubble wall extended out from the dressed stone wall approximately eight centimeters and continued downward at approximately the same scarp as the dressed stone wall above.

At 1.15 meters below the surface a large stone was encountered that altered the course of the investigations. After consultation with the Historic Architect it was decided that excavations be shifted in order that the deepest point reached in the excavation be located adjacent to this stone. The stone's horizontal angle suggested that it was the corner of the orillon as it was identical to the angle depicted in the 1742 drawing of the fort. Excavation down along the southeast edge of the stone revealed a vertical wall of solid construction consisting of five stones laid without batter or scarp on any exposed sides. It was obvious that this vertical stone wall had been constructed at a different date than the battered wall of dressed stone and the rubble stone wall.

These construction differences and the vertical joint dividing these construction units were what was anticipated if the orillon existed and had been filled. The rubble stone wall filled the orillon during the ca. 1773 reconstruction and the unbattered stone wall is the original corner of the orillon that was constructed in ca. 1602.

The stones of the vertical wall are 70 cm wide and between 40 and 45 cm thick except for a base stone which is 30 centimeters thick. The base stone extends out 30 centimeters from beneath the upper stones to the northwest providing a footing. The length of the stones was not determined as they continued beyond the width of the excavation.

In relationship to the overall study of El Morro, the archeological investigations confirmed the architectural accuracy of the 1742 drawing and provided information on the horizontal and particularly the vertical scales used in the drawing. These determinations allowed comparative studies that resulted in the understanding of the evolutionary changes the fortress has undergone (Cliver 1991).

Excavation of the soils adjacent to the rubble wall indicated that the moat was filled 2.8 meters during the ca. 1773 reconstruction and not after the reconstruction was completed as had been indicated in previous investigations. The lack of a surface finish to the face of the orillon fill indicates the likely intent of filling the moat from the onset of construction in ca. 1773. The brick courses and mortar level located at the base of the rubble wall were attached to the rubble wall and the mortar used was of the same materials as used in the rubble wall. These features, therefore, were determined to be the footing for the rubble wall and not the moat floor as had been previously suggested. The footing course at the base of the orillon corner was assumed to be the level of the original orillon floor.

Most importantly, this project demonstrates the effect of a coordinated multi-discipline team with supporting interaction producing corroboration of hypothesis and the development of new ideas. The physical history of El Morro is better understood. What initially were presumptions are clearly seen as historical fact. Architect Blaine Cliver observed, after the conclusion of this project, that often the past cannot be fully explained from the vantage point of any one discipline as this interprets the past from a single point of view. It is by observing the remaining pieces of our past through many eyes, exchanging ideas and information, that a more accurate picture of what once existed can be understood.

Bibliography

Cliver, E.Blaine, *Historic Structures Report, Volume II El Morro.* National Park Service,1991.

Deagan, Kathleen, *Artifacts of the Spanish Colonies of Florida and the Caribbean 1500-1800; Volume 1: Ceramics, Glassware, and Beads.* Smithsonian Institution Press, Washington, D.C., 1987.

Noel Hume, Ivor, *A Guide to Artifacts of Colonial America.* Alfred A. Knopf, New York, 1982.

Smith, Hale G., 1962, *Archaeological Excavation at El Morro, San Juan, Puerto Rico. Notes in Anthropology Vol.6.* Ms on file National Park Service, Southeast Archeological Center.

Wild, Ken S., *Research Design for Archeological Investigations of the Flanking Battery Wall at El Morro, San Juan, Puerto Rico.* Ms on file National Park Service, Southeast Archeological Center, 1989.

Ortega, Elpidio, *Arqueologia Colonial de Santo Domingo.* San Pedro de Macoris, Dominican Republic: Universidad Central del Este, 1982.

The William's Tower Lighthouse on Bonaire

Engineer Michael A. Newton

Introduction

The island of Bonaire, together with its neighbouring island Curaçao and the Windward islands St. Maarten, St. Eustatius and Saba, constitute the Netherlands Antilles. Together with Aruba, the Netherlands Antilles are part of the Kingdom of the Netherlands. The Leeward islands have been a colony of the Netherlands since the middle of the 17th century. Since 1954 they are autonomous.

Until 1863, when slavery was abolished in the Netherlands Antilles, it was officially prohibited, by the government of Curaçao, to settle on Bonaire as a private person. The whole island was considered a government plantation which was governed from Curaçao. Kralendijk, the capitol of Bonaire, until the turn of the last century was nothing more then a few houses and a small fort.

The subject of our study, William's tower, is the first lighthouse built by the Dutch in their colony. What makes this study interesting is the fact that a lot of data about the construction of the lighthouse and its preceding history is available. This is not common in our region. Very often dates, names, drawings and other facts about the construction of a historic structure are lost.

In the sailing era ships from Holland to Curaçao usually took the same routes. One important route ran along the Azores, the Windward islands, crossing the Caribbean in southwestern direction. Another route went more to the south via Madeira, South America (for example Surinam) and thereupon by way of Trinidad and Tobago to Curaçao. Especially this last route along the coast of Venezuela was known for its groups of treacherous rugged uninhabited islands, like the Testigos, the Roques, and the Aves Islands. Often ships ran ashore.

After passing these groups of islands, the ships encountered two more dangerous points before they could safely enter the harbour of Willemstad, the capitol of Curaçao, namely the southeast shore of Bonaire and the uninhabited island of Klein Curaçao (Small Curaçao). Ships coming from the Windward islands also had to take the same route. (*Figure 1*)

This route along Bonaire is dangerous because the northern part of the island is hilly and the southern part a bare, rocky plain, only a couple of metres above sea level. Sailors not acquainted with this situation and seeing the hilly northern side of the island thought they were far enough away from the coast. When the southern side of the island with its rocky shore came in view, accompanied by the unpredictable current, often it was too late. In various journals and descriptions throughout the centuries there are mentions of ships running ashore on the southern part of Bonaire.[1] To this day ships are wrecked here.

An identical danger occurs at Klein Curaçao, an island just a couple of metres above sea level, which barely can be seen at a distance by night. This 2 1/2 km long rocky strip has become for many captains the involuntary final point of their journey. Already in the 18th century the conclusion was made that the southeastern part of Bonaire had to be marked for a safer shipping traffic. Before a lighthouse actually was built in the 19th century there were several proposals.

The First Proposal : by Captain Cornelis Schrijver (1737)

On June 10th 1737 the Dutch Naval Captain Cornelis Schrijver arrived in Curaçao with various assignments (among which the revision of the defence of the island) from the Board of Admiralty of Amsterdam and the Dutch West India Company (WIC), the Dutch multinational company that actually was in charge in Curaçao till the end of the 18th century. [2] Two months later, in a memorandum of August 18th 1737 in which he explained his fortification plans for Curaçao, he also suggested building a lighthouse on Bonaire and Klein Curaçao for safety reasons. By introducing harbour taxes in Curaçao the costs of building the lighthouse would be covered.

Cornelis Schrijver himself elaborately described a year later how the W.I.C. reacted to his proposal which was accepted by all interested parties on the island of Curacao.[3] The administrators

in Amsterdam asked two Dutch captains of a merchant ship trading with Curaçao, captain Jan Bertrant and captain Jan Westenburg, to give their opinion of the plan. They advised against the lighthouses, suggesting that this would make it easier for an enemy to attack.

Cornelis Schrijver thought it was ridiculous to maintain this danger at the expense of the prosperity of the inhabitants. He also stated that the enemy might well be smart enough to sail around the dangerous points. According to him there was another reason why his plans were rejected. Upon his arrival in Holland he strongly criticized the way the W.I.C. operated in Holland and Curaçao. The administrators did their best to boycott his plans. They succeeded.

The Second Proposal: by Engineers C.G. Schrijver and G.C. Esdré (1743)

In connection with the fortification plans the engineers Carel Gustaaf Schrijver and Godfried Carel Esdré arrived in Curacao in 1741.[4] In spite of the rejected lighthouse plans of Cornelis Schrijver four years before, they were instructed to investigate the necessity of building a lighthouse on Bonaire. After visiting the island they too reported to the W.I.C. that a lighthouse was indeed necessary.[5] Not a word was said about enemies using this to their advantage. The engineers however did not consider a lighthouse on Klein Curaçao necessary. Their point of view was that sailors would be able to orient themselves sufficiently with a lighthouse on Bonaire to sail around Klein Curaçao.

Because of the constant wind and the trees that would be affected, they advised against the burning of an open fire. Instead they advised building a tower on which oil lamps could be burned at night.Building materials such as clay, coral stones and lime for mortar were present; only the lamps and the fuel had to be brought in. These plans also did not materialize.

The Third Proposal: by Jacob van Bosveld (1762)

Almost 20 years later Jacob van Bosveld, director of de W.I.C. in Curaçao and actually in charge of governing the island, reminded the administrators in Amsterdam, in a memorandum dated April 6th 1762 of the plans of the engineers Schrijver and Esdré.[6]

For the fireplace of the lighthouse he recommended not to use oil as fuel but to import coal from Holland. He also said if the W.I.C. agreed with his plan, he would make sure that every ship coming from abroad would pay a fee. Unfortunately he died in July of the same year, 1762, and again no lighthouse was built.

The Fourth Proposal: a Drawing by Hendrik Maurits van der Goes (1825-1829)

In 1825 a corps of military engineers under the direction of the then well-known Dutch Lieutenant General Baron Krayenhoff came to Curaçao to revise the fortification plans. A 24 year-old 2nd Lieutenant engineer by the name of Hendrik Maurits van der Goes was a member of this corps. His design of a lighthouse with a fireplace of eight lamps to be built on the southeast shore of Bonaire has been preserved in the State Archives in The Hague in Holland.[7] (*Figure 2*)

Although Van der Goes kept notes during his 8-month stay, he does not mention anything about the design.[8] It is not known who ordered the design to be made. The design was also signed by Naval Captain Lieutenant Tam but not dated. In 1829, the year he left Curaçao, he was promoted to 1st Lieutenant. Due to the fact that he signed his lighthouse design as 2nd Lieutenant, the design has to be made in 1829 or before.

Baron van Raders' Plans

In 1816 Reinier Frederik van Raders (*Figure 3*) arrived in Curaçao. From 1821 to 1826 he was the aide to the island Governor Cantz'laar. In this function, he fulfilled various governmental duties. Because of his marriage to the daughter of one of Curacao's rich shipbuilding families, he became a part of the old influential families.[9] Because his ancestors were allowed to carry noble titles, in 1835 he sent in a request to do the same.[10]

His years of experience and contacts helped him a lot when he became Governor of Curaçao and the other islands (Bonaire and Aruba) in 1836, a function he had already carried out on an

interim basis for six months.

Baron van Raders is considered to be one of the most active and most enterprising 19th century administrators of the colony of Curaçao. This became evident through his experiments with agriculture, stock breeding and salt production. Unlike his predecessors he also showed a lot of interest in Aruba and Bonaire. He visited Bonaire on numerous occasions during his term in office. Already during his interim period Van Raders set up a plan to build lighthouses on the southeast side of Bonaire and on Klein Curaçao, a plan that actually was carried out in stages exactly 100 years after Cornelis Schrijver sent his proposal to the W.I.C. As already mentioned we are well informed about the preparations and the building of the lighthouse on Bonaire through:

1) The Governor's journals .
2) The weekly newspaper, the *Curaçaosche Courant.*
3) The published notes by Naval Lieutenant Captain van Lennep, who was stationed on Curaçao with the *warbrig* "De Valk" from April 1837 to December 1839 and who regularly visited Bonaire with Baron van Raders.

The Financing of the Project.

In the Governor's journal dated June 28th 1836, for the first time Van Raders' plans are explained. Next to building the lighthouses on Bonaire and Klein Curacao, they also included the marking with beacons of the anchorage near the salt ponds on the south side of Bonaire.[11] (*Figure 4*)

Apart from the fact that Van Raders always said that the Colony has to support itself, the previous rejections by Holland (probably because of lack of finances), was his reason for a different financial approach.

Due to the fact that the trading and shipping industry of Curaçao benefited from a safer shipping traffic, he invited 14 prominent traders and ship owners to the Governmental residence at Fort Amsterdam to discuss the forming of a private building fund. To form such a fund a commission was put together and officially the Colonial Secretary I.J. Rammmelman Elsevier Jr. and the Colonial Collector C.J. van Uytrecht formed part of this commission.

On July 2nd 1836 an explanation of the plans and an appeal for financial support appeared in the *Curaçaosche Courant,* the local newspaper. In the following weekly editions of the *Curaçaosche Courant* the names of the donors and the amount they deposited appeared (later on an irregular basis).

Donations came from many directions, of course from the trade world, but also from civil servants, officers and clergymen. Donations also came from Bonaire, Venezuela and Surinam. The appeals for money in the newspaper were repeated a couple of times, especially at the Governor's request, who thought the trade world could be more generous.

Fourteen months later, after the edition of September 9th 1837, with the total amount of *f*2,935.75 the publications suddenly stopped. It is not known if the donations continued afterwards. Though it is certain that the amount was not enough, it is not known how much the total cost of building the lighthouse amounted to.

The Design

Two months after the first appeal for money, on September 12th 1836 the commission and Baron van Raders agreed that there was enough money to start the building process.[12] They decided to build the lighthouse on Bonaire first and afterwards the one on Klein Curaçao. The civil member of the commission Van Uytrecht was encharged with the preparations. He was appointed as "Director of Activities"

TheGovernor's journal also stated that on September 12th, a draft was already made and it was approved to serve as a model. The tower that was discussed had a height of 18 ells (yards) and the thickness at the base was 5 ells (yards).

In the State Archives in The Hague a second drawing of a lighthouse on Bonaire was found.[13] (*Figure 5*) Although it is not totally certain whether the draft discussed by the commission is the

same one found in the State Archives, it is certain that the lighthouse built at that time, and presently still serving as such, was built exactly according to the design on the drawing. As far as we can work out this is the oldest preserved drawing of a building in Bonaire.

If we look to Holland for a moment, we see that in 1823 the decision was made to considerably increase the amount of shorelights in that country. Until the second half of the 19th century, when the cast iron lighthouses came in use in Holland, nine brick towers were built in the first half of the 19th century.

The designs of these constructions and the design of the lighthouse in Bonaire show similarities. Round pillar shaped towers, in some cases using the style from the classical antiquity, which was introduced to the Dutch architecture via the French classical architecture of the 18th century.[14]

Shown on the "Model" drawing are a view and a vertical section both on a scale of 1:100.[15] The form of the tower is from the Doric pillar in which the classical measures are not strictly applied. The base, with a diameter of 5 metres, is not much more than a foundation. The height of the tower, beginning at the base to the top of the capital, is approximately 16 1/2 metres and consists of 6 floors joined by a straight flight of stairs. The shadow of the pillar is indicated by pink water-colour tones. The still uncertain part, the lighting installation that was ordered from Holland, are dotted lines.

Although the drawing is not dated or signed it is certain that this was made by Hendrik Willem Graham. Besides the fact that Graham is mentioned in various descriptions as the architect of the lighthouse, there is another indication. In the library of the University of Leiden there are three designs made by Graham in 1834 of a never executed defense work in Willemstad, that are signed.[16] Accurate comparison of these three drawings with the drawing of the lighthouse by the curator of the library, shows the same handwriting.

"Architect" Graham

Hendrik Willem Graham was born in the city of Sluis in the Netherlands in 1815. As a punishment for deserting the military engineering division, he was deported to Curaçao. This controversial figure was one of the first structural engineers to call himself an "architect".

On June 30th 1825 Graham sent a letter to the already mentioned Baron Krayenhoff who just arrived on the island to revise the fortification plans.[17] He requested to be included in the fortification activities. In the letter he listed his working experience on the island of Curaçao.

After first giving lessons in mathematics and "fortification" to the garrison officers, he practised civil engineering. In 1824 he was employed by Governor Cantz'laar and encharged with the management and the supervision of Governmental activities. His ample knowledge of the local building materials and his work experience with the local craftsmen he now offered to the military engineers that just arrived on the island.

Krayenhoff however reacts furiously to the letter of this deserter and forbids his subordinated to have any thing to do with Graham. The Baron also described Graham in a letter to the Commissioner General of War in Holland as "very dangerous", but not without talent. He advised deporting this shady character from the island.[18] This reaction was not beneficial to Graham's career.

Graham was later charged with committing fraud against the pastor of the Santa Anna Church after construction work in 1827. The charges were later dropped, because Graham could not pay the compensation. A payment in installments then was agreed upon.[19]

Between 1833 and 1836, Baron Krayenhoff was already back in Holland, Graham tried repeatedly to become the permanent supervisor of the Engineering Corps in Curaçao. He wrote a letter dated August 4th 1836 to the acting Governor Van Raders with the request to appoint him as supervisor and in case this was not possible to give him another job.[20] Soon after, we meet Graham as the architect of the lighthouse of Bonaire.

Construction

Building commission member Van Uytrecht, who was on vacation, was replaced as director

of building activities on March 11th 1837 by the governor's aide, Second Lieutenant E.J. Slengarde. He left the same day with governor Van Raders, workmen and building materials to Bonaire.

According to an article in the *Curacaosche Courant* of April 1st 1837, it seemed that the anchorage near the salt pond (also the mooring place during the building of the lighthouse), as part of Van Raders' plan was already marked by two six to seven metres high orange-coloured obelisks. These pyramid-like obelisks still exist.

On the 22nd of March 1837 in the presence of a very distinguished group of people the first stonelaying took place by the Governor. Prior to the ceremony it was checked from sea if the building sight, that was indicated two days before, was indeed chosen correctly. Although architect Graham was present throughout the whole building process, it was Slengarde who was in charge.

Two months later on May 22nd Van Raders visited the building site again, accompanied by captain Van Lennep Coster. According to the Captain, the building activities were progressing rapidly. [21] It was already possible to climb to the top. Also he mentions that the whole construction was made from coral stones that was found near the building site. Because the walls are plastered, common in the Leeward Islands, it is difficult to trace the exact kind of stones that were used. As a point of orientation for during the day four vertical red stripes, on the four points of the compass, were painted on the white plastered lighthouse.[22] Since the work - with the exception of the lighting equipment itself- was done in June 1837, Van Raders ordered his aide, the architect and the workmen to return to Curaçao. [23]

The lighting installation (costing *f* 1,499.20) arrived in Curaçao a year later, on June 13th 1838. Two months later, when Van Raders arrived on Bonaire, the lighting equipment was tested. The type of the installation is not known. During his stay it was decided that a house would be built near the lighthouse for the first lighthouse-keeper, mr. Gabriel Muskus. Besides a yearly salary of *f*360.00, he had a government slave at his disposal.

To cover the costs, a fire and beacon fee was introduced for all ships visiting the harbours in Curaçao and Bonaire. Furthermore it was decided to name the new lighthouse after the then reigning King of the Netherlands, William I and to inaugurate it on his birthday. [24]
With the lighting of the lights on August 24, 1838 the first lighthouse in the colony of "Curaçao and the Subordinate islands" became a fact. (*Figure 6*)

The Klein Curaçao Lighthouse

It was not Baron van Raders who built the other lighthouse on the uninhabited island of Klein Curaçao, but his successor Rammelman Elsevier, whom we already met as Colonial Secretary and member of the funding commission. After raising money again in Curaçao and Bonaire the lighthouse was built in 1849/1850. It was named after the Dutch Prins Hendrik. As in Bonaire, in Klein Curaçao a keeper's house was built. Due to the fact that the lighthouse-keeper was the only inhabitant, besides some fishermen who stayed on the island irregularly, his house was much larger and he had to be quite self-supporting. (*Figure 7*) The lighthouse of Klein Curaçao was totally destroyed by a hurricane in 1877, but rebuilt shortly thereafter and is still functioning. [25]

Conclusion

The lighting installations of the William's Tower and the Prins Hendrik Tower were modernized a couple of times in the last 150 years and are now totally automated. This means that there are no lighthouse-keepers anymore. Both keeper's houses are presently in bad shape.

Although the dangerous points were marked, building the lighthouses did not mean complete safety. Even in these days, with the most modern navigation equipment, ships wreck on the southeast coast of Bonaire and Klein Curaçao due to the unpredictable current and the rough Caribbean sea.

Notes

1. Among others: Teenstra vol.II, p.188; Hartog, Bonaire, p.148
2. Ozinga, p.27; Bruijn, p.25.
3. Manuscript: "Extract uijt het Journaal gehouden bij den Capiteijn Cornelis Schrijver", p.72, Amsterdam, November 1738. In Appendix no. 33 the proposal of Schrijvers regarding the building of lighthouses.
   Koninklijke Bibliotheek (Royal Library) in The Hague, Department of Manuscripts, Inv.nr. 73 D 20.
4. Kooyman, p.169; Ozinga, p.29, see also p.33 note 1.
5. State Archives - The Hague, WIC (1.05.01), Inv.nr.316, d.d. April 30 1743.
6. State Archives - The Hague, WIC (1.05.01), Inv.nr.317*, d.d. April 6 1762; see also Hamelberg vol. I, p.178.
7. State Archives - The Hague, Department of Maps, Inv.nr. MIKO 337.
8. De Gaay Fortman, Aantekeningen (Van der Goes).
9. De Gaay Fortman, Curaçao 1816-1828, p.6 & p.418 note 2.
10. Hartog, Curaçao, p.1111 note 22.
11. State Archives - The Hague, Ned.W.I.Bezittingen (1.05.08), Inv.nr.454, Journ.v.d.Gezagh.1836, d.d. June 28 1836.
12. State Archives - The Hague, Ned.W.I.Bezittingen (1.05.08), Inv.nr.454, Journ.v.d.Gezagh.1836, d.d. September 12 1836.
13. State Archives - The Hague, Department of Maps, Inv.nr. MIKO 582.
14. Crommelin, p.27
15. In 1817 the metre was introduced in the Netherlands as standard measure. It was allowed to use the old name "El" (an old measure) as name for the new metre. On the drawing of the lighthouse this new Dutch El (= 1 metre) was used as unit.
    See also: Ozinga, p.41 note 1 and Crommelin, p.31.
16. Library of the University of Leiden, Collection Bodel Nyenhuis (new) Inv.nrs. VI-12-10, VI-12-11, VI-12-12; see also Ozinga, p.51.
17. State Archives - The Hague, Archief van Genie 1813-1826 (2.13.13), Inv.nr.251, d.d. June 30, 1825.
18. State Archives - The Hague, Archief van Genie 1813-1826 (2.13.13), Inv.nr.261, fol.165 & fol.166.
19. Dahlhaus, p.89.
20. State Archives - The Hague, Ned.W.I.Bezittingen (1.05.08), Inv.nr.454, Journ. v.d.Gezagh.1836, d.d. Aug. 16 1836; Inv.nr.455, Journ.v.d.Gezagh. Bijlagen 1836, no.66.
21. Van Lennep Coster, p.84.
22. Curaçaosche Courant, June 3 1837; Van Lennep Coster, p.85.
23. State Archives - The Hague, Ned.W.I.Bezittingen (1.05.08), Inv.nr.456, Journ.v.d.Gezagh.1837, d.d. June 6 1837.
24. State Archives - The Hague, Ned.W.I.Bezittingen (1.05.08), Inv.nr.457, Journ.v.d.Gezagh.1838, d.d. June 13, June 22, Aug.13, Aug.23, 1838.
25. Hartog, Curaçao, p.719 & p.750.

Bibliography

Bosch, G.B.,Reizen in West-Indië, en door een gedeelte van Zuid- en Noord-Amerika, 3 volumes, Utrecht 1829, 1836, 1843.

Brusse, A.T., Curaçao en zijne bewoners, Curaçao 1882.

Bruijn, J.R.,De admiraliteit van Amsterdam in rustige jaren, 1713-1751. Regenten en Financiën, schepen en zeevarenden, Amsterdam 1970

Crommelin, Liesbeth, H.van Suchtelen,Nederlandse vuurtorens, Nieuwkoop 1978

Dalhaus, G.J.M.,Monseigneur Martinus Joannes Niewindt, eerste Apostolisch Vicaris van Curaçao, Een levensschets, 27 aug. 1824 - 12 jan. 1860, Baasrode 1924.

Euwens, P.A.,Klein Curaçao, De West-Indische Gids, jg.7 (1926), p.401-410.

Gaay Fortman B. de,Curaçao en onderhoorige eilanden 1816-1828, De West-Indische Gids, jg.9 (1927-1928) and jg.10 (1928), 9 parts

Gaay Fortman B. de,Aantekeningen omtrent een verblijf op Curaçao in 1825 en 1826; medegedeeld door ..... , Willemstad 1948. (Diary-notes from lieutenant H.M. van der Goes)

Hamelberg, J.H.J.,De Nederlanders op de West-Indische eilanden, 2 vol. and 2 vol. Documents, Amsterdam 1901, 1909

Hartog, J.,Bonaire, van indianen tot toeristen, Aruba 1957

Hartog, J.,Curaçao, van kolonie tot autonomie, 2 vol. Aruba 1961

Kooyman, J.,De wallen van Willemstad, Curaçao, omstreeks 1750, De West-Indische Gids, jg.38 (1958), p.168-173

Krayenhoff, C.R.T.,Levensbijzonderheden van den lieutenant-generaal baron....., Nijmegen 1844

Lennep Coster, G. van,Aanteekeningen, gehouden gedurende mijn verblijf in de West-Indiën, in de jaren 1837-1840, Amsterdam 1842

Ozinga, M.D.,De monumenten van Curaçao in woord en beeld, Curaçao 1959

Teenstra, M.D., De Nederlandsche West-Indische eilanden, 2 vol., Amsterdam 1836, 1837

Try Ellis, W. Ch. de la,Enkele aantekeningen betreffende Bonaire, Antilliana, verzameld werk van, Zutphen, 1981

Veen R. van der,Vuurtorens, over vierboeten, lichtwachters en markante bouwwerken, Den Haag, 1981

Figures

Figure 1 The Leeward Islands of the Netherlands Antilles.
Former Sailing-routes to Curaçao.

Figure 2 Never-executed plan for a lighthouse on Bonaire.
Drawn by H.M. van der Goes between 1825 and 1829.

Figure 3 Reinier Frederik Baron van Raders (1794-1868),
by J.H. Neuman, 1853-1854.
Photo: Iconographisch Bureau, The Hague.

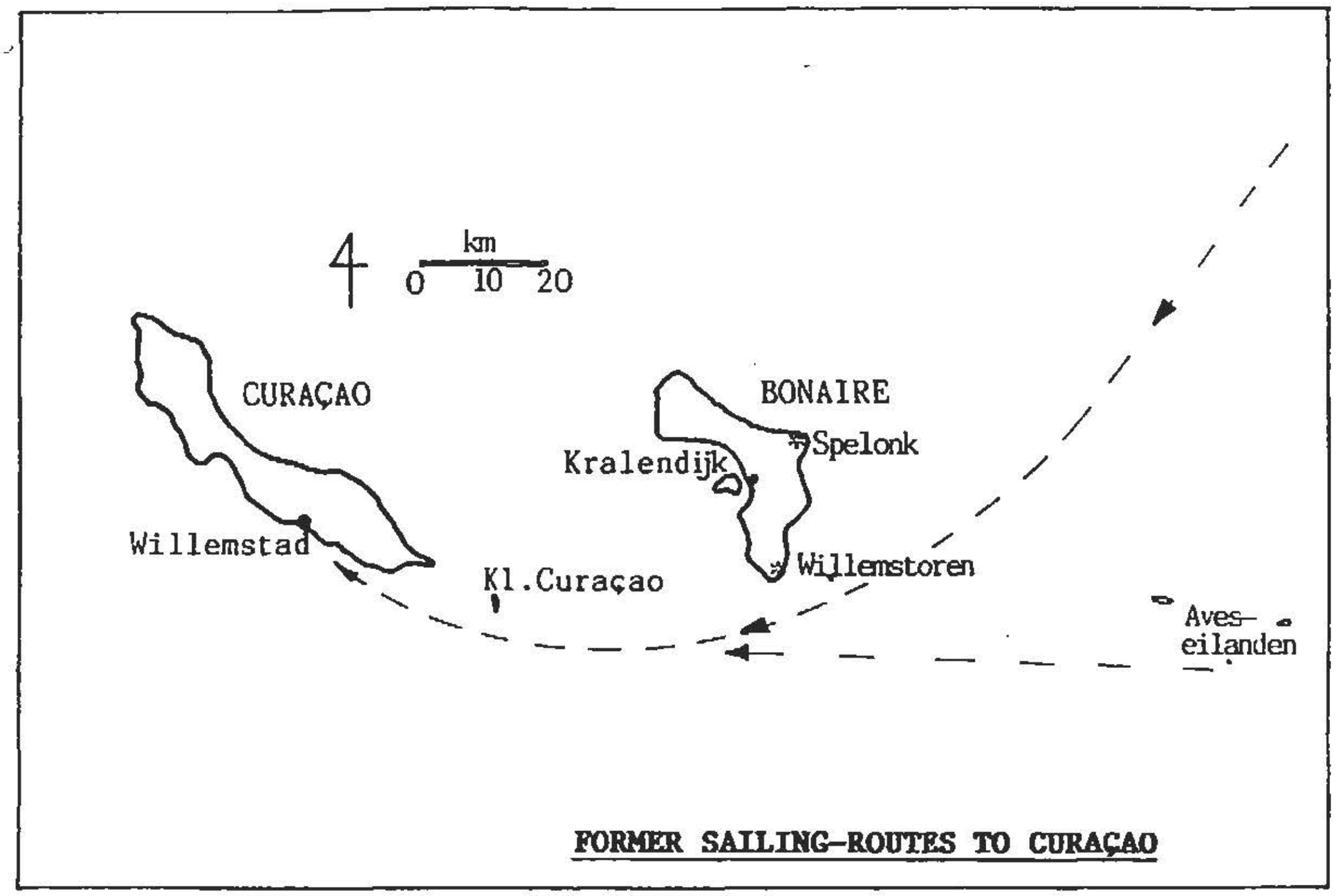
Figure 4 The most southern part of the island of Bonaire with the salt ponds and the William's Tower Lighthouse.
Detail of a topographical map, around 1910.

Figure 5 Drawing of the William's Tower Lighthouse on Bonaire,
Most probably drawn by H.W. Graham, 1836 (or 1837).

Figure 6 The William's Tower Lighthouse (1837) with on the right the house of the lighthouse-keeper.

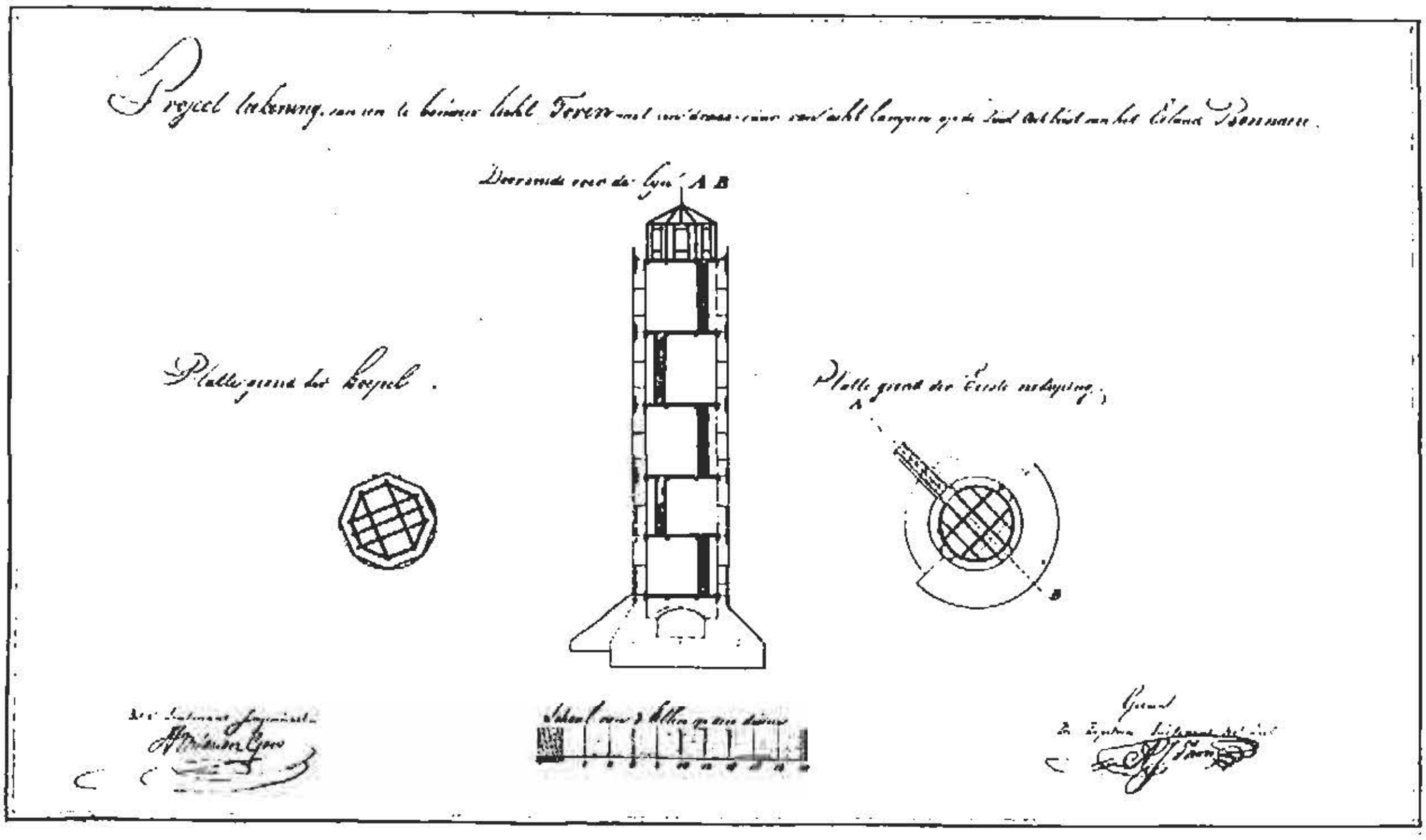
Figure 7 The lighthouse on Klein Curaçao.

1



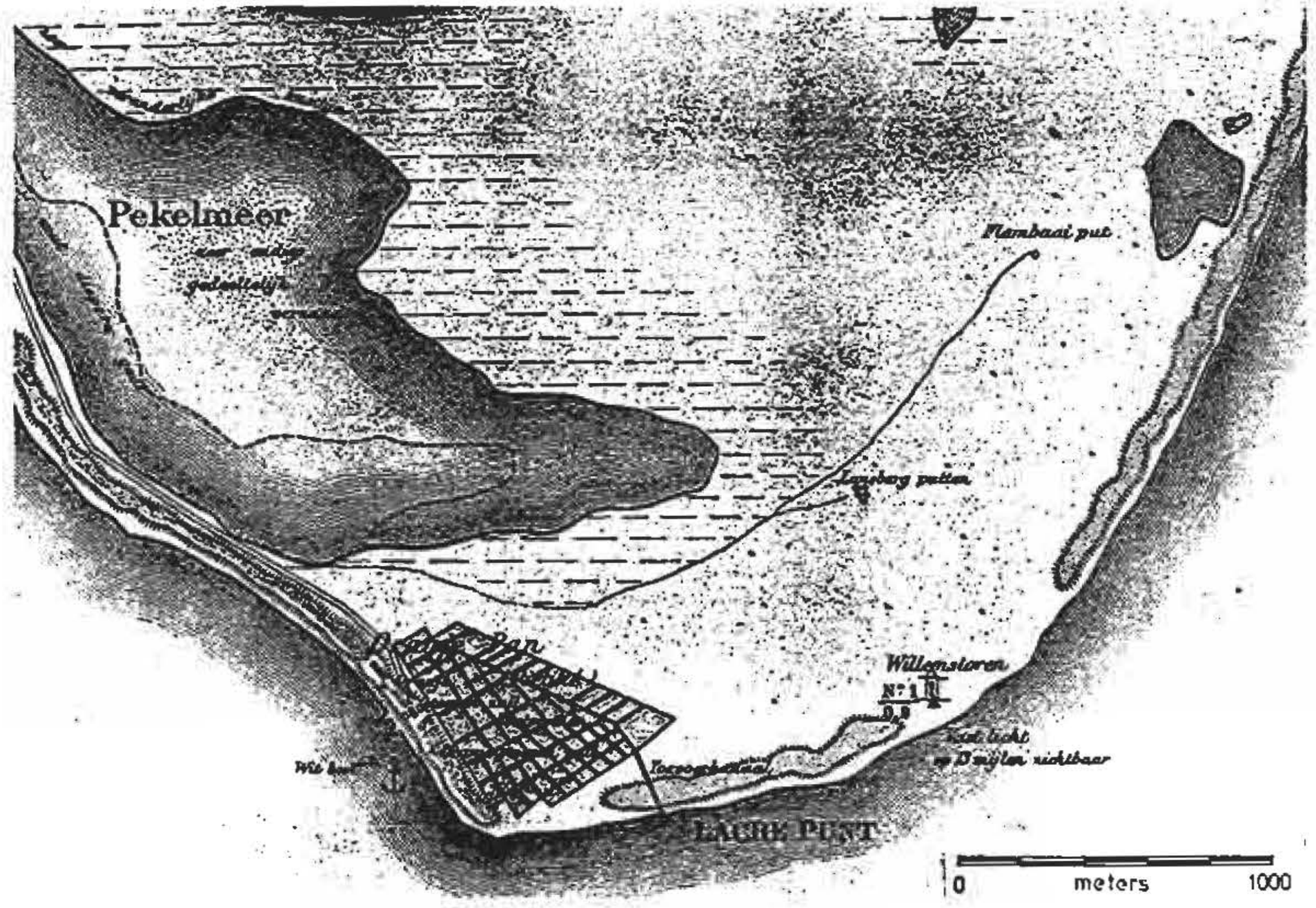
FORMER SAILING-ROUTES TO CURAÇAO

2



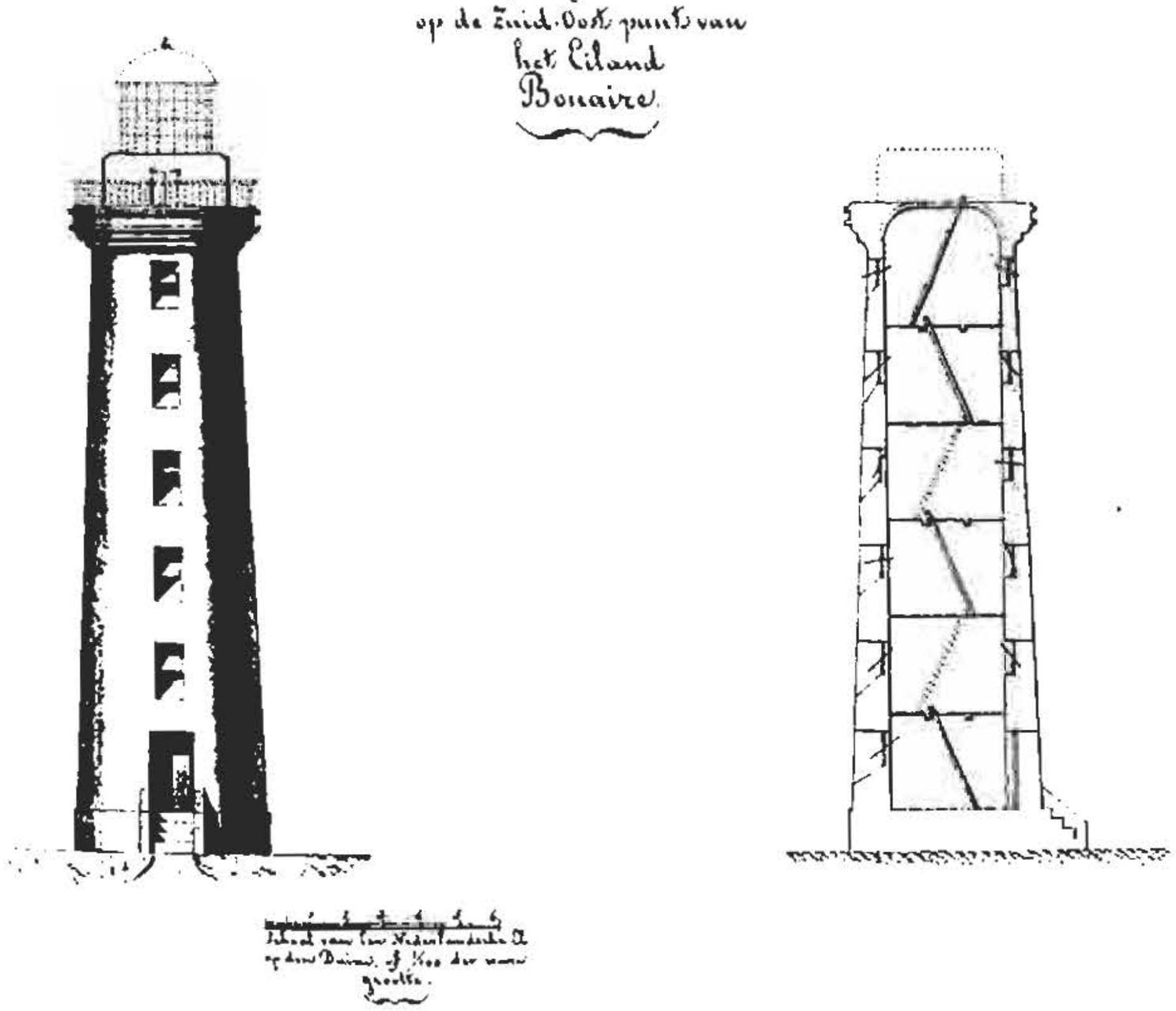
3

4



5

Model
van den opterigten Vuur-toren
op de Zuid-Oost punt van
het Eiland
Bonaire.



6

7

San Juan Historic Structure Report Stucco Project

Richard C. Crisson, Historical Architect

Introduction

Personal Background: The National Park Service

I have been employed as a historical architect by the National Park Service for nearly 15 years. My office, the Building Conservation Branch of the Cultural Resources Center, is situated in Lowell, Massachusetts. We are part of the North Atlantic Region of the National Park Service (NPS). The Center was created in 1977, and is somewhat unique in its approach to the study and management of historic resources.

The 80 permanent and temporary employees include a wide variety of specialists, which allows the Center to provide an interdisciplinary approach. We have historical architects, architectural conservators, historians, archaeologists, object conservators, and a support staff designed to provide guidance on the preservation and interpretation of the historical buildings and cultural resources administered by the 42 sites or parks within our region. We occasionally provide assistance to the other nine regions of the NPS. That is part of the reason why I an here today.

Cultural Resource Center Involvement with the Southeast Regional Office and San Juan

Happily for me, but in a strange twist of events, the Cultural Resources Center (known then as the North Atlantic Historic Preservation Center) was contacted in 1986 by the southeast Regional Office to become involved in the research and treatment of the San Juan fortifications. My first task in the office was to begin working on the San Juan fortification project, and the end product was to be a Historic Structure Report (HSR)

Description of an HSR

According to the format developed during the last 50 years by the National Park Service, an HSR completely documents a primary historic structure and guides the treatment of the building. As a planning document, an HSR is considered to be "timeless." A thorough HSR combines documentary research with materials investigation, and clearly describes the building's evolution and its architectural components. An HSR places the building within an historical framework, identifies its character-defining features, and provides recommendations for preservation, conservation, or restoration treatment, as the case may be. The site and the landscape should also be included for a total understanding of the resource.

The San Juan HSR

San Cristóbal, El Morro, and the City Walls

The HSR for El Morro, San Cristóbal, and the City Walls became one of the largest research projects ever undertaken by the National Park Service. Only el Cañuelo (el Fortín de San Juan de la Cruz) was not included. Our team included persons not only form the North Atlantic Regional Office, but also persons from the Southeast Regional Office, the Washington Office, and private consultants, including Columbia University's Center for Preservation Research. We began our research and field work in 1986, and we documented through photography almost every wall and surface. We became familiar with every tunnel, every bastion, and every sentry box. We researched hundreds of documents, some going back to the 1500's, often having to translate the archaic and complex military terms. We extracted hundreds of representative mortar and paint samples from this vast system of fortifications. Our three-volume work became known as The Historic Structure Report for the Fortifications of San Juan, Puerto Rico. (Illustrations 1-2-3)

I have been asked to discuss one of the masonry features that is most prevalent on the fortifications walls the type of mortar known as "stucco". Historical architects such as myself depend on the laboratory analysis performed by others, and most of the research discussed here is

the result of hard work done by other team members, including NPS architectural conservators Joan Berkowitz, Judy Jacob, and Barbara Yocum.

Materials of Construction: Mortar (Including Stucco)

Many materials of construction were discussed analyzed as part of the HSR, but for the purpose of this paper only mortar and its close relatives, stucco and plaster, will be discussed. Initially, it was presumed that different materials were used over time for different building campaigns. Thus, a study o materials would have led to the production of a key by which fortification elements could be dated. However, our study determined that during the approximately 350 years of fortification construction within the Spanish period, there was no significant change of construction techniques or materials. Only late 20th century changes were noticeable.

For the San Juan project, we took more than 600 samples o mortar, stucco, and plaster to assist in dating the various elements that comprise the fortifications. Mortar analysis is considered a "destructive" investigative technique, since it extracts a small portion of mortar, stucco, or plaster to determine the amount of sand, clay, lime and Portland cement (if any) used in the original mix. Under microscopic examination, we found a variety of sands, limes and aggregates including crushed brick and sea shells.

Mortar analysis done at the Center followed a system devised by Blaine Cliver, which attempted to provide the proportions of sand to lime. The analysis also determined whether Portland cement was used in the mix. Microscopic analysis provided the sand type, the color, and the grain size. By this type of testing, mortar, stucco, and plaster formulas were approximated, and replicating recipes were recommended. This was the process used for the fortifications of the San Juan project.

Various forms of cementitious materials are found throughout the fortifications. The term "mortar" is used in the HSR to describe these materials in general. Mortar is broken down specifically as bedding mortar, *hormigón*, and of course , plaster and stucco. A bedding mortar is used to bind the mampostería (or rubble), generally consisting of the sandstone or brick substrate within the walls. Hormigón, as used historically, is a pure mix with pulverized brick that was used for roofs, terrepleins, and similar areas that needed to be more impermeable to water penetration. The mix that was applied with a trowel to coat the wall substrate was referred to as "plaster" if it was an interior wall, or "stucco" if it was an exterior wall. Sometimes the exterior stucco is referred to as "pargetting." Because not all areas of the fortifications can be easily designated as interior or exterior, the term "stucco" was generally used in the HSR for all of the wall surfaces.

Stucco usually consists of lime, sand, and water, in varying proportions. Until the last decade of the 19th century, lime was the principal binding material of mortars. Portland cement then replaced lime as the binding agent, although sometimes it was used in combination with the lime.

All sands are composed primarily of quartz grains. The sands for the fortifications were obtained from beach sources (beach sands, or *arena de playa*), and/or from land sources (pit sands, or arena de tierra). Microscopic analysis differentiated the beach sands as predominantly rounded an the pit sands as predominantly angular—but both were sometimes found in one sample. (Illustrations 4-5_

Traces of charcoal, brick, and other fired ceramic materials were found in some samples. Many of the samples were found to have relatively high proportions of fines. The "fines" are those small and insoluble particles that often provide the coloring agent in the mortar. For San Juan, this indicated the use of either a dirty or clayey pit sand, or the use of poor-quality lime.

Clay was found in some samples, and may have been added to the mix as an extended. Lime was considered an expensive commodity (requiring time, fuel, and manpower for its manufacture), and the addition of clay would have increased the quantity of mortar at little expense. One side effect is that this may have produced what is known as a "weak" mortar. But as long as construction was slow, the mortar would have time to set and become structurally supportive. The lime used in mortars was most likely obtained from local limestone outcroppings, including the Bayamón and Aguada limestones. A few historic references (Menéndez in 1583, O'Reilly in

1765, and O'Daly in 1772) indicated that local lime was available and, in fact, used for the fortifications.

Fresh water is also required for the preparation of mortar mixes. It is needed to clean the sand in order to remove salts from beach sands and dirt from pit sands. Just like the drought or sequía of 1994, fresh water in San Juan was historically considered a precious commodity. This scarcity may have prevented the proper cleaning of the sands used for mortars. Many of the mortars examined under the microscope revealed a proportionally high content of fines, but were neither strong nor durable, indicating that the sands may not have been adequately washed.

Lime mortars used in the San Juan fortifications were grouped into three categories based on their overall color and constituents. The overall color is determined primarily by the fines, and to a lesser degree by the aggregate. The categories of lime mortar were white (or beige-white), red-beige (or reddish), and one made with brick dust or crushed brick.

The so-called white mortar was the one in general use for the exterior stucco, although there was sufficient evidence to conclude that the red-beige mortar was an earlier exterior stucco and one that may have continued in use as the base, or "scratch" coat, for later applications of the white mortar. The white mortars were usually characterized by a beach-sand component. White pit sand was also used, but very little clay was added to these mixes. The white mortars vary in color from bright white to cream, with fines ranging in color from white to light gray to cream.

Portland cement appears to have been first used very late in the 19th century for general construction, and more significantly in the 20th century, for patching and restuccoing. The source of this cement is unknown, but at least five different cement mortars were observed as part of the mortar analysis done for this study. The cement mortars are characteristically gray in color and extremely hard. This subject will be discussed further under the "Conditions of Deterioration."

The knowledge of the materials used in San Juan was necessary for understanding the current conditions of the fortifications and for assessing the durability of materials: it was certainly required for making preservation recommendations. The composition, the manner of fabrication, the tooling or finishing, and the method used to impart the color are all significant factors that have to be known or determined in order to replicate, patch, or replace any section of wall covered with stucco.

Conditions of Deterioration: Mortar (Including Stucco)

For San Juan, mortar analysis and documentary research were well integrated. For example, early 20th century photographs were compared to 1960 Historic American Building Survey photographs. Conditions noted during our study, conducted between 1986-1990, confirmed the high rate of stucco deterioration.

As part of the study, we saw the physical evidence of one of the inappropriate mixtures historically used in repairing the fortifications. Stucco with a high ratio of portland cement had been used in the 20th century when areas of the fortifications were restuccoed and repointed as part of the continuous task of maintaining the walls, following the same pattern that the Spaniards had been doing in the previous centuries. Many areas showed evidence of the well-intentioned, but harmful effect of portland-cement patching—particularly at the embrasure edges and the lighthouse of El Morro. They provide the classic examples of dramatic failure due to incompatible materials. (Illustration 6)

Mortars and Stucco at San Juan
How Stucco was Used

No historic formulas for mortar, stucco, or plaster mixtures were found during the research in any of the historic references to the San Juan fortifications between 1540 and 1898. However, materials used for mortar, stucco, and plaster were referenced in some of the historic documents , including stucco in 1771, clay and lime stucco en 1783, stucco in 1080, and stucco in 1832.

Stucco was applied to masonry structures as a means of protecting them and their porous substrate from the erosive effects of weathering. The stucco received the brunt of weathering and was intended to deteriorate over time: periodic restuccoing kept this sacrificial surface layer intact.

It is not known exactly how many restuccoing campaigns occurred following the late 18th century construction, or how much surface area was restuccoed later in the 19th century. Archival sources, and examination of existing structures confirmed that at different times the walls of the fortifications were covered with either red-beige or white stucco, and that the walls may have been left without stucco for periods of time as well. However, the stucco that was applied in the early 19th century, during the last major resurfacing that occurred during the Spanish period, is beige-white in color. Many sections of it, which vary from a quarter-inch to several inches in thickness, remain today.

The 1839 account by Pedro Tomás de Córdoba in his Memorias described a 9-year effort during which the fortification system walls were "cleaned and refaced,", suggesting a total restuccoing. Field examination confirmed that most of the walls may have been treated at that time. Following this last major restuccoing, a plan for maintenance was instituted to keep the fortifications in good repair, an approach that was to continue until the end of the Spanish tenure.

Following the early 19th century restuccoing, a yellow-ocher finish was applied to the exterior surfaces. Much of this thin, pigmented lime was coating remains today, but is eroded, streaked, and stained. The coating varies from a pale yellow color to a deep golden yellow color. It covers all of the scarped walls, the curtain walls, the merlons, and the banquettes. The coating has been the subject of speculation since it is not known exactly when it was applied. In some cases it appears to have been applied very soon after the smooth stucco coat, and in other instances after a little loss of the stucco coat had occurred. Surprisingly, little documentary evidence was found for it or its application, other than the 1861 color renderings by Manuel Castro. (Illustrations 7-8)

Why Stucco was Used

Laboratory analysis indicated that in most instances the lime-rich stucco and plaster had been originally applied as an exterior protective wall coating. In a very few instances, the stucco or mortar were used as a base for decorative wall painting, such as the marbling in the Chapel of Santa Barbara and the rustication in the postern of Tunnel 2 under *el Caballero*, both at San Cristóbal. The stucco was painted to give the appearance of sillería (ashlar or stone masonry blocks), and to finish the edges of a gateway or entryway. (Illustrations 9-10)

Why Stucco Deteriorated

The types of deteriorated conditions observed in the fortifications are the result of the materials and building systems used, the climate, weathering and exposure, and to lesser degree, human impact. Although plaster walls were damaged on a continual basis, they were also continually being upgraded or replaced with new coats of plaster.

Exterior walls covered with the stucco were only replaced on an as-needed basis, or when extensive deterioration was evident. The defensive walls could also have been damaged as a result of the effects of bombardments, or by natural causes such as earthquakes, storms, salt-driven rains and winds, and excessive humidity and vegetation. (Illustrations 11-12)

Additional 20th century deterioration has been caused by wear and tear from the many visitors over the years, by automobiles parked too close to the walls (or sometimes on top of the city walls themselves), and even by the impact of golf balls, as was seen on the scarped walls of the moat of el Morro, the 9th tee of the U.S. Army golf course near the Ochoa Bastion.

Using incompatible materials is another highly significant factor, and the damage caused by the use of stucco with high concentrations of portland cement is one example. The cause of this damage is due to the cement's density, its excessive strength, and its impermeability. The extremely hard and impervious portland-cement stucco traps moisture within the walls. Over time, not only did sections of the portland-cement stucco erode, but the sandstone and brick walls underneath (the substrate) began wearing away at an increasingly alarming rate.

Biological growth is another cause of damage. Tropical vegetation can be invasive, and in many instances, vines were allowed to grow on wall crevices. Not only did the roots erode and damage the wall surfaces, but the additional moisture trapped by the vegetation weakened the stucco. Fungi, mildew, and other types of microscopic plant life also cause long-term damage that

begins appearing as streaks, stains, and wall discoloration. Cleaning the walls is strongly recommended, but root systems can penetrate and extend within the wall, even when no growth is visible on the outside surface. (Illustrations 13-14-15)

Hand-held moisture meters were used during the HSR research to determine the extent of moisture that had migrated into the wall; they confirmed that water is seeping down from the top of the 10 to 20 foot thick walls. Of concern is that over time, this moisture can cause the substrate to crumble or collapse within the walls. (Illustration 16)

Conclusions

Recommendations in the HSR

The multivolume San Juan HSR was completed in late 1991. It had been expanded and modified in may ways, and tailored to attempt to meet the needs of the park and those in charge of preserving the fortifications. One of the key chapters of the report was the "Recommendations" section.

All of the recommendations were placed within the context of a strategy for preserving the military fortifications at San Juan, and were based on the exhaustive research discussed above. In broad terms, the recommendations were as follows:

1. All historic fabric from the Spanish period, the lighthouse at El Morro, and the 20th century harbor defenses should be preserved. Emphasis should be placed on preserving materials and features from the Spanish II Period (ca. 1760-1835) as well as any surviving historic fabric from the Spanish I Period (ca. 1539-1760).
2. Restoration should consist primarily of removing non-historic features and re-establishing protective wall coatings.
3. Rehabilitation should focus primarily on safety and security issues. Accommodating visitor facilities and park operations should be considered in non-historic, or less significant, structures.

Differentiation between historic and non historic fabric was essential in developing a preservation strategy. The identification process was grounded in a clear understanding of the historic associations ascribed to the military fortifications.

Based on this, the general treatment recommendations for the San Juan fortifications was to "preserve significant historic features, existing prior to 1961." The advantage of this approach was to preserve the greatest amount of extant historic fabric. It would avoid the issued of documentation needed to satisfy the standards for restoration that would be required to reconstruct with a minimum of conjecture. Preservation would be consistent with the General Management Plan and National Park Service policies. This approach would allow interpreting Spanish-period features without destroying significant 20th-century features.

Applicable Stucco Recommendations

Of the 20 prioritized and specific recommendations in the HSR, four were directly related to stucco and its preservation or restoration. These were the following:

#2. Stucco Exterior of Masonry Walls
#3. Stucco and Repair Embrasures
#4. Repair Paved Surfaces
#8. Preserve and Repair Sentry Boxes

The white stucco, being the last "historic period" coating, was the recommended mortar in the HSR. The general recommended mortar formula given in the HSR was one part portland cement, two parts lime, and six-to-nine parts of sand. The small percentage of portland cement was considered acceptable and necessary to allow the stucco mix to set up properly when used in combination with the hydrated lime, it being much purer than the historic lime.

Test patches for mortar were strongly recommended, in order to determine which mortar mix would perform the best and appear to give the most appropriate appearance. Testing was also needed to approximate the final tooling, achieved by "floating" (smoothing out) the stucco, and to

achieve the exact color of the applied pigmented yellow-ocher lime wash coating.

Status of Recommendations Leading to the "Stucco Project"

The HSR recommended a program of on-site testing to develop adaptations of the given base mix. Careful monitoring, using exact proportions, noting the conditions under which the stucco is applied, and inspection and documenting the weathering capabilities of each test patch over time, was determined to be the most responsible solution, and one that would ensure the most accurate preservation efforts.

Keeping the walls in a state of abandonment was categorized as the "No-Action" approach. It was rejected for being an irresponsible approach, insistent with NPS preservation policies and against Federal mandates. Without remedial action for the stucco, the eventual destruction of the walls and fortifications remains remains a possibility. (Illustration 17)

I am happy to say that the Maintenance Division of the San Juan National Historic Site has been implementing the recommended on-site experimentation required to implement the recommendation to restucco the walls. The long research process resulting in the HSR can now lead to the best and most sympathetic treatment for the preservation of this impressive fortification system. the final session of this symposium will explain this in greater detail.

Illustrations

1. EL MORRO - GENERAL VIEW
   Richard C. Crisson, 1972

2. TROOP'S QUARTERS AT SAN CRISTOBAL - GENERAL VIEW
   Richard C. Crisson, 1986

3. CITY WALLS FACING WEST - GENERAL VIEW
   Richard C. Crisson, 1990

4. MICROSCOPIC SAMPLE OF SANDS - SAN CRISTOBAL
   Barbara A. Yocum, 1986

5. MICROSCOPIC SAMPLE OF SANDS - SAN CRISTOBAL
   Barbara A. Yocum, 1986

6. BRICK EROSION - EL MORRO
   E. Blaine Cliver, 1986

7. YELLOW STUCCO FINISH - EL ABANICO
   Richard C. Crisson, 1986

8. YELLOW STUCCO FINISH - EL ABANICO
   Richard C. Crisson, 1986

9. 1861 ELEVATION OF SANTA BARBARA CHAPEL - SAN CRISTOBAL
   Richard C. Crisson, 1986

10. RUSTICATED POSTERN WALL OF TUNNEL 2 - SAN CRISTOBAL
    Barbara A. Yocum, 1986

11. EROSION OF STUCCO AT EL ESPIGON - SAN CRISTOBAL
    E. Blaine Cliver, 1986

12. CRACKING & DISPLACEMENT AT EL CAÑUELO
    E. Blaine Cliver, 1986

13. STAINING AT THE NORTH - SAN CRISTOBAL
    Richard C. Crisson, 1986

14. PATCH AT THE NORTH CASEMATE - SAN CRISTOBAL
    Richard C. Crisson, 19

15. VEGETATION AT OCHOA BASTION - EL MORRO
    E. Blaine Cliver, 1986

16. MOISTURE METER READING - EL MORRO
    Richard C. Crisson, 1988

17. BRICK EROSION -LEPER COLONY (MONA ISLAN)
    Richard C. Crisson, 1986

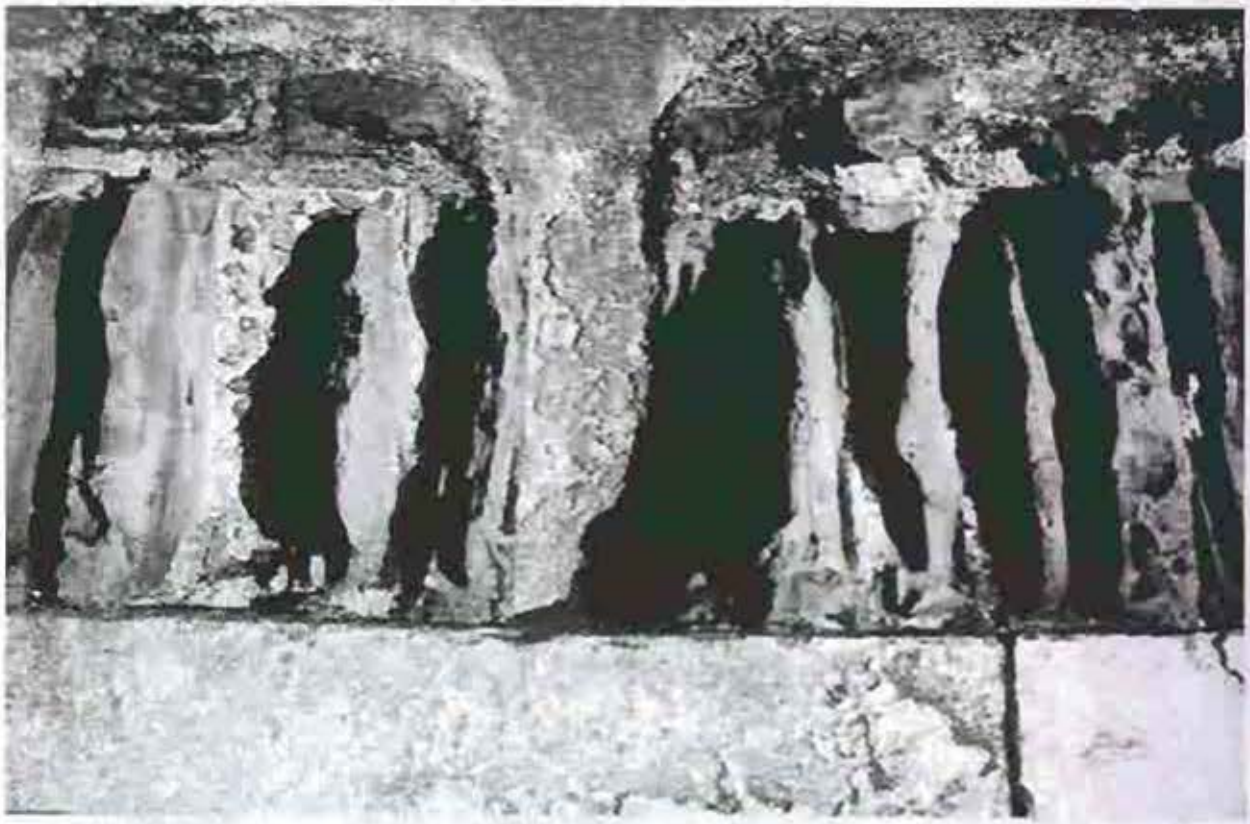
1

2

3

4

5



6

7

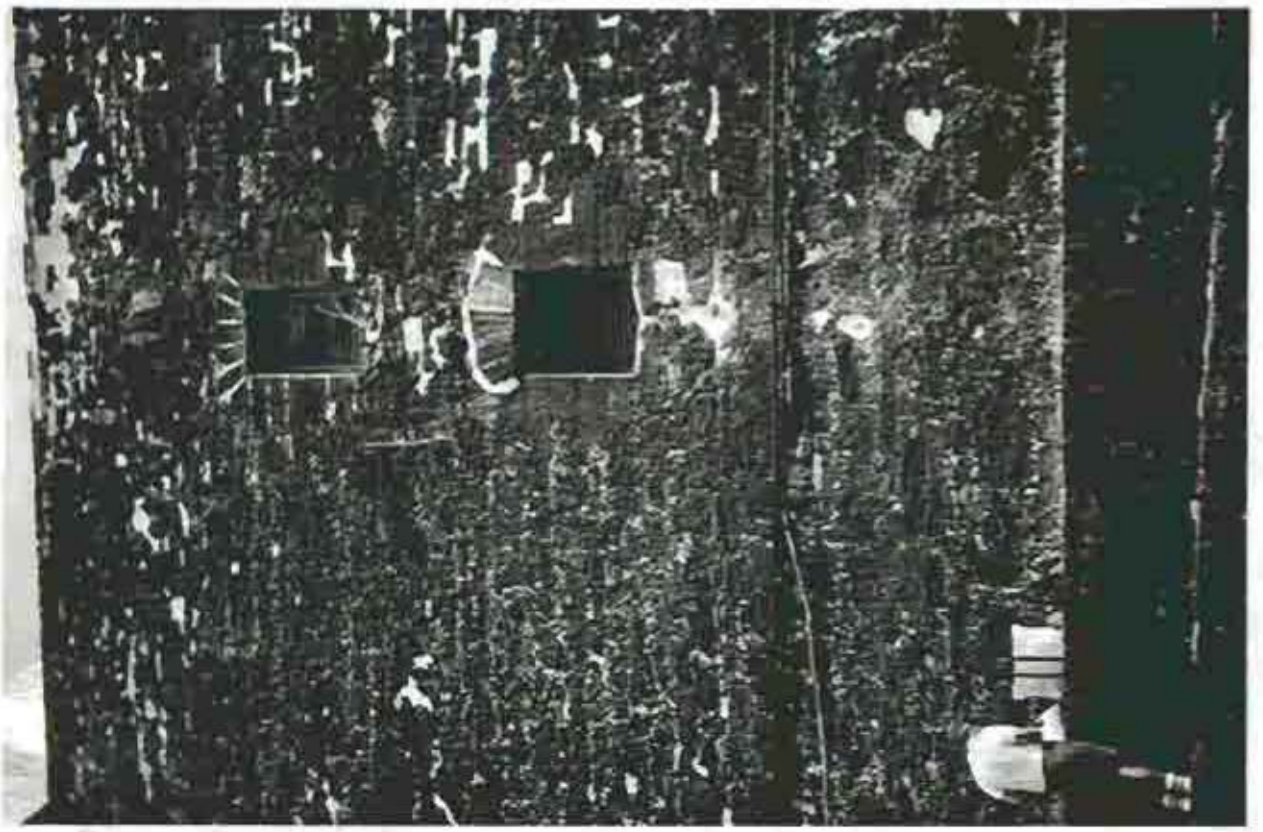
8

9

10

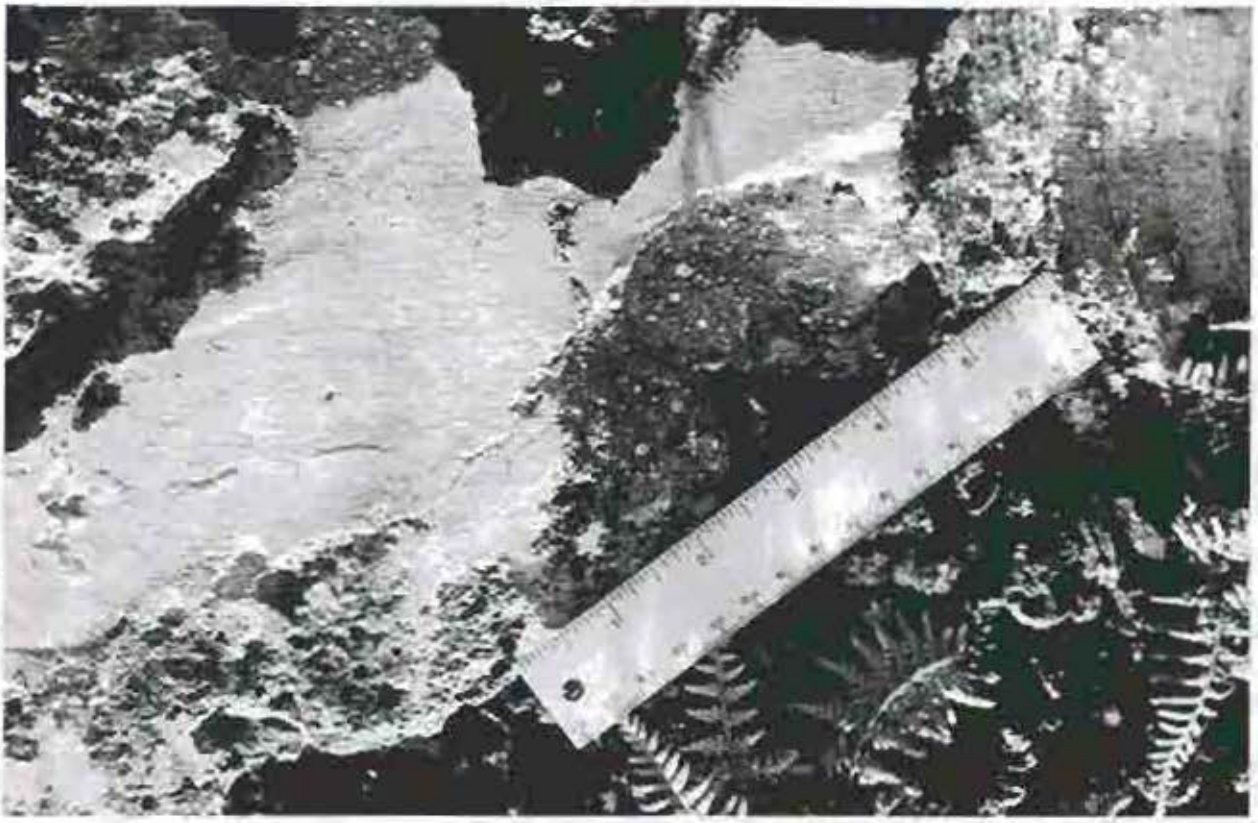
11

12



13

14



15

16

17

Historic Structure Report Stucco Workshop

Mark Hardgrove, Assistant Superintendent, San Juan National Historic Site, National Park Service, Puerto Rico

Hello and welcome to San Juan National Historic Site's symposium presentation on the restoration of the stucco on the fortifications and city walls. The purpose of this session is to discuss the technical aspects of how the stucco will be applied. We will be showing you our test samples in the San Cristobal Dry Moat area and some sections which were completed to show you the finished product.

As you know, the Historic Structures Report (HSR) prepared for the fortifications of San Juan NHS was one of the most extensive HSR's ever undertaken by the National Park Service. One of the HSR's primary recommendations was to remove non-historic features and re-establish the protective wall coatings.

The HSR recommended a program of on-site testing to develop adaptations of the given base mix. Careful monitoring, using exact proportions, noting the conditions under which the stucco is applied, and inspecting and documenting the weathering capabilities of each test patch over time, was determined to be the most responsible solution, and one that would ensure the most accurate preservation efforts.

The following technical specifications, work methods, and procedures followed by an on-site inspection where you will be able to see the stucco applied and even try it yourself.

The staff of San Juan NHS has been implementing the recommendations of the HSR. The long term research can now lead to the best and most sympathetic treatment for the preservation of this impressive World Heritage Site.

The agenda for the workshop is as follows:

Introduction for Participants and Overview of Workshop: Mark Hardgrove
Stucco Criteria (Discussion of Samples): Richard Ramsden
"Hands-on" (Visit to Site): Richard Ramsden, Ross Hunt, Edwin Colón, Carlos Oquendo

Stucco Criteria - Discussion of Samples
Criteria for Evaluating Stucco Test Samples

Color:	Match existing historic stucco remnants on site and as identified by HSR.Surface finish: Provide a fine, dense, hard surface to encourage water impermeability as identified in the HSR.
Performance of mix:	Demonstrates good adhesive and cohesive qualities with minimal cracking and fracturing. Encourages the release of internal moisture. Component ratios are within the parameters of historic mixtures.
Labor Intensity:	Requires nominal working and tooling to achieve large surface applications within the time constraints of stucco mix.
Long-term maintenance:	Durable material that will withstand the effects of wind, rain, and sun, and retain natural color tones and finish texture.

Test Panel #1 - March, 1992

Formula:	7 Parts beach sand 1 Part white portland 2 Parts lime	
Color:	FAILED	Did not match existing historic stucco.
Surface finish:	PASSED	Provided a good surface to encourage water impermeability.
Performance of mix:	PASSED	Demonstrates good cohesive qualities and fell within the parameters of historic mixes.
Labor Intensity:	PASSED	Works well within the time constraints of stucco mix.
Long-term maintenance:	PASSED	Durable, retains color and texture.

Test Panel #2 - March, 1992

Formula:	9 Parts beach sand 1 Part white portland 2 Parts lime	
Color:	FAILED	Did not match existing historic stucco.
Surface finish:	PASSED	Provided a good hard surface to encourage water impermeability.
Performance of mix:	PASSED	Demonstrates good cohesive qualities and fell within the parameters of historic mixes.
Labor Intensity:	PASSED	Works well within the time constraints of stucco mix.
Long-term maintenance:	PASSED	Material seems to be durable.

Test Panel #3 - March, 1992

Formula:	7 Parts beach sand 1 1/2 Part white portland cement 1/2 Part clay	
Color:	FAILED	Did not match existing historic stucco.
Surface finish:	PASSED	Provided a good hard surface to encourage water impermeability.
Performance of mix:	PASSED	Demonstrates good cohesive qualities and fell within the parameters of historic mixes.
Labor Intensity:	FAILED	Does not work well within the time constraints of stucco mix.
Long-term maintenance:	PASSED	Material seems to be durable.

Test Panel #4 - March, 1992

Formula:	9 Parts beach sand 1 Part white portland cement 2 Parts lime 1/4 Part clay	
Color:	FAILED	Did not match existing historic stucco.
Surface finish:	PASSED	Provided a good hard surface to encourage water impermeability.
Performance of mix:	PASSED	Demonstrates good cohesive qualities and fell within the parameters of historic mixes.
Labor Intensity:	FAILED	Does not work well within the time constraints of stucco mix.
Long-term maintenance:	PASSED	Material seems to be durable.

Test Panel #5 - March, 1992

Formula:	9 Parts crushed limestone 1 Part white portland cement 2 Parts lime	
Color:	FAILED	Did not match existing historic stucco.
Surface finish:	FAILED	Produces a lot of cracking.
Performance of mix:	FAILED	Poor cohesive quality.
Labor Intensity:	FAILED	Required a lot of working and tooling.
Long-term maintenance:	FAILED	Not durable due to cracking and flaking.

Test Panel #6 - March, 1992

Formula:	9 Parts lime carbonate 1 Part white portland cement	
Color:	FAILED	Did not match existing historic stucco.
Surface finish:	FAILED	Produces a lot of cracking.
Performance of mix:	FAILED	Poor cohesive quality.
Labor Intensity:	FAILED	Required a lot of working and tooling.
Long-term maintenance:	FAILED	Not durable due to cracking and flaking.

Test Panel #7 - October, 1992

Formula:	7 Parts yellow sand 1 Part white portland cement 2 Parts lime	
Color:	FAILED	Tone slightly different than historic stucco.
Surface finish:	FAILED	Some cracking, high permeability.
Performance of mix:	FAILED	Demonstrates poor cohesive quality.
Labor Intensity:	FAILED	Required a lot of working and tooling.
Long-term maintenance:	FAILED	Did not stand up well to effects of wind, rain and sun.

Test Panel #8 - October, 1993

Formula:	9 Parts yellow sand 1 Part white portland cement 2 Parts lime	
Color:	FAILED	Tone slightly different than historic stucco.
Surface finish:	FAILED	Some cracking, high permeability.
Performance of mix:	FAILED	Demonstrates poor cohesive quality.
Labor Intensity:	FAILED	Required a lot of working and tooling.
Long-term maintenance:	FAILED	Did not stand up well to effects of wind, rain and sun.

Test Panel #9 - October, 1993

Formula:	11 Parts yellow sand 1 Part white portland cement 2 Parts lime	
Color:	FAILED	Tone slightly different than historic stucco.
Surface finish:	FAILED	Some cracking, high permeability.
Performance of mix:	FAILED	Demonstrates poor cohesive quality.
Labor Intensity:	FAILED	Required a lot of working and tooling.
Long-term maintenance:	FAILED	Did not stand up well to effects of wind, rain and sun.

Test Panel #10 - October, 1993

Formula:	9 Parts yellow sand 3 Parts lime	
Color:	FAILED	Tone slightly different than historic stucco.
Surface finish:	FAILED	Some cracking, high permeability.
Performance of mix:	FAILED	Demonstrates poor cohesive quality.
Labor Intensity:	FAILED	Required a lot of working and tooling.
Long-term maintenance:	FAILED	Did not stand up well to effects of wind, rain and sun.

Preferred Formula

Test Panel #11 - October, 1993

Formula:

3 Parts yellow sand
4 Parts sand
1 Part white portland
2 Parts lime

Color:	PASSED	Mixes well with historic stucco.
Surface finish:	PASSED	Provides a dense, hard good hard surface to encourage water impermeability as recommended in the HSR.
Performance of mix:	PASSED	Demonstrates good adhesive qualities with minimal cracking due to the intense heat, which was corrected by shielding the area from sunlight.
Labor Intensity:	PASSED	Requires nominal and ornamental work for large surfaces, when used by experienced personnel.
Long-term maintenance:	PASSED	Demonstrates good consolidation and stands up well under the rain, wind and sun. Retains the color tones and finish texture.

Hands-on Discussion

1. Planning requirements for large scale, complicated project

a. **Equipment**: Mortar mixers, wheelbarrows, handtools and sufficient scaffolding to construct three double stages as high as required at any particular wall section. The first scaffold stage will be used for surface prep. A second and third stage will be used by the plasterers, as they "leap frog" down the wall.

b. **Manpower:** Two crews necessary.

Surface preparation crew. Minimum 3 individuals required. Experienced in safe scaffold erection, water blasting techniques, vegetation removal, and masonry.

Stucco crew. At least 3 skilled tradesmen required to ensure completion of large surface areas applications with minimal cold joints.

2 laborers required to mix and deliver stucco to scaffold staging area.

2 to 3 laborers required to deliver stucco to tradesman.

Surface preparation crew duties include:

A. Remove all metal anchors, screws, nails, bolts, and other appurtenances not currently in use or required for historic interpretation.

B. Hand remove all live vegetation followed by the application of NPS approved herbicide to assure elimination of the material.

C. Pressure wash all wall surfaces to remove accumulations of salt, carbon, dirt, other airborne pollutants, and loose, friable masonry. Pressures up to 800 lbs. psi have proven effective in cleaning wall surfaces with negligible damage to sound masonry.

D. Make necessary repairs to wall surfaces, corners, and edges at this time. Replace or repair missing stone and brick or mortar matching existing materials as needed.

E. Remove all portland cement patches to within two inches of the finished surface. Replace these patches with a lime and cement stucco mix applied in 1/2 inch coats until the application is brought out to the original finished wall surface.

F. Ensure all wall surfaces are treated and repaired to the extent that during the stucco operation, plaster thickness is kept to the required minimums.

Stucco Application

Scratch Coat. Apply in 1/2 inch coats as needed to remove all low spots or valleys. Some surfaces may require more than one scratch coat application in order to bring the finished surface up to a smooth, even plain prior to the application of the finish coat. All work at the end of the day shall receive a "key" cut into the edges of the plaster using a straight edge and trowel.

Finish Coat. Apply a 1/4 inch finish coat smoothly and evenly over a well-cured scratch or brown coat. Allow two to three days for proper curing before applying the finish.

Edges, Corners, and Returns. When making a transition from a horizontal to a vertical surface (e.g. the tops of merlons) apply stucco over a corner or edge and down the vertical surface a minimum of six inches with the scratch coat and four with a finish coat.

Protection of Work. Protect all work from sun, wind, and rain, until all work has cured. Attach sun screens or tarps to scaffolding to shield fresh plaster from direct sun exposure.

Guidelines for the Survey and Restoration of Spanish Bastioned Fortifications in the Americas

Dr. Juan Manuel Zapatero
Military Historian

Overview

Among the most preeminent cultural aspirations of the nations that are fortunate enough to posses historic fortifications is the aspiration to ensure their preservation These structures are cultural assets, product of and witness to the countless traditions and events of the past, and constitute a fundamental element of the personality that characterizes a nation, as defined by the UNESCO General Conference.

The historic, artistic, and spiritual importance of these fortifications mandate their conservation, as well as their interpretation in a manner in which will enable people to identify with their transcendence. The fortifications are a legacy, a foundation of civilization, and, therefore, in our view, it is the duty of the nations that posses them to ensure their protection and conservation as the cultural heritage of all humankind.

Preventive, responsible measures must be taken to save these cultural assets, which are often at risk due to natural deterioration brought on by the passage of time and the effects of erosion. A further element is the intervention of humans—builders, and yet, contradictorily, destroyers, subject to private or public developers, who are in turn driven by the forces of economic, urban or industrial development. And finally, as a consequence of all of these factors, one finds misuse of the resources and grounds of the fortifications: there is a cumulative effect of wanton destruction of these structures.

Countries that wish to conserve their fortification must rely on highly-trained specialists, who due to their experience in construction, and training in Military Arts, History and Architectural Styles, may make decisions regarding the technical, historic, and artistic supervision of restoration, under guidelines that are a product of the several agreements on the conservation of cultural heritage (Memoranda of the International Conference at Athens, 1931; the Venice Charter, 1964; Conference on Restoration, Rome, 1972; the Quito Guidelines, 19676; the UNESCO General Conference in 1968; the "Amsterdam Declaration" of the International European Conference in 1976; the ICOMOS Proposals, in the Sixth General Assembly, 1981), as the legal basis for the restoration projects. This is the body of expert opinion, in short which has received the approval of the decision-making authorities of various countries, and which facilitates and guides the recovery of these works.

We would also like to emphasize the impact of restoration work on fortification, from the viewpoint of its historic value and its technical and artistic importance, as well as in regard to its role as a "tourist attraction," a new economic resource, which is an important consideration for a country's development.

Generally speaking, we feel that based on the many projects in which we have participated—studies and restorations of Spanish bastioned fortifications in the Americas—we are able to offer a method as a result of this extensive work. In our view, based on our personal experience, any effort to preserve a fortification or a system of fortifications, will include three clearly differentiated phases, which nevertheless share a common objective: the technical, historical and aesthetic recovery of the structure.

Phase 1:

1.1 Gathering of documentary, cartographic, and bibliographic information for each fortification.

1.2 Preparation of the historical narrative or historical and technical text including Military Arts, with abundant facsimilar material from national or foreign archives.

1.3 Careful *in situ* survey guided by the Treatises on Fortification and the recommendations on Restoration, directed at the preparation of a Preliminary Study, along with Analytical Master Plans and the Project Objectives, as well as photographic documentation.

1.4 Presentation of the Preliminary Study to the nation's highest authorities for approval and publication, to be used as a guide by the work teams and for the public at large.

Phase 2:

2.1 Restoration work, under the direction of an expert, working as a team with architects or engineers, who are versed in military construction techniques, its terminology, and its measurement systems in use during the period of history corresponding to each fortification.

2.2 Museographic rehabilitation or historical and military furnishing, installation of original materials or accurate reproduction in the fort: arms (artillery, guns, swords, etc.) and clothing (uniforms, ordinance banners), and other appropriate fixtures for military building and the Castellan or Commander-in-Chief's quarters.

Phase 3

3.1 Economic Planning: Tourism. Plans for "attractions" that take advantage of the points of interest that have been created, as a source of income. In our experience, several countries have been able to reap significant benefits from these projects, having a significant impact on their development.

3.2 Preparation of adequately trained guide teams, who are provided with literature for distribution to visitors.

Methodology

The methodology used in surveying the bastioned forts is based on the principles of sixteenth and seventeenth century treatises on Military Arts. My own work, *La fortificación abaluartada en América*, published in 1978 by the Institute of Puerto Rican Culture, offers information on the European schools, their methods and systems, and also on the Hispano-American School of Fortification, which we first set forth at the 26th International Conference of Americanists at Seville. In this work, we described the information we believe is indispensable for the identification, historic evaluation, and technical analysis of the fortifications that were built in the Americas (valid as well in Europe, Africa and the Philippines). Nevertheless, it is necessary to complete the information for each particular fortification based on an analysis of documentary and cartographic records, as these reveal the conditioning circumstances faced by military engineer in this fascinating period of Military History. Thus, once we have the Treatises on Fortification, the drawings and construction records, and the indispensable original cartography, a formal work plan, a methodology, and documentation are prepared according to the requirements for the surveying of the fortifications and the preparation of the preliminary studies.

Procedure

The standards and technical principles as set forth by the authorities in the treatises (included in La fortificación abaluartada en América, are adhered to strictly in the preparation of the guidelines we call the preliminary study, or compilation of the historical and technical records of a

fortification. These are gathered first in the field notes and reflect the analytical impressions obtained in the survey. Considerable importance must be given to the conclusions regarding issues related to the condition of the stonework in each fortification, the brick and mortar, to win that contest "battle of erosion" against physical agents (the sun's heat, the wind, atmospheric electricity, etc.); and chemical agents (alkaline or acid, industrial gases); the roots of the surrounding brush; even human beings whose destructive powers are boundless.

Besides these basic issues, there is the matter of how to about surveying the fortification (so different from the attitude in a cursory visit, if you like, a tourist's impression, totally lacking in detail and methodological and technical rigor).

Our experience and careful studies have led us to value this painstaking procedure, developed in surveying the bastioned fortifications: we have been able to fully appreciate the poliorcetic value, from the earliest moment to the last of the structure's use as a military facility, until the most recent phase of abandonment and disuse, in which the structure has fallen into a ruinous state due to the inevitable passage of time and the effects of erosion).

Such a procedure, in short, is based on cartographic research, in chronological order, ending with the most recent elevation drawn of the fortification, which is a summary of the poliorcetic evolution of its elements. Using a facsimile of this drawing at the same scale (royal feet or *pitipies*, in the sixteenth century, the Castilian rod, *vara castellana* or *toesa* in the sixteenth and seventh centuries, only occasionally converted to the decimal system for stereometric calculations, since applying this conversion in the survey or restoration itself could interfere with our understanding of the originals used by the engineer who erected the structure).

Once we had a copy of the plan, which we call the Master Plan, because of its use in decision-making, we draw the master lines on it to identify the fortification as regular or irregular, the standard proportions as established by the authorities in their Treatises. This gives us the Analytical Master Plan which is essential in determining the capacity or consideration of the fortification; first we find the geometric center when the fortification is regular, or the approximate center it is irregular, since the authorities, particularly Maestre de Campo Sebastián Fernández de Medrano (Director of the Royal Military Academy at Brussels during the seventeenth century and Master Instructor of the Spanish engineers who traveled to America during the first half of the eighteenth century), recommended that all fortifications " should be as regular as possible and for that reason they must be subject to the Standards."

The lines or capital radii, are drawn out from the geometric center, as are all other lines, according to the scales established in the corresponding period of the Art of Fortification: Renaissance, sixteenth century; Baroque, seventeenth century; and Neo-Classic, eighteenth century. Then the lines for the emplacements, firing lines and grade lines arfe drawn. These lines and their scales will give us the technical analysis of the fortification: whether it was built according to the "Axioms", or whether there are deficiencies. These were matters that were tremendously important in defensive and offensive tactics, and fundamental characteristics of primary importance in the constructino of bastioned fortifications.

All bastioned fortifications are fortified structures "that are defended by attacking the besieging enemy." Therefore, when surveying the fortification, we will look for both the strengths and weaknesses of its construction, and to do this we must apply the principles of the Treatises, whose guidelines should be recorded in our field notes. Each fortification should be classified by categories: "Offensive", in terms of attack, "Defensive", deployment of the few against the many; "Natural," an impregnable work, "Artificial" imitation of the natural "Royal" or fortified enclave "Campaign," an outerwork; by condition: "Comfortable", when possessing good sanitary conditions, water, and being easy to supply, "Advantageous", when dominating the field; "Useful," if key to strategic defense; by position: "Horizontal," if all parts are at the same level, "Vertical" if the orthographic planes extend from the horizon; by slope: "Gentle," if the land is at

15°; "Average", if 30°; "Steep", if 45°, and impracticable if steeper; according to range: "Far-reaching", according to the number of cannon that give it its dominance, "Remote", a range of 1,400 Castilian *varas* (maximum range of 24 inch cannon), "Close", if the distance is 700 *varas* (point blank range).

As for the classification of the "Parts and Pieces", these are grouped as "essential": curtains, bastions, moats and covered ways; "Convenient": flanking walls, orillions, tenailles, and the ravelin; "multilevel": cavaliers or retrenchments, lower esplanades, lower outer ramparts and hornworks; "accessories": sentry boxes, drawbridges and stationary bridges, doors, gates, storage rooms, the infirmary and chapel.

By applying these principles one can determine whether the fortification was of some consideration, and thus offer an opinion. We recommend consultation with the work we have mentioned, *La fortificación abaluartada en América*, which was written expressly to offer guidance in the discipline of historic military engineering. In this book there are several layouts from the sixteenth, seventeenth, and eighteenth centuries with their magnitudes and scales, which can be used in interpreting the structures of the fortification for the Preliminary study which should be prepared and used as a point of departure in the difficult task of artistic restoration.

On a separate sheet, we prepare the "Master Plan Restoration Objectives", and following the points of the compass we proceed to survey the fortification, which is begun, as recommended in the Treatises, from the northern part or subsector (it must be borne in mind that the fort is the "whole,", while the bastions, curtains, ravelins and parade grounds are the "parts", and that the inor works or "accessories" are called "pieces").

During the survey, the position and condition of the "Master Cordon,", which divides the fortification between the exterior and interior, should be held steady, and work should proceed in rotation from left to right, that is to say clockwise, numbering the "objectives" in the same order as they are numbered in the field notes," which includc thc observations on the condition of the "Parts and Pieces". At the end of the mission it will be the field notes that will provide knowledge of the general condition of the fortification, while at the same time describing the restoration work that may be carried out. In other words, a rationale is created for the restoration as a basis for the decision-making and judgment of the authorities responsible for the preservation of the nation's historic and artistic heritage. In addition the field notes will contain a partial analysis of costs, the necessary cost projection, with a view to preparing a general budget at a later stage.

In short, in our method, the survey or inventory of a sixteenth to eighteenth century bastioned fortification, done for restoration purposes, follows this order:

Historic inventory cards or sheets

Historic and artistic information analysis. Facsimiles of original working drawings. Numbering of the objectives of the "Parts and Pieces," using the cardinal points. Museographic rehabilitation: artillery, gun carriages, "juegos de armas;" firearms; sords; dressed figures; flags; fukrniture and gear, etc., corresponding to the period and conditions obtaining at the fortification.

Photography

Organization of phoographs of structures to be restores, numbered according to the field notes, indicating the condition found during the survey, to be compared with photographs taken after restoration, and which will illustrate the Project Report.

Master Plans

The original construction drawings for the fortification should be obtained from the military archives. The Analytical Master aPlan shows the master lines and the scale used in the layour of the construction lines (toesas or varas castellanas). The Master Plan Restoration Objectives will be marked with the points to be restored in numerical order, and the "Parts and Pieces" should be

described according to their respective technical classification.

Final Consideration

We have described e guidelines to facilitate restoration work on bastioned fortifications, as we have practiced them in our restoration work on castles, forts, fortified structures, and palaces in America.

Along with this paper we are providing " Analytic Master Plans and the Restoration Objectives, for example, for the San Fernando de Omoa Fort in Honduras, which reveal the efforts of the engineer Francisco Alvares, the builder in 1756, emphasizing the technical principle "Axiom XV: An irregular fortification will be as similar as possible to the regular."

The Master Plans along with the Preliminary Studies, are the methodology and guides for the studies done at San Juan, Puerto Rico; the restoration work at Cartagena de Indias, Santa Marta (Colombia); Real Felipe del Callao, Lima (Perú); San Felipe de Puerto Cabello, and its "Theatro Bélico", or theater of War (Venezuela); the fortifications at Portobelo; the royal enclave at Panama city; and the San Lorenzo el Real de Chagre Castle (Panamá).

And finally, we may add that bastioned fortifications follow the rule: "The defense of a Fortress is based on symmetry, which provides technical and tactical perfection; robustness, which means its construction is sturdy and resistant; and convenience, which allows easy communication between the garison and the combat posts. The "Theatro Bellico" will thus be a multiplicity of actions under the decisive leadership of the *Castellano* who is responsible for its defense, under the basic principle o war: the valor and the value of a soldier to their ultimate consequences."

Military ethics, which now go hand in hand with considerations of historic, artistic, and patrimonial aasets, warrant our obligation to preserve these forts, which are cultural, tourism, and economic resources for Hispano-American nations.

On presenting this paper at the "Third International Symposium on Historic Preservation in Puerto Rico and the Caribbean," organized by the National Park Service, at San Juan, Puerto Rico, I feel it is fitting to evoke the illustrious Spanish military engineers who embroidered the Caribbean coast with such handsome fortifications, and especially with those in Puerto Rico, erecting such a formidable line of defense. Bautista Antonelli, in the sixteenth century; Juan de Haro, Novoa and Moscoso, in the seventeenth century; Tomás O'Daily, Juan F. Mestre, Felipe Ramírez, and Ignacio Mascaró in the eighteenth century: their lives, spirit and science are present in every stone of the castles, forts and walls of the "Key to the Indies."

O.B.— principal radius (from the center to the capital angle or flank B.)
O.P. — minor radius (from the center to the bastion B. semigorge)
O.F. — right line (intersects the curtain)
B.S. — line of fier, "líne of defense" (earlier "line of first fire")
B.N. — elevated linte of defense (earlier "radient line")
A.V.R.G.K.B. — frente de plaza del fuerte, que se forma con los mediobaluartes de A. y B. y la cortina R.G. La "línea del frente de plaza" corre por toda la fortificación sin solución de continuidad y por ello recibe el nombre de "magistral" señalizada por un adorno (que recuerda al arrabá medieval), se le denomina "línea del Cordón" y delimita las zonas, pues hasta la "línea " desde el rodapié por la escarpa se considera el exterior del fuerte, y desde la "línea" incluido el parapeto con sus merlones y troneras hacia el adarve, corresponde el interior.

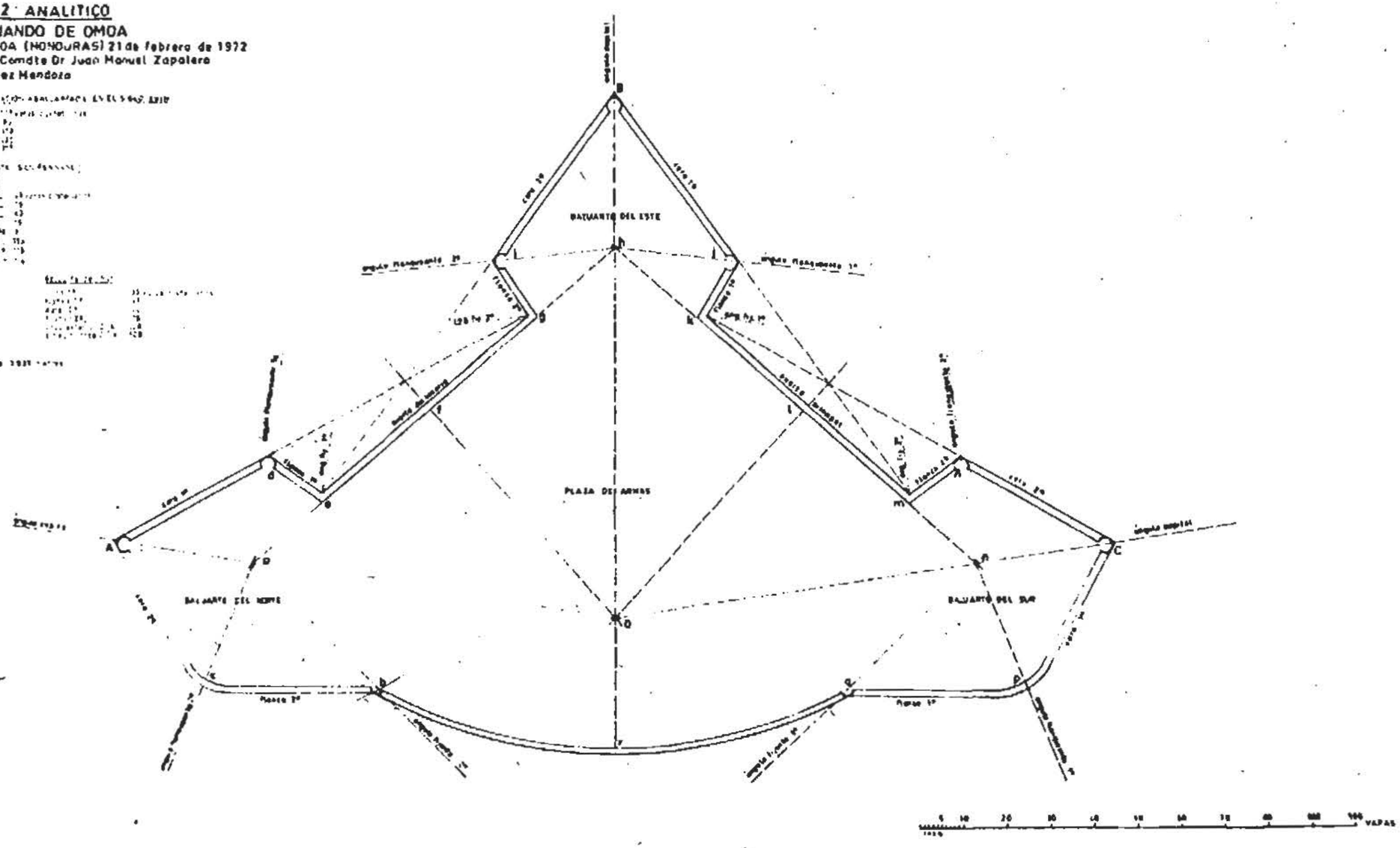
Editor's note: Se incluye esta síntesis de la "Ichnographia" en la página 43 de *La fortificacieon abaluartada en América*, para beneficio del lector no especializado.

PLANO RECTOR ANALÍTICO

PLANO RECTOR 1,2 ANALITICO

FUERTE SAN FERNANDO DE OMOA

SAN FERNANDO DE OMOA (HONDURAS) 21 de febrero de 1972
Asesor Histórico Militar, Comdte Dr Juan Manuel Zapatero
Delineante José Dominguez Mendoza



ANALITICA

O CENTRO GENERAL DE LA FUENTE
O A RADIO CAPITAL DEL BALUARTE DEL OESTE
O A LINEA CAPITAL
O a GOLA
a n SEMIGOLA DERECHA
a O SEMIGOLA IZQUIERDA
n A LINEA FLANQUEANTE 1ª
A a LINEA FLANQUEANTE 2ª
a t RADIO RECTO

t O RADIO CAPITAL DEL BALUARTE DEL ESTE
n B LINEA CAPITAL
g t GOLA
h g SEMIGOLA DERECHA
t p SEMIGOLA IZQUIERDA
h j LINEA FLANQUEANTE 1ª
B i LINEA FLANQUEANTE 2ª
B t RADIO RECTO

O C RADIO CAPITAL DEL BALUARTE DEL SUR
n C LINEA CAPITAL
m q GOLA
n q SEMIGOLA DERECHA
n m SEMIGOLA IZQUIERDA
n p LINEA FLANQUEANTE 1ª
n A LINEA FLANQUEANTE 2ª
B t RADIO RECTO

AB DE LOS LADOS EXTERIORES
ab DE LOS LADOS INTERIORES
A d q y E LOS FRENTES DE PLAZA DEL NORESTE
B j m y E FRENTE DE PLAZA DEL SUROESTE
C p b o A FRENTE DE PLAZA DEL OESTE O DEL MAR
A d q y B i LINEAS RASANTES DEL FRENTE DE PLAZA DEL NORESTE
B j m y C A LINEAS FLANQUEO DEL FRENTE DE PLAZA DEL SUROESTE
- - - EL FRENTE DE PLAZA DEL OESTE NO TIENE LINEAS FLANQUEO POR LA DISPOSICION CURVA DE LA CORTINA

5 10 20 30 40 50 60 70 80 90 100 VARAS

PLANO RECTOR OBJETIVOS DE RESTAURACIÓN

PLANO RECTOR 1,2

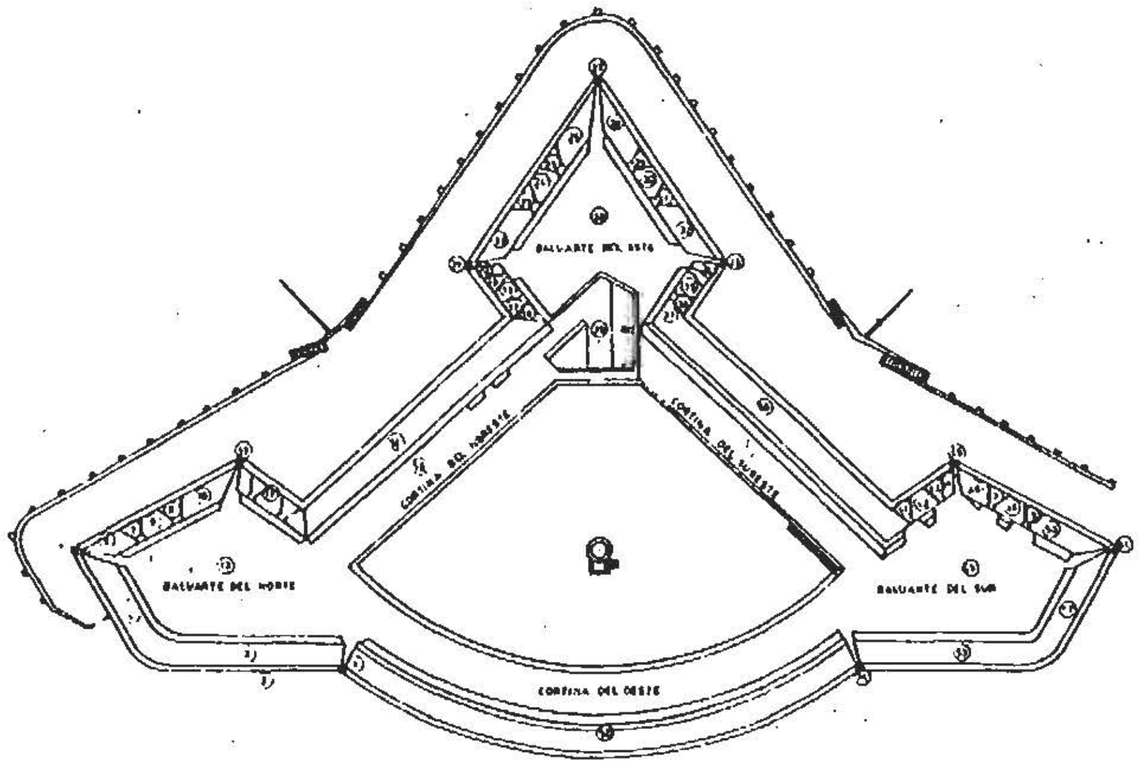
FUERTE SAN FERNANDO DE OMOA

PLANTA SUPERIOR

SAN FERNANDO DE OMOA (HONDURAS) 21 de febrero de 1972

Asesor Histórico Militar, Comdte Dr Juan Manuel Zapatero

Delineante José Domínguez Mendoza



N

0 5 10 15 20 25 30 35 40 VARAS CASTELLANAS

NOTA: 1 VARA CASTELLANA = 0,835 m.

OBJETIVOS DE RESTAURACION

BALUARTE DEL NORTE

1 GARITA
2 FLANCO 2º
3 PARAPETO
4 CARA 2º
5 GARITA
6 CARA 1º, PARAPETO, MERLON 1º
7 TRONERA 1º
8 MERLON 2º
9 TRONERA 2º
10 MERLON 3º
11 GARITA
12 FLANCO 1º PARAPETO TRONERAS 1º,2º MERLONES 1º,2º,3º
13 EXPLANADA

CORTINA DEL NORESTE

14 PARAPETO
15 EXPLANADA

BALUARTE DEL ESTE

16 FLANCO 3º, MERLON 1º
17 TRONERA 1º
18 MERLON 2º
19 TRONERA 2º
20 MERLON 3º
21 GARITA
22 CARA 3º, MERLON 1º
23 TRONERA 3º
24 MERLON 4º
25 TRONERA 4º
26 MERLON 5º
27 GARITA
28 CARA 1º, MERLON 1º
29 TRONERA 1º
30 MERLON 2º
31 TRONERA 2º
32 MERLON 3º
33 GARITA
34 FLANCO 1º, MERLON 10º, TRONERA 1º
35 MERLON 11º
36 TRONERA 2º
37 MERLON 12º
38 EXPLANADA
39 RAMPA

CORTINA DEL SURESTE

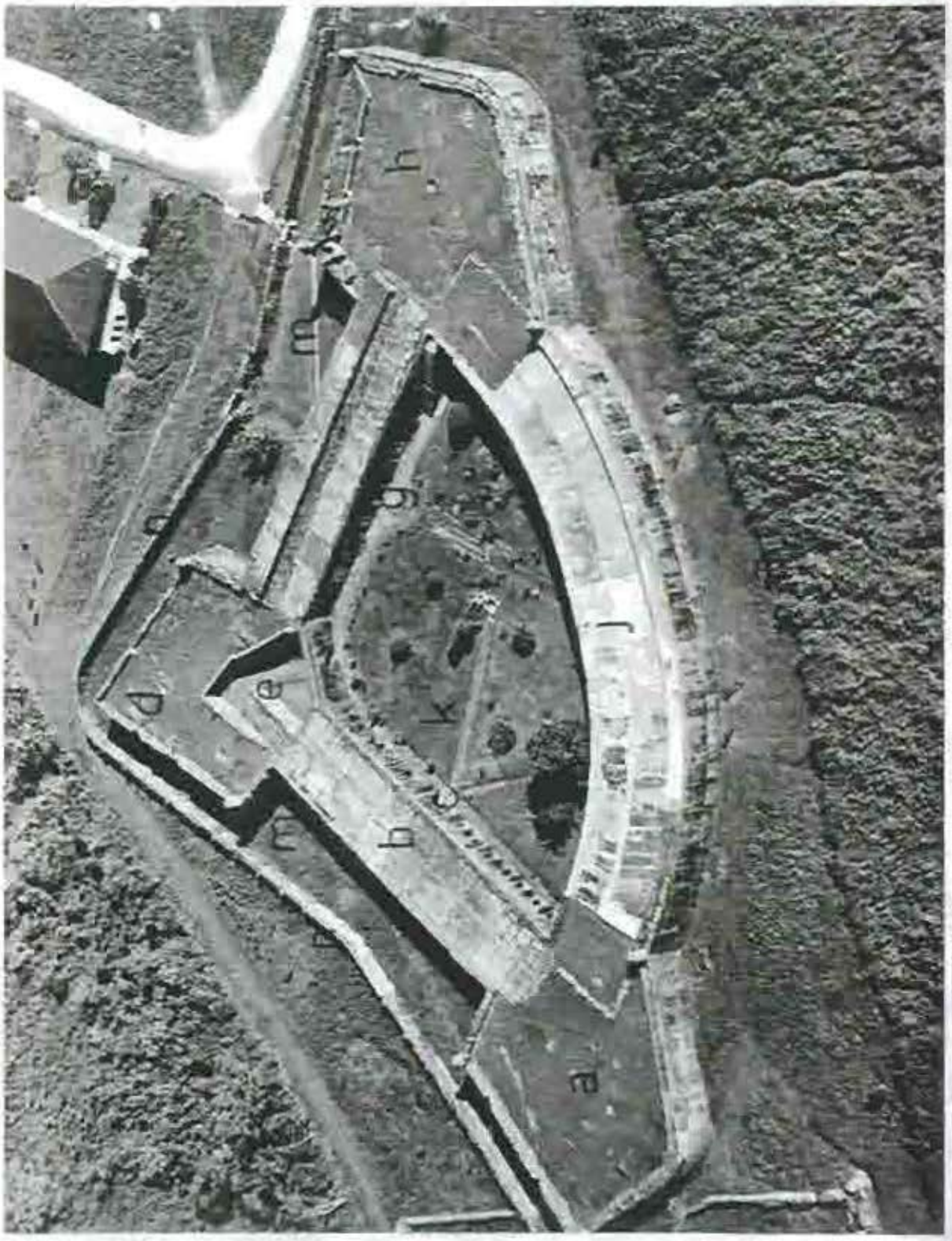
40 PARAPETO

BALUARTE DEL SUR

41 FLANCO 1º, TRONERA 1º
42 MERLON 1º
43 TRONERA 2º
44 MERLON 2º
45 GARITA
46 CARA 2º, MERLON 2º
47 TRONERA 3º
48 MERLON 4º
49 TRONERA 4º
50 MERLON 5º
51 GARITA
52 CARA 1º PARAPETO
53 FLANCO 1º, PARAPETO
54 GARITA
55 EXPLANADA

CORTINA DEL OESTE

56 CORTINA CIRCULAR PARAPETO, EXPLANADA ABAJO Y ESPALDON



"ESCENOGRAPHIA"

"Escenographia" del Fuerte San Fernando de Omoa (Honduras), construído según el proyecto 15 Diciembre de 1756. La vista fue tomada por J.R. Schauer, San Pedro de Sula, durante los "Reconocimientos" y "Estudio Asesor para la Restauración", hechos por el autor de esta Comunicación.

The Restoration of Casa Roig, Humacao, Puerto Rico

Otto Octavio Reyes Casanova, Architect, Puerto Rico

Casa Roig is a private residence built in 1919 for Don Antonio Torruellas, a regional sugar cane plantation owner. The house was designed and constructed by Czech architect Antonin Nechodoma, who arrived in Puerto Rico at the turn of the century and developed many projects in the Prairie Style. Nechodoma used as a model the Burton Westcott house by Frank Lloyd Wright, the perspective taken from the Wasmuth Portfolio of 1910, but with major modifications and adaptations to the tropics, making this house unique and an entity that stands by itself. Other mayor designs by Nechodoma were the Georgetti Palace and the Korber House, both masterpieces and unfortunately demolished and altered. Hence, Casa Roig is probably the best surviving example of Nechodoma's legacy.

The house, although donated to the University of Puerto Rico in 1977, fell into neglect and into such a ruinous state that preservation seemed impossible. Through the courageous and persistent effort of the Humacao community, this landmark has been saved.

The restoration effort included the replacement of the structures and the meticulous reconstruction of the details of the woodwork, mosaics, stained glass, and also the gardens and the interior furniture and furnishings, in order to recapture the architectural integrity of the house and the spirit of a by-gone era. The project has taken over five years to complete. Design began in 1983, restoration in 1984; the house opened to the public in June 1989, but the Final Phase IV, Interiors, Furniture and Furnishings, is still in progress.

This final phase involves the completion of the interior spaces. Nechodoma designed his spaces with total integration of all trades: woodwork, floor and ceiling patterns, mosaics, stained glass and furniture, the design motif being carried through all architectural expressions, producing a unified creation.

It is in this spirit that we have designed the furniture for Casa Roig, and based also on archival evidence of Nechodoma's work. A prototype of the dining room chairs was developed by the wood shop at the Humacao University College and after revising the prototype, six dining room chairs have been built. The chairs are totally dismountable, attached by pegs as per Nechodoma's detailing.

Perhaps the greatest challenge in the Casa Roig project was to get the whole community involved in the preservation effort: the University, the regional industrialists, local, state and federal government, private enterprise, the merchants, the students, and private citizens, joined together in a fund-raising effort. In Puerto Rico this is a most innovative approach since traditionally the citizens rely and expect the government to do all the work and to provide all of the funding. Casa Roig has been a notable exception and a laudable example to be emulated.

The greatest benefit of the restoration has been the unification of the community, the awareness created around the preservation movement, and the precedent for Puerto Rico. The task was enormous and, because it was difficult to accomplish, it has become all the more dearly appreciated. Casa Roig has become the bridge between the University and the community; it has become the symbol and pride of Humacao.

Recognizing the excellence in the protection and enhancement of the Caribbean's cultural and architectural heritage, Casa Roig and the Humacao Community received the 1990 American Express Preservation Award.