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Vol. 3 of 3

THE FORTIFICATIONS OF SAN JUAN NATIONAL HISTORIC SITE

Volume III



HISTORIC STRUCTURE REPORT

Castillo de San Felipe del Morro
The City Walls
An Investigation of the Materials Used
Cultural Landscape Report

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Castillo de San Felipe del Morro

The City Walls

An Investigation of the Materials Used

Cultural Landscape Report

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Southeast Regional Office
National Park Service

1991

I. CASTILLO DE SAN FELIPE DEL MORRO

San Juan National Historic Site
San Juan, Puerto Rico

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PHYSICAL DESCRIPTION

The fortress of San Felipe del Morro stands as a massive monument to the empire once ruled by Spain. Multi-level, constructed of masonry, and built over a period of four-and-a-half centuries, it has evolved into one of the largest New World fortifications. The overall size and appearance of the fortress is best shown in the HABS drawings and photographs contained in this Historic Structures Report. The following description is supplied to elucidate those aspects of the fort that do not lend themselves to graphic illustration.

El Morro is constructed of local materials: sandstone with a calcareous matrix (the binding agent), sand, and clay (see the section on Materials for a more detailed description of these items). Brick was used also, however the origin of the early brick is unknown, but certainly, the later brick was made in Puerto Rico. Local wood (ausubo) was used for doors, shutters and fenestration framing. In recent years, the National Park Service (NPS) has used mahogany as a replacement wood for these elements. The Spanish use of these materials was very conservative and changed little over the centuries. Mampostería, rubble construction, is used, in varying forms, for non-fortified construction (interior walls, fill behind ashlar construction, etc.) until the 1890s. Fortified walls were constructed of cut (roughly dressed) stone, laid in courses varying from 43 to 56 centimeters (17 to 22 inches) high. Varying in length from 0.46 to 1.0 meter (18 to 40 inches), these stones were set in a mortar and had a rubble fill behind. (An early example of this type of construction can be seen on the ocean side, below Ochoa Bastion. Here, the stone courses are set in mortar on thin stone leveling courses.)

The use of stucco over masonry, rubble, and cut stone, also persisted until the end of the nineteenth century. All walls and other masonry surfaces, with the minor exception of some decorative elements, were coated with a stucco or plaster utilizing either lime, or lime and clay, as the matrix. This stucco has acted as a protective coating for the masonry, and its loss can be seen to have caused deterioration to the material below (see the **CONDITIONS SURVEY** in Volume III for a more detailed explanation of this process). Part of this protective layering is the coating of a wash on the stucco surface. The last of these coatings was ocher in color and, where it still remains, has left the walls with a warm mellow appearance, evoking age and a timelessness that seems to bring the past into the present. Yet, this is deceiving. In reality, the weathered appearance is signalling decay; the romance of age seen in the walls may not be as ancient as dreamed; and the massiveness of the masonry hides within it the elements of its own demise.

El Morro is triangular in plan with the apex defending the harbor entrance and the base defending the land front. At the apex is located Santa Barbara Bastion (23 meters, 75 feet, in elevation above sea level) with the Water Battery (6 meters, 20 feet, in elevation) situated below on the channel. Below the terreplein of Santa Barbara Bastion, and enclosed within its walls, is the lower plaza with its dirt floor (17 meters, 56 feet, in elevation). A circular stair as well as a stair at the base of the main ramp, descend from the Santa Barbara terreplein to this level. Remains of seventeenth-century buildings were found here by archaeologists in 1960; the tops of some of the walls can be seen on the surface. On the north side of this lower plaza are the Santa Barbara casemates. The eighteenth-century kitchen was located on this level. As originally constructed, near the end of the eighteenth century, this plaza was divided into two parts by a wall running in the north/south direction. This wall was removed just before World War II. In the northeast corner of this plaza is a postern gate that leads out to the ocean front.

Santa Barbara Bastion is reached by a great ramp leading down from the upper plaza (35.75 meters, 117.5 feet, in elevation), and by a triangular stair descending from the Carmen terreplein, located at the north end of the upper plaza. This ramp and stair are part of the high wall, built during the last major building phase in the eighteenth century. On this upper level are located the casemates that were used for support functions and the chapel. (Today they contain a museum, book store, rest rooms, storage and office space.) At the north end of the upper plaza is Carmen Bastion, from which leads one of two ramps to the upper terreplein (the other ramp is located at the south end of the upper plaza). Below Carmen Bastion, and accessed from it, is the Mercado demi-bastion. Mercado Bastion is reached by a stair/ramp that is enclosed within the wall, referred to as a "Gallery."

Anchoring the corners of the land defense are Ochoa and Austria Bastions. Between them runs the curtain wall through which the fortress is entered. The upper terreplein (42.5 meters, 140 feet, in elevation) comprises the terrepleins of the curtain, Austria and Ochoa Bastions, and the top of the high wall. From this level, cannon could cover the land approach as well as that from the sea. Being the highest level, it is here that the lighthouse is located, as are the remains of the Spanish breach-loading gun emplacements. Built into the northwest angle of the high wall, at this level is a concrete observation post (called a man-hole), part of a World War II harbor defense system. The upper plaza is reached by descending the ramp at Austria Bastion.

At the base of this ramp is a magazine. Another magazine was built within Ochoa Bastion in the space now occupied by part of the museum. Opposite the main ramp leading to Santa Barbara Bastion, at the upper plaza level, is the entrance way to the fort. This space is vaulted and has in its outer bay a hollow space below the

floor that contained the counter weight of the earlier bascule (drawbridge). Outside of the bastion and curtain walls is the moat, with counterscarp. The entrance (sally port) is reached by an arched masonry bridge that crosses the moat from the glacis beyond the counterscarp.

Over time, buildings have risen and been demolished in and around el Morro. Change has occurred to the fort. Walls have been added, and others rebuilt. What remains is the culmination of the Spanish effort to fortify one of its New World possessions. As can be seen, this effort was enormous.

Conception: ca. 1540-1600

Guarding the entrance to San Juan Harbor, the fortress el Morro has undergone considerable development in its 450-year history. The purpose of this section is not to cover in detail the full physical history of the site, this would involve considerable conjecture, but to identify in character and extent those portions of the existing fabric that date from the various periods of its history. To accomplish this, a study has been made not only of the materials of construction but of the available historic documents, including plans and photographs. A comparative analysis of the stuccos and mortar was done to distinguish differences and characterize the material from sections of known date. Thus, through grouping by similar material and mixes, dates can be assigned to areas of



Figure 1. Interior of ca. 1540 "Tower." (J. Boucher, HABS, ca. 1960.)

unknown construction period. Because of the conservative use of materials, this process has been able only to generalize the use of various materials over time and has not led to a comprehensive dating tool. However, by comparison with the available historical documents, a good deal of information has been developed on the earlier appearance of the fortress as well as early portions that still remain, much of which is buried within the present walls.

The earliest remains of fortification on the el Morro site lie within the walls of the Santa Barbara Bastion, at the entrance to the harbor. It is "The Tower", said to have been built in ca. 1540, at the suggestion of Gonzalo Fernandez de Oviedo,[4] to protect the harbor entrance. The first description we have of the fortification is by Treasurer Castellanos in June of 1554, who describes the fort as being "... a small tower and a bastion, which are at the harbor entrance; ..."[5] Originally constructed with walls 3 meters (7 feet) thick, now it only can be seen from within its 6 meter (20 feet) diameter interior space (fig. 1).



Figure 2. Ca. 1593 sketch of el Morro. (AGI-SD-10, 11, Seville.)

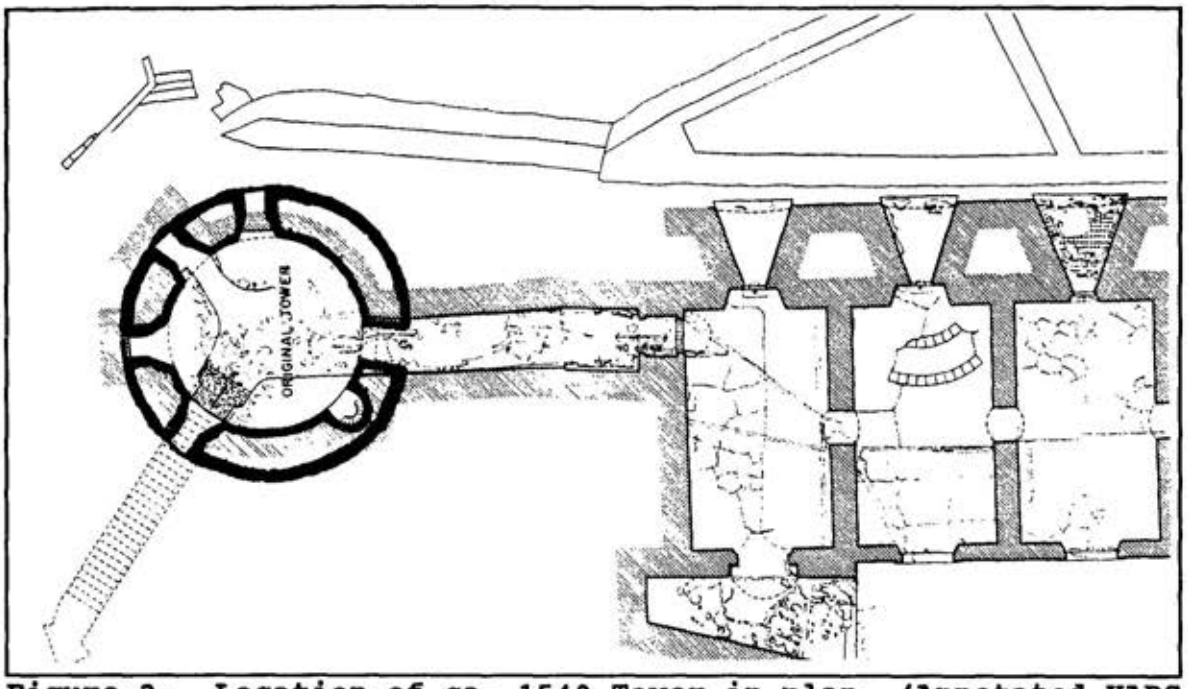


Figure 3. Location of ca. 1540 Tower in plan. (Annotated HABS drawings.)

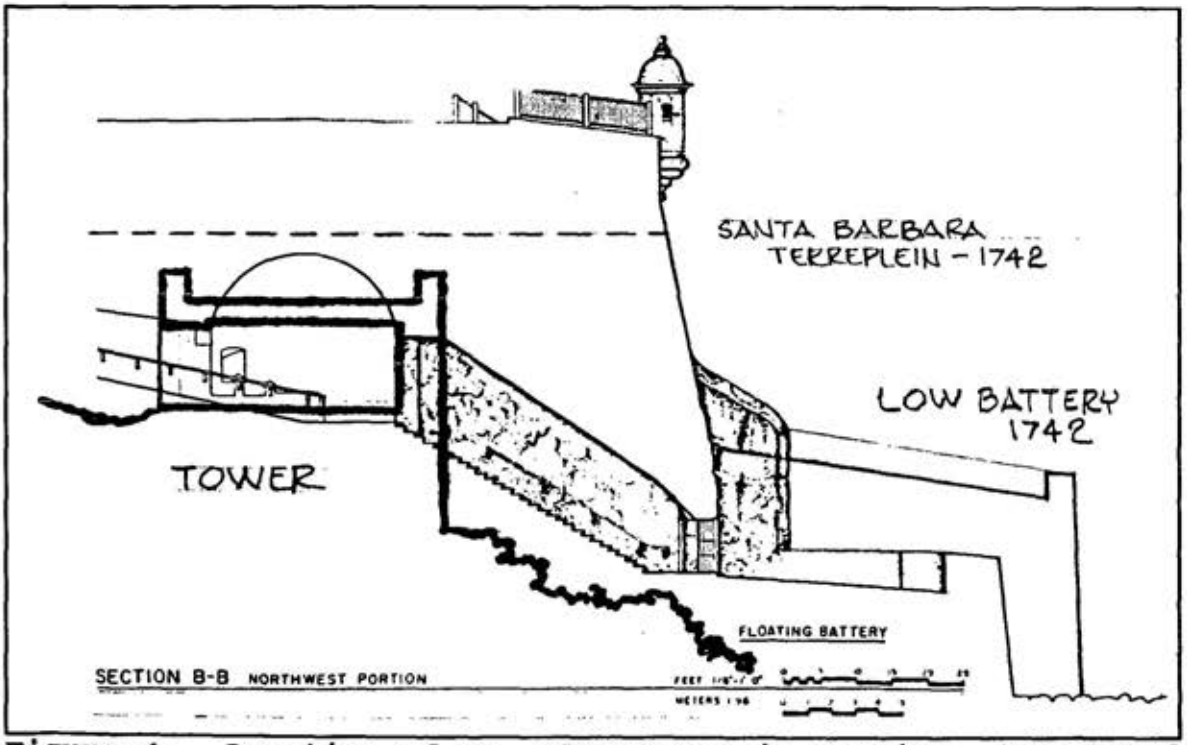


Figure 4. Location of ca. 1540 Tower in section. (Annotated HABS drawings.)

Visible on the interior are filled openings, or embrasures, for four cannons. Figure 3 (ca. 1591), schematically shows four cannons at the harbor entrance, behind a curved wall, with three cannons on a platform below; this presumably depicts the site before the bastion known as Santa Barbara had been built.[8] (It is not certain whether the curved wall represents the tower, or a later expanded upper platform.) At a later date, when Santa Barbara Bastion first took form, one of the three embrasures was converted to a doorway for access to the "Low Battery", as will be discussed below. Today, the first opening on the left accesses a stair leading to the so called "Water" or "Floating Battery", and is a more recent change, dating from ca. 1970, when the present Water Battery was constructed.[9] The present masonry dome over this space also dates from a later period when much of the fortress was rebuilt and many of its levels increased in height (details of this period will be discussed below). From the little evidence that remains for us to scrutinize, this earliest structure stood about 18.5 meters (60 feet) above sea level, with an interior height of about 3.6 meters (12 feet). The interior dimension is shown on a reconstruction from the HABS drawings (figs. 5 and 6), and the later increase in height is based on the physical evidence of existing elevations and an early (1742) drawing of the fort.



Figure 5. El Morro Castle, ca. 1960. (HAJO HBS Archives.)

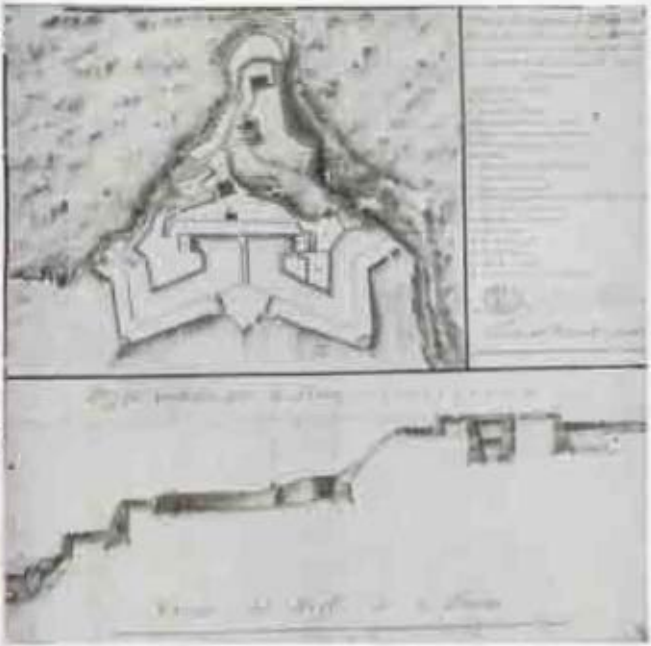


Figure 6. 1742 Drawing of el Morro. (SHM-Madrid; sign. 2.750: K-b-2-58.)

Santa Barbara Bastion was created by enclosing the earlier tower and high platform within a more massive masonry structure. Its height then would have been greater than that of the tower but lower than at present because of an additional late-eighteenth century increase in elevation. Judging by the change in construction, as evidenced by changes in the adherence of stucco on the outer bastion wall (fig. 2), the earlier level was at least

3 meters (10 feet) below the present level. Change in the level of the Santa Barbara terreplein (upper floor) also can be interpolated from the 1742 drawing of el Morro shown in fig. 6 (also as historic drawing 1, Volume I).

At this point it seems best to discuss this important drawing of 1742. Located at the Servicio Histórico Militar in Madrid, it is the oldest known depiction of the fortress that shows architectural detail in scale; all earlier plans can be characterized as being schematic in illustrating the fortress. Depicted in the drawing is a plan view and a section with sea level delineated. Both the plan and the section have scales shown in Spanish pies (equivalent to 0.92 English feet[5]). The section, in addition, has some vertical dimensions shown. A close examination of this drawing indicates that it must have been redrawn from an earlier drawing by someone unfamiliar with the dimensions of the fort; possibly redrawn in Spain. If the scale associated with the plan is used for measurement, the dimensions of the fort would become impossibly half as large as they presently are. Therefore, the scale of the plan is incorrect by a factor of two. The scale of the section is also off by a factor of two in a more complex manner. When adjusting the heights shown on the drawing, based on doubling the scale, some of the dimensions become much too high for the present fort. For example, the overall elevation of the fort as given on the 1742 plan is 97 pies (89.25 feet); if corrected by using a factor of 2, the elevation becomes 184 pies (178.5 feet), much too high given the current elevation of 140 feet for the Austria terreplein. Therefore, the original section must have had a different scale for the vertical dimensions. By comparison with current heights and features on the upper plaza (Plaza des Armas), it seems likely that there was a ratio of 4:3 between the horizontal and vertical scales; 4 horizontal units equal 3 vertical units. (This difference in scale is not unusual and is often used to accentuate the vertical dimension in a section.) However, it should be noted that this difference in scales does not seem to hold true for the lower elevations. Also, it should be remembered that the use of decimal notation was not common at this time, and that a relationship between the scales in a whole number ratio would have been the common practice. This 1742 drawing will be referred to for other aspects of the fort development, and the corrected ratio between the horizontal and vertical scales will be used in the **Table of Elevations** below on page 16.

If the 1742 section is used to scale the height of the Santa Barbara terreplein, an elevation of about 20.9 meters (67.5 feet) is obtained (see below for an explanation of this dimension). The elevation of the dome is 19.5 meters (63 feet). An elevation of 19.5 meters gives the dome an overburden of a little more than a meter; hardly necessary for a domed structure to support such a small masonry mass. The dome cannot have been part of the original tower for it would then have been above the height (18 meters) of the tower roof (terreplein), and near the level of a platform

recommended by Governor Diego Menendez de Valdez in a 1582 report.[6] This report recommended that a high platform be built on the tower to provide more space for artillery. The "high platform" would have had a lower elevation than the terreplein of the later Santa Barbara Bastion which was presumably built upon it. Therefore, it can be assumed that the dome is later than 1582. Based on the elevation in the sketch above (fig. 4), the ceiling of the tower interior was not much above the spring line of the present dome, about level with the top of the doorway lintel. This lintel appears part of the original entrance. It certainly predates the tunnel because the alignment with the tunnel is skewed and there is evidence of exterior stucco on the lintel's outer surface, now covered by the tunnel vault. Considering that the floor above would have been supported by beams, the thickness of the masonry overburden could not have been much more than a meter for the beams to have withstood the load. An accumulative total of these dimensions is as follows: the elevation of the tower floor (12.5m.), the interior ceiling height (approx. 3m.), the thickness of a masonry overburden (approx. 1m.) and a parapet (approx. 1.5m.), giving an estimated elevation for the top of this original tower of approximately 18 meters (60 feet) above sea level. (It can be assumed that the tower would have had a crenelated parapet, as seen in early drawings,[7] from which soldiers fired on approaching ships.) The remains of circular towers of similar construction can be found at Concepción de la Vega in the Dominican Republic, dating from the early-sixteenth century,[8] as well as in Fortaleza in San Juan.

The weakness of el Morro during the sixteenth century was the land defense. To remedy this situation Juan de Tejeda and engineer Juan Bautista Antonelli visited the island in 1586 under the governorship of Valdez. The result of their visit, that included the inspection of other fortifications in the Spanish possessions of the Caribbean, was the request for proposals on updating these defenses.[9] In 1589, Tejeda and Antonelli began to carry out a project of improving the fortification of el Morro by laying out the plan for a new fortress that was to ". . . be built triangle wise: for it must reach into the bay . . . "[10] With these plans, the concept of el Morro as it is organized today was born.

The early years of the site remain vague and no physical remains, with the exception of the "Tower", have been identified as dating prior to ca. 1600. What is evident from the 1742 drawing, is that the defenses at the site consisted primarily of two separate fortifications; one guarding the harbor entrance and one providing protection from a land attack. It should be noted that at this early date there is little concern, judging from the layout of defenses and lack of cannons with a seaward orientation, for attack from the sea, including naval bombardment. Such considerations were based, on the size of cannon carried by naval vessels and their ability to fire at elevated targets.[11] As the capacity of ships to carry larger cannon increased, an increase in

fire power toward the sea was reflected in the later construction of the fort. The fact that the major, and more successful, early attacks on San Juan were land based justifies the defensive emphasis during this period. (These attacks were: Cumberland in 1598, and Hendrik in 1625.) It was after the Cumberland capture of San Juan, including el Morro, that the fortress began to take on the beginnings of its present form.



Figure 7. Drawing of San Juan, presumed to have been made at the time of the Dutch attack, 1625. (Collection of La Casa del Libro, San Juan.)

Development: 1600-1765

Following the capture of el Morro by Cumberland (1598), the land defenses or, "Hornwork" were rebuilt.[12] Judging from a few early schematic sketches (fig. 2), in addition to the tower at the harbor entrance, there were some cannon located at intermediate levels between the tower and the hornwork. During the intervening years before 1600, recommendations were made regarding improvements to el Morro. Mostly these consisted of strengthening the land defense and raising the elevation of the tower in order to create a larger gun platform. In 1591, a program was proposed under Governor Tejeda for rebuilding the fortress.[13] However, not much of this work was carried out before the attacks of Drake (1595) and Cumberland showed the need for greater defenses. Prior to 1600, the hornwork might best be described as a weak construction of rubble masonry that may have been partly demolished by Cumberland.[14] After the departure of Cumberland, the Spanish began to rebuild their fortification in March of 1602, following the basic plan laid down by Antonelli.[15] It would appear that much of this rebuilding was completed by the 1620s, for the Dutch, under Hendrik, failed to take el Morro in 1624. There is a drawing supposedly from the period of this attack, that shows a relatively complete el Morro (fig. 7). However, it is printed in reverse and may actually be of a later date since. The appearance of the fortress in this drawing is similar in detail to a Dutch drawing of el Morro, from this period, located at Forteleza.

Archaeological excavations done in 1960 and in 1990 have exposed some elements of this construction (see archaeologist's report, Appendix G). The 1960 excavation done in the moat exposed the foundations of the curtain wall between Austria and Ochoa bastions, as well as that of the flanking wall of Austria Bastion. The foundation of the flanking wall consisted of a vertical rubble, or mampostería, wall at the base of which were several courses of brick; these brick were assumed at that time (1960) to be part of the surface of a floor.[16] Also, the rubble foundation was considered to be the possible remains of the pre-1600 hornwork. The 1960 excavation extended along the flank wall from the corner where it met the curtain, partially across an area where the 1742 plan showed an orillón (a recess in the flanking wall from which riflemen could enfilade the curtain and entrance gate). Clearly, the rubble foundation wall dated from the period when the orillón was closed and the flanking wall extended to the curtain (ca. 1773). Therefore, a point on the moat floor, approximately 13 meters (42 feet) out along the Austria flanking wall from the corner where that wall met the curtain, was selected for the 1990 excavation in an attempt to locate the outer corner of the orillón. It was assumed that a construction joint would be found where the fill met the masonry of the flank.

Based on the 1742 drawing and physical evidence (clearly seen in the north wall of the North Bastion of San Cristóbal, see

Chapter 10 in Volume II), it had been concluded that the walls of both forts had been increased in height by about 2.5 to 3.5 meters (3 to 4 vara in Spanish measurement) during construction dating to the end of the eighteenth century. Therefore, it was assumed that the walls of the hornwork may have been raised at this time, and that undisturbed seventeenth-century construction material would be found below the moat floor. The May 1990 excavation in the moat floor was to reveal even more information on the fort's construction.

After a week of work during which no construction joint at the orillón fill was found in the below-grade surface of the flanking wall, the archaeological team uncovered the top of the orillón corner approximately 0.8 meter (32 inches) out from the flanking wall's surface, and about 1.25 meters (4 feet) below the ground surface. This discovery was different from what had been expected. As the excavation continued to expose the corner, it became clear that the earlier hornwork wall had not been increased in elevation, but had been demolished down to a level approximately 70 centimeters (28 inches) below the anticipated level of the moat floor (ca. 1773) and now acted as a foundation for the present wall. (See fig. 8, a section through the excavation.) The moat floor was increased about 2.8 meters (9 feet) at the orillón corner during the ca. 1773 construction. The rubble foundation at the orillón corner began and continued to the curtain wall; clearly not pre-1600, but part of the ca. 1773 construction that filled in the orillón (fig. 9). The brick courses at the base of this foundation appeared to be the footing for the rubble foundation wall, and not the beginning of a floor surface; clearly, part of the later construction, owing to the type of mortar in which the brick were bedded. The construction of the earlier wall (presumed to be that constructed in ca. 1602, owing to the lack of any record of major construction in this area between ca. 1600 and ca. 1773) was similar to the later construction (fig. 10). In fact, the ca. 1773 work may have incorporated into its construction some of the demolished material of the earlier wall including the cordon course just below the embrasures. When fully exposed, the orillón corner inches) in height and roughly dressed. The wall had no batter, or scarp, on was four stone courses high,

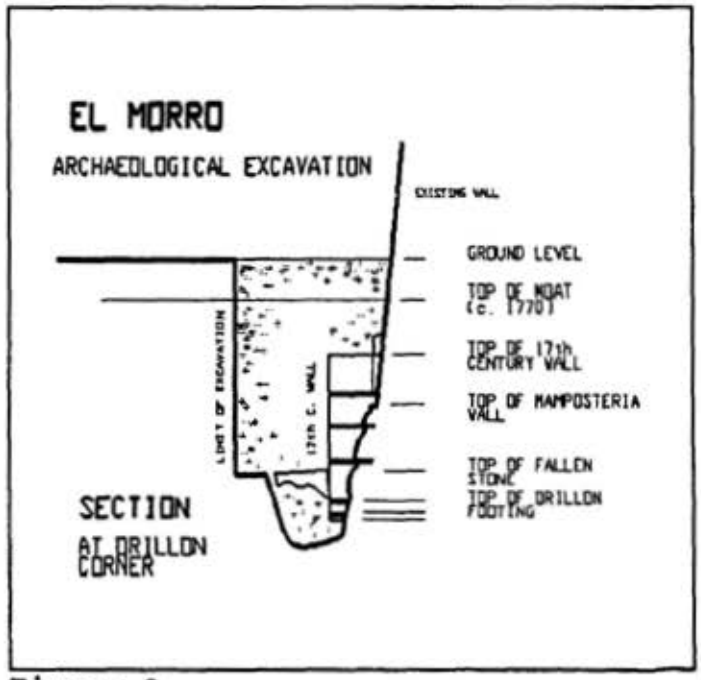


Figure 8.



Figure 9. Rubble wall (c.1773) meeting seventeenth-century orillón corner. (Photo by E.B. Oliver, 1990.)

each course or, stone being about 43 centimeters (17either the east side or the side forming the orillón. The mortar and the remains of stucco on the stone surface were a mixture of lime, reddish clay and sand (see **MATERIALS** section contained in this volume). At the orillón corner the stones were dressed to the oblique horizontal angle of the wall forming the orillón and gave an appearance of solid construction. Below this corner was a footing course that was assumed to be the level of the orillón floor, and thus, the level of the moat at this point.

By using the corrected scale to measure on the 1742 section, the pre-1770 elevations above sea level were scaled and compared with the actual heights found today. These comparisons show some surprising correlations and contradictions:

TABLE OF ELEVATIONS

	1742 Section	Present Elev.
Floor of Orillon	29.0 m.(95.5')	30.0 m.(97.5')[a]
Upper Patio	36.0 m.(118.0')	36.0 m.(117.5')
Floor of Moat[b]	31.0 m.(101.5')	32.0 m.(103.0')
Austria Terreplein	39.5 m.(129.0')	43.0 m.(140.0')
Santa Barbara Terreplein	18.0 m.(51.0')	23.0 m.(75.0')
	20.9 m.(67.5')[c]	
Lower Patio- west end	15.5 m.(50.5')[c]	17.0 m.(56.0')
east end	18.5 m.(60.5')[c]	
Floor of Water Battery [d] (Low Battery)	8.0 m.(26.5')	6.8 m.(22.0')
	10.9 m.(36.5')[c]	

a. Taken at the top of the orillon footing.
b. At the counterscarp.
c. Uncorrected with 4:1 ratio.
d. Taken at Santa Barbara scarp

The measurements help to place the archaeological findings into our present context. The relative correlation between the measurements for the orillon floor indicate some value in the accuracy of the 1742 drawing. Differences found in some of the other elevations are indicative of the changes in elevation that took place in the fort after 1742. It is best to examine these changes, or proposed changes, in order to understand what took place in the construction of the fortress during the seventeenth century, and to determine what of these earlier features still remain.



Figure 10. May 1990 excavation showing corner of the 17th c. orillon. (Photo by E.R. Oliver.)

The 1742 drawing illustrates the fort as it had evolved from ca. 1602. In 1765, changes to el Morro were recommended in a description and an accompanying plan (see historic drawing 7, Volume I) to the Spanish government by Marshall Alexandre O'Reilly. The following is an extracted description from that report indicating the existing conditions:

> This castle is an irregular fortification that follows the contours of a large rock on which it is built. From the point that is at the harbor entrance, it widens and increases in elevation to the front that faces the city which is its greatest width; in such manner that all the interior of the castle, is in amphitheater and entirely disclosed from the sea. In order to remedy this defect to some extent, in the last war a short bulwark of fascines was made that covers the entrance and part of the curtain but much more is needed The form of this fortification is triangular.* It has at the harbor mouth two batteries; one low and the other high. The first which is circular would be enfilade and dominated by the fire of ships that might attack it. Its greatest width is only 34 feet [pie] diminishing at the extremities to 25.
>
> The descent to this battery [the earlier Low Battery] that is steep would make the good servicing of it difficult, and the ruins that would fall from the high battery in time of action would make it almost unserviceable, all reasons that convince of the small utility of this battery; but since it is already built, it is agreed to leave it . . . The high battery that at present mounts 12 cannon is all the defense at this castle for the entrance to the harbor, . . .
>
> The curtain of wall that runs from the battery at the mouth of the harbor along the sea-side on the north to its union with the land front is incapable of mounting artillery nor does it even serve to protect the fusileers [artillerymen]. This wall has no terreplein. The parapet is reduced throughout its length to a wall two feet thick that is already so ruined that it is necessary to demolish it as well as the portion of wall that runs from the re-entrant angle past the sentry-box [in the salient] to the aforesaid land front [Mercado Bastion must be considered part of the land front since it and its ramp wall have remained] . . .
>
> The other rampart that from the aforesaid high battery to the land front serves as a boundary, [the harbor side] is at

---

The most recent war was the Seven Years War (ending in 1763), but fascines, or "Batería de Fagina y Tierra", are indicated on the 1742 plan in this area; as might be expected, some work was done on the fort during this most recent war, especially during Spain's years of involvement (1762-63).

present composed of various walls of different thicknesses that with very great irregularity, form a multitude of angles harmful to the defense. The construction of this wall is of bad mortar; ruin already threatens in many parts especially in that . . . over the lower battery . . . the upper part of this rampart having no parapets or terreplein to hold the artillery . . . [the 1742 plan shows this area as sloping terrain].

The land front of this castle is in the form of a hornwork. . . . the ramparts are of good construction; but with the great defect that its barbette parapets [lacking embrasures and merlons] are five feet in width, and low flanks of such small capacity that they cannot receive more than two cannon.

The Sea Bastion . . . is divided into a high and low part [at this time Ochoa Bastion had two levels]. This greatly narrows the higher part . . . Its communication to the low [one] is by a hanging [vaulted ?] ramp enfilade from the sea, and from the curtain there is only a little narrow passage two feet wide as the flank, that is uncovered from its low battery, does not permit more. These bad communications make extremely difficult the service of the higher battery and, given suitable width to its parapets, would scarcely allow room in it for three cannon.

The low part of this bastion . . . has even greater inconveniences. It is dominated from the heights [hills in front of the fort], . . . and from this last, it is enfilade so that its principal sea battery can be knocked down in a very short time . . .

The gate of the castle is entirely uncovered. Through it, the enemy could easily enfilade the interior of the fort.

This front of the castle, that is the only part open to attack by land, has no covered way, nor the glacis sufficient fill [slope]. The counterscarp itself serves in some parts as a parapet against the castle.[17]

This description indicates why an extensive rebuilding campaign was begun after 1765. (However, it does not explain why the hornwork wall was demolished and rebuilt, since it is the one area of the castle described as being "of good construction.") The description conforms well with the 1742 drawing. A major difference with present conditions is the description of the lower battery at the harbor entrance. Through scaling the elevation of this battery on the 1742 drawing, and from the physical evidence at the toe of Santa Barbara, it is evident that the present configuration is not what is shown on the plan. In 1742, the Low Battery was higher than the present Water Battery, some 11 meters (35.5 feet) above sea level as compared to the existing 6.3 meters



Figure 11. Conjectured view of el Morro, 1742.

(20 feet), and projected out into the harbor entrance a greater distance than at present (the elevation found in the chart, using the 4:3 ratio, is inaccurate; see explanation below). In 1742, the intersection of the curved outer wall of the Low Battery with the harbor side wall of the fort was farther past (to the southeast) the present intersection of the Water Battery wall. O'Reilly speaks of the battery as "already built" and not worth changing. In fact, the 1765[18] plan accompanying the description shows a similar configuration to the 1742 plan. A 1772[19] plan of O'Daly shows the present configuration for this battery. Therefore the present battery was constructed sometime between 1765 and 1772. At that time, access to this battery was provided by the construction of the present stair, using the embrasure farthest to the left (south) as the stair entrance, and descending through the wall to the battery floor level.

The reason for the rebuilding of this battery may well be associated with the recent problems of erosion at the harbor entrance. Currents in this area are swift, and have caused the undercutting of the stone supporting the fort walls. Assuming that this same problem existed in the eighteenth century, it seems probable that the foundation walls of the Low Battery were eroded

change is based on scaling elevations on the 1742 section, and on evidence from the inner doorway at the upper end of the tunnel leading to the old tower interior. Here can be seen the post-1770 architrave of the doorway that opened to the tunnel, the threshold of which is approximately 1 meter (3.25 feet) above the floor level at the beginning of the tunnel. At the point where the tunnel begins its descent there is a vaulted space, higher than the vault of the tunnel, that probably dates from the post-1770 period. The tunnel itself is not on axis with this vaulted space (see HABS Drawing 19), as if it already existed at the time the entrance and vaulted space were constructed. Therefore, the tunnel, the southwest wall of which may be the northeast wall of the early Artillery Quarters, must date at least from the construction of the Low Battery, if not to the original construction of the high platform, possibly as early as 1591-1602.[21] The upper end of the older portion of the tunnel floor must be near the earlier level of the Lower Plaza at this point.

Dating the beginning of Santa Barbara Bastion is difficult. The "high battery" referred to by O'Reilly is now the toe of Santa Barbara Bastion. The "high platform" recommended by Valdez was in existence by the beginning of the seventeenth century (see above). What we see on the 1742 plan as Santa Barbara Bastion, appears to have been there by 1678, judging from a plan done by Luis Venegas Osorio in that year (see **CITY WALLS** section in this volume). Because historical descriptions of this area are imprecise, it is difficult to be sure in what form the high platform was built, and if it was, in fact, enlarged to create the Santa Barbara Bastion by 1678. It remains possible that the high platform as constructed before ca. 1600, is what is depicted in 1678 and can be seen in the 1742 plan. However, if the ca. 1590 sketch showing el Morro (fig. 2) is illustrating the high platform, it shows only four cannon on the terreplein; this seems too small for the bastion as drawn in 1742, or even in 1678. Because the construction work at the beginning of the seventeenth century concentrated on the land defense until ca. 1620, it is assumed that the work creating the bastion we call Santa Barbara, including the Low Battery, was begun closer to the mid-seventeenth century. Also, there exists a 1625 plan of the city found in the Rare Book Department of the Cornell University Library.[22] This plan, though lacking in detail, shows several rectangles connected by lines (walls) in the area of the harbor entrance (as described by Gonzalo Perez, endnote 21). Much of the form seen in the 1742 plan is present. What stands out in this plan of 1625 is the land defense, which is depicted with a double line following the foot print of what is seen on the 1742 plan, and near what exists today.

As mentioned previously, there are indications that the terreplein of Santa Barbara Bastion had been increased in height, probably after 1765 (see below). An indication of the earlier level is seen in the remains of an internal screen wall of the Low Battery; this became the north (seaward) wall of the ca. 1770 Water

Battery (see the 1776 plan). On the 1742 plan there is a curved wall within the battery that extends out from the scarp wall of the higher battery screening the passage entrance from the harbor. It is the remnant of this wall that extends up the exterior of the Santa Barbara wall (see HABS drawing 33, and figs. 5 and 12). Presumably, the earlier height of the Santa Barbara Bastion, or high platform, cannot have been lower than the top of this wall remnant; that is approximately 3 meters (10 feet) below the present terreplein. There also is a change in angle of the wall slope, and in the character of the stucco at this point. These changes place the height of the earlier level of the Santa Barbara terreplein at about 20.3 meters (66 feet) above sea level; higher than the dimension found by scaling off the 1742 section using the 4:3 correction (see chart above). A reason for this difference would seem to be an inaccuracy in the 1742 section. The elevation of 16 meters (51 feet), scaled off the 1742 section using the 4:3 correction, cannot be correct; it would place the terreplein height below the elevation of the door lintel leading into the tower chamber, which is 16.3 meters (53 feet). Since the tower chamber, and the Santa Barbara terreplein existed together, the terreplein could not have been at that low a level and still allowed entrance to the chamber. If the height is scaled without using the 4:3 correction, an elevation of 20.8 meters (67.5 feet) above sea level is achieved, approximating the height of the wall fragment; it also appears that the height of the Low Battery is accurately scaled without the 4:3 correction. The elevation of the Santa Barbara terreplein, scaled from the 1742 plan, is close to the figure based on the height of the curved wall remnant found above. Without further documents, or partial demolition of the wall, it is difficult to be certain of the exact seventeenth, or late-sixteenth century elevation of this level.

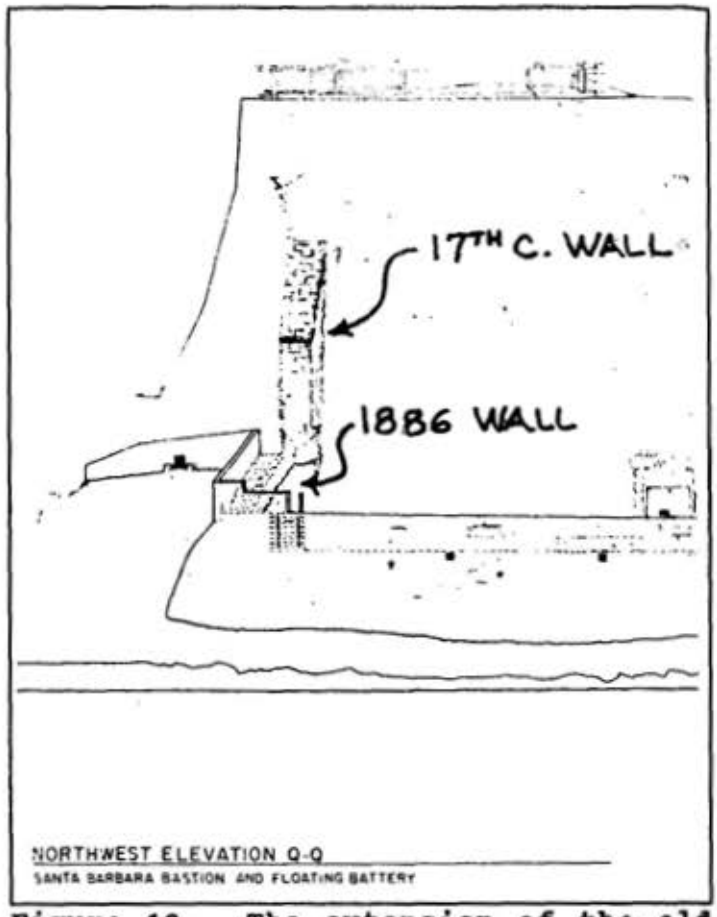


Figure 12. The extension of the old wall is seen going up the scarp; at the base is the 1886 rubble wall.

Above the battery on the harbor side (described by O'Reilly as ". . . composed of various walls of different thicknesses . . ."), Granados was an open space, or plaza on the 1741 plan. On this main plaza stood the troops quarters, guard house and the chapel. The chapel was constructed by 1638,[37] and remuilt in 1683.[38] To the harbor side of the guard house (Cuartel de la Tropa, Arruinado) is what appears on the 1741 plan to be a retaining wall, part of the future wall of the Hornwork. This wall steps back in four tiers where it terminates as a double dogleg in plan. Today, the top of this quadruple tier dogleg can be seen 2.25 meters (17 feet) below the west wall of Austria Bastion, standing as an anomalous masonry mass (Fig. 13). Its height marks the lower limit of the pre-1770 Upper Plaza level. In addition, the 1741 plan shows an interior wall returning from this mass toward the ramp to Austria Bastion, forming the southern enclosure of a space to the southeast side of the ramp. This enclosed space was at the same level and connected to the main plaza. Currently, this wall forms the southern wall of the "Triangular Chaira", accessed from the Austria Bastion ramp. (These stairs are mislabeled in the current waylds sign as existing in 1741. This is not the case since the other two walls forming the triangle are part of the post-1770 construction.)



Figure 13. Seventeenth c. masonry retaining wall. (U.S. Corps of Engineers, 1924, RAJU NHS files.)

On the southeast side of the ramp, across from the triangular stairs at the plaza level, is the entrance to the post-1770 magazine (to be described later). Over the entrance is an arch forming the end of a vault extending over the passageway leading to the magazine. At the springing point of this arch is a line formed by the slight (3 centimeters) projection of the lower wall surface in front of the surface above. This line extends to where the wall meets the ramp and is at an elevation of 40 meters (128.5 feet) above sea level. Scaled off the 1741 section, the elevation of the Austria terreplein is approximately 39.5 meters (129 feet), approximating the line on the wall. Therefore, it is assumed that this line represents the level of the seventeenth-century Austria Bastion terreplein. This being true, then the terreplein was raised about 2.5 meters (11.5 feet) to its present height during

the post-1770 construction. (This work included the rebuilding of the horseshoe as shown in the archaeological described above.)

Prior to the construction of the existing Austria terreplein ramp, there was another ramp in the same location. This earlier ramp, as shown on the 1743 plan, began at the point near where the present ramp turns at an angle to the left (see HABS Drawing H). At this place there is what appears to be a wall, about 1.5 meters (4.5 feet) high, built across the earlier ramp to the height of the existing ramp surface; an extension of the present ramp continues from this wall to the terreplein of the main plaza. In raising the terreplein of Austria Bastion (ca. 1771), the Spanish would have had to increase the length (or increase the slope) of the ramp in order to reach the height of the new terreplein; an increase of 3.5 meters (11 feet) in height. If the ramp was extended only at the upper end, it would have taken up too much space in the new terreplein. Therefore, they had to extend the new ramp at both ends. To do this they built the wall across the low end of the old ramp, increasing its height by 1.5 meters. Following the footprint of the old ramp, it was extended to the level of the new terreplein. The extension increased the height 3 meters (4.5 feet) at the upper end. It was then a matter of extending the ramp down 1.5 meters (5 feet) from the ramp cross wall to the main plaza floor. The surface of the pre-1771 ramp must be about 1.5 meters below the surface of the present ramp.

The spaces occupied by the present magazine and a portion of the museum were once the "Plazas vacas del Flanco",[29] open to the sky and used for firing through the orillón to enfilade the entrance gate. The floor levels would have been about the same as the main plaza and nearly that of the present magazine. Access to the spaces within Austria Bastion was probably through the existing passageway to the magazine. Seen in this passageway, at the springing line of the vault, is the evidence of filled cavities that may once have held wooden beams that rested the passageway, supporting the masonry terreplein above.

On the sea side of the fort, below Carmen Bastion,



Figure 14. Only remaining seventeenth c. embrasure - Marcado B. (Photo by E.B. Oliver, 1990.)

is the Mercado demi-bastion (referred to as "Medio Baluarte de Texada" on the 1742 plan). Constructed in ca. 1602,[26] it served as a battery to enfilade the seaward side of the hornwork as well as the northern curtain wall. This bastion retains the only remaining, pre-1770, embrasure in its western wall (fig. 14). The north and west walls may be part of the original construction (these have a cordon just below the embrasure line, typical of the seventeenth-century construction as seen at el Cañuelo; the cordon on the hornwork may be reused from the earlier works) but the east wall was rebuilt during the post-1770 construction.

These conclusions are based on observations of the existing fabric of the walls, the lack of cordon on the east wall and plan overlays. (Overlays were made through the use of photo-copies of historic drawings, printed to the same scale. An 1861 plan was xeroxed onto an acetate transparency and placed over the print of the 1742 plan.) The 1742 plan shows a wide ramp leading from Mercado Bastion up to an intermediate level that was connected by a narrower ramp to what now is Carmen Bastion ("Batería del Diablo" on the 1742 plan). Access could be made from this intermediate level to Santa Barbara Battery, via the curtain wall, and a wide retaining wall upon which the 1770's great wall was built. (It has been expressed by previous writers, that access to the lower levels in the seventeenth century was made using the triangular stairs on the harbor side of the fort. This is incorrect since these stairs are post-1770. There is no evidence of a means of descent on the harbor side of the fort, and the change in elevation is too steep to allow an efficient means of descent without a ramp or stair.) Evidence for the wide ramp to Mercado can be seen in the sea-side of the existing wall supporting the present covered ramp and stair (gallery) to this bastion (fig. 5). The line of stones that formed the top of the ramp parapet still are evident, as is the corner of the wall were the ramp leveled and turned toward the main plaza. This ramp wall is of the same period as the construction of Mercado Bastion (ca. 1602), since this ramp is its only means of egress.

Granados Battery, previously mentioned as providing access to the Low Battery, was constructed in ca. 1702.[27] It provided room for additional cannon for the harbor defense without having to raise the level of Santa Barbara Bastion that would have been required to achieve a level terreplein for the additional cannon, as was done later. Spain seems to have done as little as possible to improve the fortress during the late-seventeenth century. Judging from comments made about the construction, what was accomplished often was done in a parsimonious manner. There was reason for this caution in obligating funds. By the middle of the seventeenth century Spain had been bankrupt by almost continual war in Europe and was never again able to rise to the greatness of its Hapsburg past.[28] This fact may help to explain why the fortresses of San Juan were often described as being in poor condition.

It is doubtful if any of the early (seventeenth century) elements of the land defense still remain. (The portion of wall uncovered by the archeological team was part of the hornwork and had been demolished in the 1770's.) The existing walls probably follow closely the footprint of the earlier construction. Part of the process of identifying changes in the wall alignments has been the use of an overlay of the 1861 Castro plan with the 1742 plan. Although the scales of these plans are not precisely the same, nor is the accuracy of each equal, they are very close; similar enough to indicate the change in alignment of existing walls with those on the 1742 plan. Close scrutiny of the overlays show many areas that obviously have been rebuilt in their entirety during the late-eighteenth century. The north walls of Ochoa and the Carmen bastions were entirely rebuilt judging from the overlay and the similarity of the construction to the east wall of Mercado Bastion. As will be explained later, the whole of the hornwork walls most likely are post-1770.

Other areas that appear to date from the pre-1770 period are the outer bay of the entrance portal (not the vaulting), possibly the west facing wall of the Austria Bastion, and the lower portion of the tunnel to the tower room. In addition, walls by the sea that formed part of the land defense on the 1742 plan and seem to have been abandoned in the late-eighteenth century, still have sections remaining, albeit in poor condition (fig. 15). These walls are found on the far side of the most outside Ochoa and Carmen bastions.

A portion of a retaining wall remains seaward of the moat. Based on construction and the early plans, it is believed that these walls are from the first quarter of the seventeenth century with some rebuilding during the twentieth century using rubble and limestone slabs.



Figure 15. Remains of seventeenth c. retaining wall at the sea end of the counterscarp. (E.B. Oliver, 1990.)

At the other end of the moat, on the harbor side, is the San Fernando Battery (Bat. del Fosso on the 1742 plan). The access to this battery is by a ramp that descends from the moat floor to the floor of the battery. In the pre-1770 period, this battery was longer then at present judging by differences between the 1742 plan and now. These earlier walls still remain visible below the existing parapets, and a change in the elevation can be seen by a variance in the material of the cheek walls of the ramp. These differences indicate an increase in height of about 1 meter (3.25 feet) between 1742 and ca. 1773. This would mean that the moat level at the top of the ramp to San Fernando Battery in 1742, was slightly more than 0.5 meter (1.7 feet) lower in elevation than the moat floor near the counterscarp at that time (see **Table of Elevations** on page 16). This data indicates that before the construction in the 1770's, the moat floor sloped more than at present, dropping less than 1 meter on the harbor side and dropping at least 3 meters on the end toward the sea, judging by the difference in elevation that exists today at the moat cross wall (see below for further discussion of this wall).

The remains of the pre-1770 counterscarp, seaward of Ochoa Bastion, are less than a meter above the level of the moat floor in this area. (On the top of this older wall are portions of later construction, possibly eighteenth-century, raising its height.) This must be the counterscarp appearing on the 1742 drawing because, at the point where it meets the ca. 1780 cross (retaining) wall of the moat, can be seen the beginning of a curve; the stone is cut to form an arc. Such a curve in the counterscarp is located here in the 1742 plan. The later material on top of the earlier wall does not follow the curve, but runs straight to the cross wall of the moat and dates from the post-1770 period. From this evidence it would appear that even the moat floor, seaward of Ochoa Bastion, has been raised to near the level of the counterscarp top, probably after the cross wall was built, so that the 1742 (and presumably seventeenth-century) floor level must have been about 2 meters below the present floor level in this area. This means the moat floor must have dropped in elevation more than 4 meters (15 feet) from the center of the hornwork to along the seaward side of Ochoa Bastion. (A change in elevation of this amount explains why Ochoa Bastion was constructed in two levels prior to ca. 1780.)

Transformation: 1765-1790

Beginning ca. 1770, el Morro underwent a major period of construction. The result of these changes is the fort we see today. It is assumed that the cause of the construction was the need to modernize or improve the defenses of San Juan, partly as a result of the increased fire power and range of naval guns, and also because of the ruinous condition of the works as described by Marshall O'Reilly.[29] For the first time, it is during this period we see a concentration of fire power seaward in both el Morro and San Cristóbal. The North Casemates (seaward) are built at San Cristóbal, the city wall is begun along the north shore and completed on the harbor side and, much of the work at el Morro increases the number of guns covering the sea approach as well as improving the harbor-side defenses.

With the work at the end of the eighteenth century, el Morro became a single entity; a fortress that functioned as one, protected from land attack, guarding the entrance to San Juan harbor, with good internal communications. A major part of this construction was increasing the height and thickness of the walls as well as the height of certain bastion terrepleins. This change in height is best seen by comparing elevations. The elevation differentials can be computed by comparing dimensions in the **Table of Elevations** (see page 16). Dimensions are scaled in Castilian feet (pies), then converted to metric and English measurement using the 0.92 factor to convert from pies to feet. It was as part of these changes that Mercado Bastion had the present stair gallery added (1774[30]) to enclose the ramp and its walls thickened; except for the short west wall that appears to retain the seventeenth-century thickness of the walls as described by O'Reilly, and depicted on the 1742 plan. Some of these changes are described in the 1765 proposal prepared by O'Reilly:

> In order to remedy all the aforesaid inconveniences and that having so many separate batteries, very difficult to serve well, all have been reduced to two; one high that occupies the land front; the other low for all that concerns the seacoast. This will be attained by the terrepleins that will be formed in the part where . . . the irregularity of angles is corrected as far as the terrain has permitted, and the special thought that was taken of not increasing expenditure beyond what was very necessary for the defense of the fortress.
>
> Taking advantage of the thick wall that is found within the castle . . ., it will be raised a sufficient height to form a small plaza in the upper part of the castle in which will be made the strong buildings permitting the extension of which the castle so greatly lacks. This wall will cover the buildings and the garrison from the fires that may come from the sea.

> In the low part of the castle from the above mentioned thick wall remains a space very ample for a large cistern, and an ammunition storehouse.
>
> The Sea Bastion [Ochoa] will be made sufficiently large and serviceable, placing the low part at the level of the high and raising both flanks . . .
>
> At a distance of two hundred and twenty tuesas [375 meters (1215 feet)]from the castle is found an elevated area, . . . the Calvary. It is planned to lower it until it is dominated by the fire of the castle. Its earth will fill a hole in its northeast slope.
>
> At a distance of seventy-four tuesas [125 meters, 400 feet] from the moat of the castle extends a ravine that opens at the north beach . . . It runs parallel to half of the front, and from its beginning to the sea it is 110 tuesas [187 meters, 605 feet] long, twenty to thirty tuesas [34-50 meters, 110-165 feet] wide and from twelve to eighteen [pies] feet [3.4-5.0 meters, 11-17 feet] deep, which will be very favorable to the enemy for advancing his attacks. It has been judged essential to grade all this terrain and to fill the ravine with what is taken from the neighboring heights until it is left in clear view and dominated by the fires of the . . . castle bastion itself.[31]

O'Reilly also proposed the construction of a ravelin in front of the entrance to the fort. This was never constructed although it was again proposed by Ramirez in 1793.[32] The anticipation of this ravelin may have been a contributing reason for increasing the elevation of Austria and Ochoa Bastions since this would be necessary for the guns of these bastions to be able to fire over any proposed ravelin located in front. As previously mentioned, the remains of the earlier hornwork wall were located along side of, and used as a foundation for, the existing hornwork flanking wall of Austria Bastion. A reason for its demolition may have been the lack of scarp or batter, assuming this condition extended to all sides, or the fact that the only foundation was a partial course below grade.[33] Because of the lack of stucco on the face of the seaward end of the Ochoa moat wall, an area covered by earth until the ninth tee of the golf course was built by the U.S. Army (fig. 16)[34] exposing the stone, it can be assumed that this wall, and all of the present hornwork, date from the post-1770 period of construction. That this wall surface of Ochoa was covered with earth at the time the wall was built, explains the lack of stucco. The earth fill is associated with a short retaining wall that closes off the seaward end of the moat. Both the wall and earth fill are indicated on a 1784 plan[35] of the fort. The short wall does not appear in plans prior to ca. 1780, and without the wall the area of fill could not be held in place. (This short cross wall closing the end of the moat was associated with the last phase

in raising the Ochoa terreplein.) In addition, the reason for building the short wall was to have a retaining wall for the fill used to raise the east floor level by about 3 meters (10 feet), in order to increase the height of the counterscarp, and thus, increase the slope of the glacis as recommended by O'Reilly. Therefore, the short wall, fill, and the wall of Ochoa Bastion must date from the post-1770 period of construction as does the wall of Austria Bastion. It is therefore reasonable to conclude that the whole of the walls between these two locations also are of the same period, including some of the walls beyond. In essence, the walls from the harbor side of Austria Bastion, through the hornwork (with the possible exception of the curtain), to Mercado Bastion, were all built during the post-1770 period of construction (fig. 17, showing dates for various elements on the plan). There are two old plaques, one in the southeast wall of Austria Bastion and the other in the same facing wall of Ochoa Bastion. These plaques date the construction of the bastions to 1686. However, the plaques could easily have been saved and rebuilt into the late-eighteenth century walls with the other reused material.



Figure 16. Area at the base of Ochoa Bastion, originally (1770s) covered by earth and having no stones. (Photo by E.E. Oliver, 1999.)

The great wall that O'Reilly recommends be built ". . . taking advantage of the thick wall . . ." that already existed at the lower level of the pre-1763 fort, was to become one of the most imposing features of el Morro. Under the direction of Engineer Thomas O'Daly, this wall, and the great ramp that descends from the upper plaza to the terreplein of Santa Barbara, was constructed in the mid-1770's and completed by October 1776.[4] O'Daly's report of January 1776 states:

> In the Castle of el Morro continues the train of works in the construction of the great wall that divides the castle in

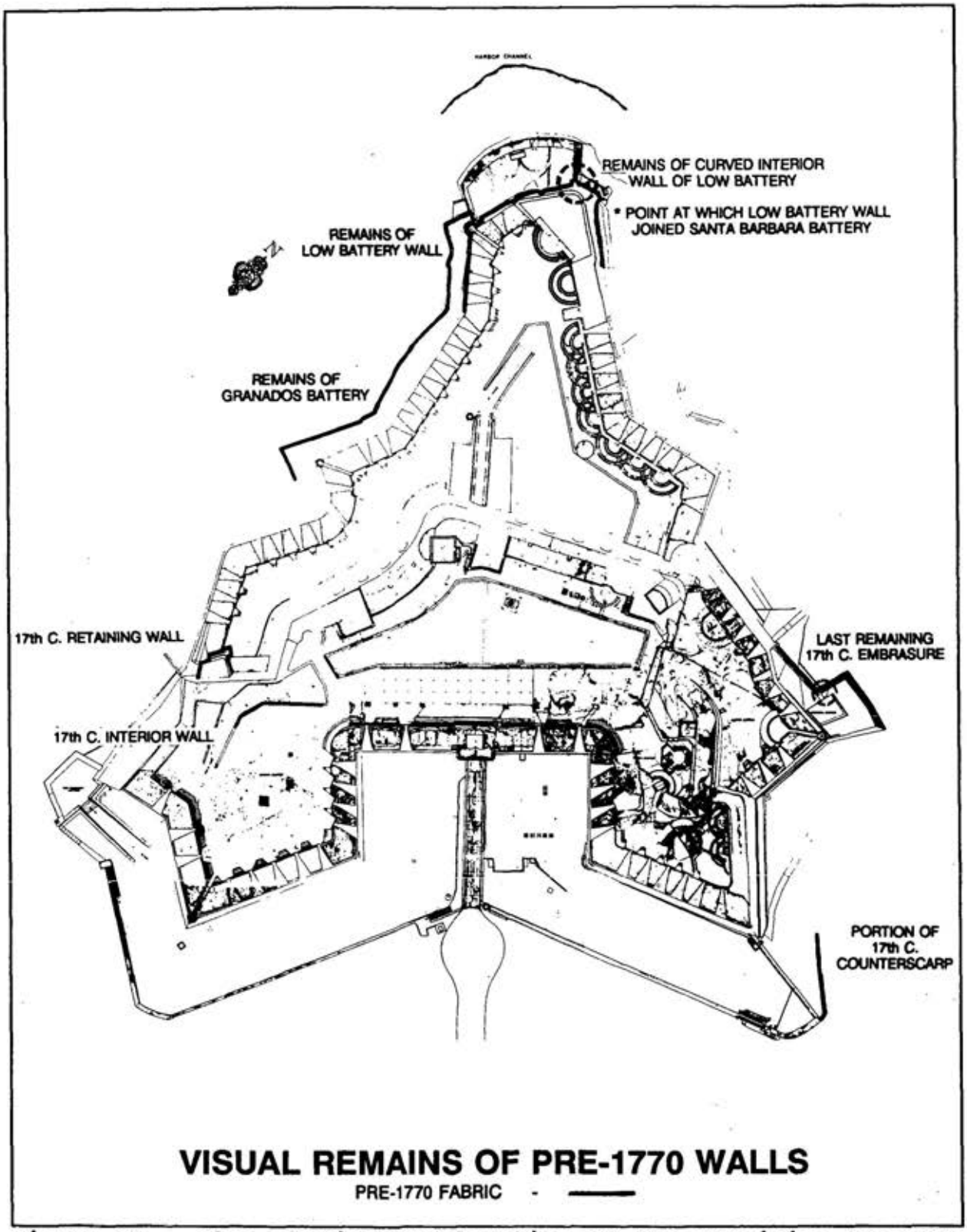


Figure 17. Plan showing the location of the remaining pre-1765 historic fabric at the fortress. (HABS, ca. 1960.)

> high and low parts, whose object and use I have explain in my last report, and I hope that in this month will end the foundations uniting it with the San Phelipe [sic] Bastion. Meanwhile the remainder that was begun on the east side is raised to the level of the High Plaza, and four buttresses with stanchions of the strong vaults that should be constructed in all the upper circuit of the castle. The difficulty and cost of excavations continues until encountering firm ground in order to assure the consistency, and firmness of this part, all possible means being practiced with great pains in order to guarantee its solidity and permanence.[9]

As part of the construction of the wall, a large cistern was built, filling the void under the main plaza. On the surface of the plaza was a cistern head (similar to that of a well) from which water could be drawn. (The present cistern head is a reconstruction by the NPS after 1960.) For the great wall to have been built by 1774,[10] the terreplein of Santa Barbara already would have to have been raised, or its elevation determined, so the ramp could end at the correct level. In raising the elevation of the Santa Barbara terreplein, the old Granados Battery, of which O'Reilly was critical in his 1765 description, was filled and used as a foundation for the harbor side of the extended Santa Barbara terreplein.[11] Evidence for this can be seen on the 1742 plan. A small triangular projection (a guard post) exists at the transition point to the Low Battery, just below the wall of the then smaller Santa Barbara Bastion. The configuration of the present foundation wall supporting the Santa Barbara harbor wall, follows that of Granados Battery as depicted on the 1742 plan, including the small triangular projection (fig. 6). If one follows the outer wall of the foundation (the old Granados Battery) westward, the height drops down, as the Granados wall does on the 1742 plan, to the remaining fragment of the Low Battery (fig. 18) leaving no doubt that the Granados Battery exists under the later fill that



Figure 18. Harbor side of Santa Barbara B., showing the line of Granados B., the triangular sentry post and the fragment that was the beginning of the Low Battery. (Photo by E.B. Oliver, 1990.)



Figure 19. Detail of 1784, Mestre plan. (Servicio Histórico Militar No. 5795, Madrid.)

transformed it into a supporting element. (The evidence of these wall fragments also supports the conclusion of the higher elevation of the Low Battery over the present Water Battery elevation.)

Ochoa Bastion was raised in height beginning in 1771, as was Austria Bastion,[42] but not as recommended by O'Reilly. Prior to 1765, Ochoa Bastion was of two tiers, with an upper and a lower level (see the 1742 plan). The reason for the two levels was the rapid drop in elevation toward the sea from the level of the hornwork moat. In order to avoid the construction of massive foundations and a high retaining wall on the sea side, the Spanish, in raising the levels of Ochoa Bastion during the 1770s, maintained the two tier configuration. Later, a 1784 Mestre drawing (Fig.

19) proposed the increase in elevation of the seaward side of Ochoa Bastion. In 1786, before a 1787 earthquake that caused some damage to this bastion, the seaward side of Ochoa was raised to the existing elevation, and the Ochoa terreplein became one continuous level, equal in height to Austria Bastion and the curtain wall terreplein.[41] It is curious that prior to the seaward level being raised, the upper level is shown in the 1784 drawing with three embrasures on the southeast wall facing the moat (fig. 19). This same drawing proposes three embrasures on the northeast (seaward) side of the raised wall. A May 12, 1787, Mestre drawing, after the terreplein elevation has been increased, shows three embrasures on the northeast side, and five embrasures on the southeast wall (see historic drawing 21 in Volume I). From this document, it would appear that after the increase in elevation, the southeast wall had five embrasures. However, today there are six embrasures. Either the drawing is incorrect, or when the two en barbette guns were installed on Ochoa in the 1850s (discussed below), an additional embrasure was added at the corner; this seems unlikely if the Spanish were going to a different gun arrangement, one that did not require embrasures. It is possible that the wall was rebuilt after being damaged in the earthquake. However, a 1793 drawing (Historic Drawing 24, Volume I) proposing a ravelin, shows four embrasures on the southeast wall. This seems impossible. The simplest assumption is that after the terreplein was raised, the southeast wall had six embrasures, as it does now, and that what we see in the drawings are inaccuracies that may be attributed to focus, due to the fact that the drawings are either a plan of the city as a whole, or one depicting a proposed ravelin; the number of embrasures may have been irrelevant.

Along the top of the "great wall" (fig. 5), at the upper plaza level, casemates were constructed, forming a cavalier. (In this section, the main Plaza de Armas will be referred to as the Upper Plaza, elev. 117.5′; the floor levels of Austria and Ochoa Bastions are terrepleins, elev. 140′, as is the floor of Santa Barbara Bastion, elev. 75′; and the lower Plaza de Armas is the Lower Plaza, elev. 56′.) These casemates served several purposes including: housing for troops stationed at el Morro, kitchen, latrine and embrasures for cannon. On the walls of the casemates, where eighteenth-century material still survives (excluding the casemates used for the kitchen and latrine) is left the imprint in the original plaster of a double cross (fig. 20). Each cross was approximately 53 centimeters (21 inches) high, with a wooden peg at its base containing a wrought iron nail, 60 centimeters (24 inches) above the floor. The walls on either side of the casemates had these crosses spaced about 1 meter (3.25 feet) apart. The crosses had been removed at a later date, probably by the Spanish judging from the red/beige mortar used to fill the voids. It is possible that the crosses are from the imprint of original brackets (the original plaster has sharp edges showing that it was applied wet when the bracket was in place) for supporting sleeping platforms along each wall.

Part of the post-1770 work included a chapel, built into the first vaulted casemate to the west of the entrance; near the earlier chapel location on the 1762 plan. A row of vaulted rooms, of which the chapel is one, was built at this time along the rear of the curtain wall. This work was done to widen the terreplein above, as recommended by O'Reilly. One of these spaces, second to the east and now used as a lunchroom, retains an original eighteenth-century wooden door judging by the aged appearance, the hand-worked surface of the wood, and the hand-wrought nails used in its fabrication. The present iron grill over the small look-through in the door is not original; evidence of mortises for a similar, but earlier, grill remains. In 1786, [42] the present classical monumental entrance gate (in the Tuscan order) was added with the coat-of-arms of the then Spanish king, Carlos III, placed in the pediment (see HABS Drawing 1). (The present coat-of-arms is a replacement by the NPS.) Connecting this gate to the counterscarp was a new, arched-masonry, entrance bridge with a drawbridge (bascula) at the point where it met the curtain wall. Judging from the type of masonry construction employed in completing the last section that fills the gap left by the bascula, it (the bascula) was removed later in the nineteenth century. This would have been done after 1841, since the bascula is represented on the Castro drawings. (Historic Drawings 28 and 31, Volume 1). The space arrived at upon entering the fort through this gate, may date from the seventeenth century, however, the vaulting above is post-1770, constructed as part of the increase in wall height because the height of the vault is above the level of the earlier terreplein. The second bay in this entrance dates from the post-1770 construction, and contains fragments in the west wall of what may have been a gun rack. This assumption is based on the curious slanting alignment found in these fragments, formed as if to lean something the length of a musket against the wall.



Figure 28. Double cross imprint in the casemate wall plaster, possibly from a bracket. (E.B. Cliver, 1992.)



Figure 21. Only remaining unaltered el Morro seventeenth c. sentry box, on Santa Barbara B. (J. Boucher, HABS, 1960.)

Another feature that is typical of the post-1770 work is the sentry boxes (these have become a symbol of San Juan, and are found on automobile license plates). Almost decorative in character (fig. 21), they are located at the corners of walls (city and fortress) where the most opportune views for detecting intrusion existed. The present type of sentry boxes, from the post-1770 period, are characterized by their ogee curved domes with finials, and the corbelled rings, resting on a ball, supporting the boxes at the bastion corners. The earlier sentry boxes from the seventeenth century were simple in appearance, having only a semi-spherical dome over the cylinder of the guard space. Rather than being corbelled out from the corner, as are the later sentry boxes, they merely sat on a circular slab built into the curved corner of the wall. Only two of these seventeenth-century sentry boxes remain; one at el Cañuelo (ca. 1660)[17] seen in fig. 22, and the other on el Explgón (mid-seventeenth century), below San Cristóbal. Evidence remains of the circular supporting slab for the earlier sentry box of the North Bastion at San Cristóbal; this is now part

of the curved corner of that wall that has been raised in elevation above the level of the old sentry box.



Figure 22. A seventeenth c. sentry box on el Cañuelo, 1957. (SAJU NHR Archives.)

Modifications: 1790-1866

With the completion of Ochoa Bastion, el Morro took on the general appearance that we see today. Following the construction in the latter part of the eighteenth century no major construction projects were carried out at el Morro, with the exception of cleaning and the application of a new coat of stucco to many of the masonry surfaces. Again (1821), as had happened so often in its history, el Morro was described as being in "abandonment,"[41] necessitating another campaign of repairs. This work occurred during the period from 1824 to 1833,[42] and involved the application of a white, lime and sand, stucco over the masonry surfaces. By 1861, based on colors in the Pastor elevations and evidence remaining on the walls, some wall surfaces had been covered with an ocher-colored coating (see **MATERIALS** section in this volume). Also, gutters were installed (ca. 1810) along the embrasures at the gun platforms and down the edges of the ramps. Included in this work were the small vaults under banquettes to allow passage of the gutter (fig. 33). The 1824 initiated a period of programmed maintenance during which the fort was kept in good condition through periodic repairs.[43]



Figure 33. Small banquette vault. (Photo by J. Jacob, 1989.)

Primarily, the nineteenth century saw alterations for incorporating new types of gun emplacements, and included the addition of a lighthouse and signal tower. The addition of the first type of modern gun emplacement can be seen in Santa Barbara Bastion at its western end. Between 1844 and 1854,[44] four embrasures were eliminated (filled in) and positions for two newer guns (possibly mortars, or casemate) en barbette were built. This work is characterized by an iron pintle with three arcs (the inner arc is missing on what visibly remains) of dark basalt on the

terraplein surface, to which iron tracks once were fastened (Fig. 24). A raised wooden platform, on which the gun was placed to fire above the parapet, pivoted around the pintle supported by wheels running on the tracks. (Eventually the U.S. Army built a large gun emplacement in this area covering most of the left-hand installation and raising the floor elevation to the height of the parapet top.) Similar stone tracks are found in the first Santa Barbara casemate west of the casemate that leads to the tower tunnel. Others probably existed in other casemates (most of the evidence has been lost with the installation of new concrete floors). Iron pintles still remain in each of the eight casemates. In addition, there are two gun emplacements of the same construction, with the iron track and pintles still in place, on the seaward side of Gunna (Fig. 25; also see HABS drawing 2). These emplacements were covered with earth in the late- nineteenth century (1897) when breach-loading rifles were installed, and reopened in the 1910s by the U.S. Army (see below). (A similar installation to that of the 1850s is found at the top of the main ramp at San Cristóbal.) This early modernization of the artillery involved the en barbette (above the parapet) installation of four guns at El Morro, and installation of an additional eight guns in the Santa Barbara casemates.



Figure 24. Tracks for an 1850's gun emplacement; note groove in dark stone from the iron rail. (Photo by E.R. Oliver, 1984.)

Confirmation of these mid-nineteenth century gun emplacements is seen in the 1861 Centro drawings that show the embrasures missing (filled in) in the two area of Santa Barbara Bastion (these drawings do not show terraplein gun emplacements).[44] It is interesting to note that this change, and others following in the nineteenth century, have guns that face exclusively toward the sea, no longer oriented to a land or harbor attack. Defense was shifting entirely against naval bombardment.



Figure 23. Two 1850's gun emplacements on Cohoe Bastion. (Photo by E.B. Oliver, 1996.)



Figure 24. Santa Barbara Bastion with filled embrasures, 1918-19. (NAJU WNS files.)



Figure 27. Tracks for 1842's gun emplacements on Santa Barbara Bastion. (F. Boucher, NADS, 1960.)

On a drawing dated 1866,[48] proposing stucco repairs to the area of the Water Battery, embrasures on the north (ocean) side of Santa Barbara Bastion are missing (filled in), indicating the emplacements found on this level had been installed by that date. The installations on the Santa Barbara Bastion in the 1860s involved filling in the embrasures on the north side (fig. 26). (These embrasures remained filled until the 1930s, when the U.S. Army restored the embrasures to their earlier conditions.) At this time the sentry boxes were cut down, flush with the tops of the merlons, in order to have a clear field of fire for the en barbette cannons that now could pivot above the parapets allowing a wider field of fire.

The 1860's emplacements (fig. 27) are characterized by having two tracks of a lighter colored limestone without evidence of iron rails and with a different type of pintle using four wooden posts as part of the support (not much remains of this material). Although not much evidence remains, it appears that four emplacements in the Water Battery were installed as part of this work since they also exhibit the four wooden post pintle support.



Figure 28. Iron carriage for an 8in Sathetts gun emplacement, Battery Park, Charleston, S.C. (Photo by E.H. Oliver, 1989.)

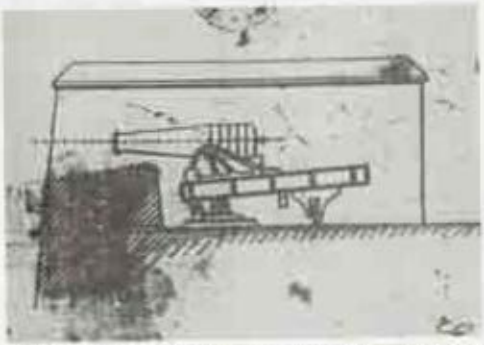


Figure 29. An 1879 drawing for a gun emplacement in Havana, Cuba. (Servicio Historico Militar-España, Madrid, drawing # 031-098.)

Based on the archaeological work done in 1960, an 1886 wall[50] covered a portion of the track of the northern most emplacement.[51] Therefore the installation must pre-date 1886, and may have been abandoned at that date. Emplacements with a single track of similar material are found on Carmen Bastion, however these emplacements had guns of a more modern breech-loading type. Guns installed during the 1850s and '60s would have been of the muzzle-loading type, similar to those installed before, and after, the Civil War at fortifications in the United States (Fig. 28). There exists a drawing of a similar type of installation for Havana, Cuba, dated 1876 (Fig. 29). At the end of the American Civil War, American Parrott rifles and Rodman smooth bore, muzzle-loading, cannons were being purchased by the Spanish government for Cuba (and possibly Puerto Rico).[52] These may be what were installed in the 1860s. During the 1870s and 1880s,[53] more modern breech-loading emplacements were proposed but never seem to have been installed.

Near the end of the nineteenth century (1894-97) the Spanish began the installation of the breech-loading rifles and howitzers that had been earlier approved.[54] At el Morro, these installations still can be seen on the terreplains of Carmen, Ochoa and the high wall;[55] the howitzer installation on Austria Bastion was dismantled by the U.S. Army in the 1910s (see below). Semi-circular walls were built behind which the guns were placed en barbette, and at each of the three emplacements on the high wall terreplein, magazines were built (Fig. 32). The construction of these walls was similar to much of the nineteenth-century construction; they were built of a rubble and red/beige mortar, reinforced with double courses of brick spaced about 0.5 meters (20 inches) apart, and cover with a lime and sand stucco. (This stucco has since been covered in many locations with a Portland cement coating, giving the appearance of poured concrete.) On Carmen Bastion the two emplacements used the existing parapet and date from 1894.[56]



Figure 30. Near the center of the photograph is the crane used for raising ammunition from the magazine below. In the background are the 15 cm. Ordoñez rifles. (EAJU WHS files.)

The nineteenth century also saw the construction of a lighthouse on the Austria Bastion. In 1876 this structure was relocated to the Ochoa Bastion replacing an existing signal tower. A portion of the lighthouse base still remains, supporting the present lighthouse. The old lighthouse tower base, with a new platform

built on top, was left on Austria Bastion to serve as a signal tower for communicating with San Cristóbal and with ships entering the harbor (see discussion of the **Lighthouse**, page 55).

New Ownership: 1898-1958

Three weeks before the U.S. Army formally occupied el Morro, a survey was conducted by the Americans. El Morro was found to have ". . . been repeatedly struck by projectiles from Admiral Sampson's squadron during the May 12 bombardment. No serious damage had been suffered, and all but two or three of the damaged areas had been repaired."[47] (This statement is inconsistent with the repairs that were later accomplished at el Morro.) The armaments found at el Morro were: 2 15-cm.Ordoñez rifles mounted behind the parapet of Carmen Battery, 3 15-cm. Ordoñez rifles, mounted on barbette on the terreplein above the high wall casemates, and 2 24-cm. howitzers mounted on Austria and Ochoa terrepleins (one each); these were the guns the Spanish had installed in the 1890s, and that were returned to Spain in 1904.[48] No other guns were found installed in el Morro.[49] Following the Spanish evacuation, the damage caused by the bombardment was documented by Maj. Edwin A. Root of the Corps of Engineers (a copy of this drawing exists in the park files). The drawings Maj. Root prepared indicate 26 areas where naval shells had struck and where repairs were needed.[50] An estimated cost for the repair of this damage was over $2,000.[51]

Little in the way of major projects was done by the U.S. Army at el Morro in the years immediately after the American occupation. El Morro and its outworks generally were in good condition. However, minor work was undertaken in 1902 that included repairs to the ". . . lower level (Santa Barbara) sentry box damaged in the May 12, 1898 bombardment,"[52] and the conversion of the semaphore



Figure 21. Semaphore tower on Austria Bastion, after the 1902 alteration. Ca. 1913. (SAJU NHS files.)



Figure 32. Aerial view of el Morro, ca. 1919. (SAJE NHS files.)

tower into a position and range-finding station. This involved the removal of the roof and razing of the upper portion of the walls for sighting purposes.[91] (Figure 31 shows the tower in 1931 after the upper portion had been removed in 1930.) During these early years of American occupation, the water supply for el Morro was from the large cistern under the main plaza, and was pumped to a 2,310 gallon water tank by a windmill. It was decided that the garrison required about 5,000 gallons per day and a proposal was made to convert an old masonry magazine, located above the salty port, into a 10,000 gallon storage tank;[92] eventually, this work was done, for the removal of the "concrete water tank" is listed as an item in the 1938 restoration proposals.[93] (The concrete water tank can be seen in fig. 32.) As part of the improvements to the water supply, in 1903, the cisterns were drained, cleansed, and whitewashed.[94] Later (by 1923 judging from photographs) a large steel water tower appears on Austria Bastion (fig. 33).

Electricity was first installed in el Morro in 1901,[95] and was extended to additional areas within the military facilities in the following years. In the spring of 1918, the U.S. Army installed, along with two other coast artillery installations, a 8.72-inch Armstrong breech-loading rapid-fire rifle on the top of the Santa Barbara Bastion.[96] (This gun remained in this position until its removal in 1942.)[97] The lighthouse, which had been damaged during the war, was rebuilt in 1899, and after a partial collapse, rebuilt again in 1908 (see **Lighthouse** on page 96).

Damage to the walls that had resulted from the war, was not repaired until the 1920s. In 1916, a proposal and estimate for work was prepared that included filling in "... a shell hole near the northeast angle of El Morro," and replacing a section of wall just east of this angle.[98] Initially, the American repairs, begun in 1919, were crude, little more than filling the voids with Portland cement, and hatching or scoring the surface of the patch to give the appearance of joints (this type of repair can be seen on the west wall of Mirrado Bastion). As identified by Maj. Root, the salient corner along the north wall of Santa Barbara Bastion

had received the worst damage, with much of the corner and wall toward the postern gate missing (fig. 33). Here, the void was filled with a poured concrete. (In the process of doing this work the sentry-box, that had been in the salient corner, was not replaced.) This type of insensitive approach by the U.S. Army was severely criticized in the local newspaper, El Mundo. The district engineer agreed with the local preservationists that it was desirable for the new work to "harmonize" with the old, and that this could be achieved by inserting stone into the repair, so as to ". . . harmonize with existing walls."[39] However, when the wall near the angle was repaired in 1939, the work was not done to harmonize with the old, judging by what remains; such attempts at harmony would come later. (Reese indicates that this wall was poured concrete faced with stone; our investigation found it to be exposed concrete showing only marks from the forming.)



Figure 33. Santa Barbara salient damaged during the 1898 bombardment, 1935. (SAJU HRS files.)

As previously mentioned, in the 1930s the military again planned work at El Morro. In 1933, the district engineer was requested to prepare a program ". . . for preservative and repair of the San Juan fortifications."[40] The military had difficulty in obtaining appropriations for this work, and it was not until April 1938, that a project was started; one that would last until May 1940.[41] A change in method was needed and the Army seems to have tried their hand at restoration. This change also employed a different material in the wall construction. It is a composite block made of pieces of the same stone used elsewhere in the walls, cast in a block with a lime mortar, and cut into 8 centimeter (3 inch) thick square slabs, 31 centimeters (12 inches) on a side. These slabs are found in the restored areas of Santa Barbara and Carmen bastions, along the interior surfaces of the merlons and in other wall surfaces repaired at this time. (See the section on materials for a more detailed description of this material and its use.)

This new work, begun by the U.S. Army in 1938, included the following projects for el Morro:

(1) The sentry boxes (one on Carmen and one on Santa Barbara), that had the upper portions removed by the Spanish in the nineteenth century, were restored to their present appearance (fig. 34); a second sentry box on Santa Barbara Bastion at the salient, was intended to be reconstructed, but was eliminated from the work. (The sentry box on Austria Bastion had been reconstructed as part of an earlier project, but is not listed by Bearss.) The restoration used a cast-stone block for the wall and cap (the drawings for the molds are found in the park archives) that was set in place with mortar but left without stucco. The original post-1765 sentry boxes were made of brick with stuccoed surfaces. One of these eighteenth-century sentry boxes remains, unaltered, on the harbor side of Santa Barbara Bastion (fig. 21).

(2) As part of the work, wall and floor areas were filled, patched and repaired; these repairs to the walls employed the composite blocks described above (page 45). Earth fill over the earlier (1880's) gun emplacements on Cubos Bastion was removed, exposing the metal tracks (fig. 25). The 1880's gun emplacements were repaired and coated with a cement plaster. On the curtain terreplain, a new terrazzo floor was laid down.

(3) In its efforts to restore el Morro the Americans opened the embrasures that had been filled by the Spanish as part of the en barbette artillery modernization of the 1860's (fig. 27). This was part of the restoration of nine embrasures as well as the rebuilding of two embrasures on the north side of the Santa Barbara terreplain, and the restoration of all the embrasures and firing steps (banquettes) along the west side of Santa Barbara. Other embrasures also were restored or repaired on Carmen Battery, where the incinerator had been, and in the casemates off the plaza, judging by the number of embrasures cited on this level.



Figure 34. Rebuilt sentry box on Austria Bastion. (J. Boucher, HABS, 1940.)

(4) The stairs and ramps also were repaired during this effort. Repairs were made to the stairs from the "Upper Patio" to the "Lower Patio" (probably the triangular stairs, although they do not go all the way to the lower plaza), and to

the circular stairs from the Santa Barbara terreplein to the lower plaza. In addition, the stairs leading from the tower room to the Water Battery were repaired, as were the stairs and ramps of the "subterranean passage" (gallery) to Mercado Bastion. This last project specified the type of material and technique that is found in all of the stair repairs: "Repair stairs, treads and risers using brick and concrete similar to former construction."[4]

(5) The erosion caused by the wave and current action at the Harbor entrance, that has been implicated in the demise of the Low Battery below Santa Barbara Bastion, again had taken its toll. Work was required to plug the holes and rebuild portions of the wall, including the reapplication of facing stone (fig. 35). In this same area, the northwest corner of Santa Barbara Bastion, the wall that had been damaged earlier in the bombardment was rebuilt.

(6) The effort to preserve fortifications of "historical interest", resulted in the Army removing an incinerator that had been constructed earlier by the Americans, on the exterior wall at the junction of Ochoa and Carmen bastions (fig. 36). Also removed from the terreplein of Austria Bastion in this zeal of restoration were: the water tower, built by the Army earlier in the century; the before stated 1898's mortar emplacement on the Austria terreplein, built by the Spanish; and the signal tower, constructed by the Spanish on the base of an earlier lighthouse when that lighthouse was relocated to Ochoa Bastion in 1874. (See fig. 32 for the location of these structures.) In addition, a small eighteenth-century magazine structure (fig. 37, called a storeroom by the Army) located at the toe of Santa Barbara Bastion was demolished. The footprints of these structures still remain visible in the terreplein paving. As part of the removal work, the ventilators for the magazine below were rebuilt on Austria Bastion, as well as other



Figure 35. Sea wall work, ca. 1940. (U.S. Army Corps of Engineers, SAJU MSS files.)



Figure 36. Ochoa and Carmen Bastions with stack from incinerator at center. (SAJU NHS files).

ventilators on the curtain terreplein. Also, during this period, a wall located in the lower plaza, running north to south, was removed leaving evidence of its existence as patches in the corner of the Santa Barbara casemate wall (fig. 35).

World War II saw additional changes to el Morro. A new harbor defense system was planned involving the construction of coastal batteries for 6-inch guns at Escambron Point and Punta Salinas, and a 12-inch battery at Catano Island. To accompany the new artillery, eleven fire control stations were required. A multi-decked "manhole", or fire control station was built on the high wall at el Morro, as well as two searchlights were located on the Santa Barbara Bastion (fig. 19). This new work, involving the use of reinforced concrete at el Morro and San Cristóbal, was begun in 1942. During construction, and in response to a new need for a separate harbor defence command, plans were initiated for a communications bunker built. It was built in the el Morro moat just east of the entrance adjoining the entrance bridge and filling the space between it and the Ochoa flanking wall. Work was completed in November 1942.[74] (A similar bunker was constructed in the San Cristóbal moat.) As part of the Caribbean defense two SCR-296 radar towers were



Figure 37. Small eighteenth c. building at the toe of Santa Barbara Bastion, demolished in 1940. (Col. F.J. Parra, SAJU NHS files.)



Figure 36. Inside corner of the Santa Barbara terreplein where earlier masonry wall had been. (J. Boucher, HABS, 1960.)



Figure 39. World War II search light track at the east end of Santa Barbara Bastion; demolished. (F.C. Ojeening, 1957, park files.)

constructed during the winter of 1941-42: a 50-foot tower on the northeast bastion of San Cristóbal, and a 75-foot steel tower on el Morro's Ochoa Bastion.[77] In addition, a visual signal station was constructed at the same time on top of the high wall of el Morro over the center 155? gun emplacement (fig. 40). This consisted of a single deck concrete manhole or platform. These features at el Morro and San Cristóbal remain today as important elements of the role the San Juan fortifications played in the last significant phase of their military history.



Figure 40. World War II concrete signal platform on top of the high wall, existing. (HAER HHH files.)

An additional element that has left its traces upon the fabric of el Morro was a small "officer's latrine",[78] later converted to a ladies room. This structure was built on the Caronen terreplein between the ramp and the parapet wall (fig. 41) and has since been demolished. The erosion of the rock cliffs on the channel side of Santa Barbara bastion continued to present problems.[79] Work again was done in this area by



Figure 41. World War II latrine, demolished. (J. Boucher, HAER, 1960.)

the Corps of Engineers in the early 1960s.[84] By the first half of 1955, the Army was beginning to pull its activities out of el Morro and to turn responsibility for the fort over to the NPS.[85] Earlier in that year the NPS had proposed the restoration of the el Morro chapel. The project was carried out during March and April of 1956 (fig. 42).[86] In 1961 official title to the site passed to the NPS.

With the completion of the World War II elements, the evolutionary history of fortification at el Morro ends. The changes that followed, such as the removal of U.S. Army buildings, and several attempts at restoration and adaptive use by the NPS, have been carried out in the name of a new educational and interpretive purpose.



Figure 42. Elevation of the Chapel. (J. Boucher, HABS, 1960.)

This nineteenth-century structure originally was built on Austria Bastion. The facts surrounding the original construction of this structure are well documented in "El Morro Lighthouse Expediant No. 160", located in the park files. Prepared in 1884, this document was transcribed from Castilian Spanish to modern Spanish by Dr. Maria de los Angeles Castro of the University of Puerto Rico, and translated into English by Gregorio Batista in 1981.[84] The early information on the lighthouse is taken from this document.

Plans for building the lighthouse at San Juan began in 1844, with a survey of other Spanish lighthouses in the Caribbean to determine the best type of tower to construct. The lighthouse at the entrance to Santiago Harbor, Cuba, was considered to be a good model, provided that ventilation problems found there could be corrected. This Cuban lighthouse had a cast iron tower and lantern manufactured by the Seat Point foundry in New York. Originally, in September 1844, it was recommended that the light be of the French type (Fresnel), on a masonry tower, built on a stone base. Approval for the project was granted in December of 1844, by the Board of Commerce for Puerto Rico. The approval recommended that a cast iron tower be built, and as a result, the Spanish Consul in New York was instructed to contact Mr. H. P. Dunham and Company for the manufacture and construction of an iron tower and lantern. The tower was to be located at the entrance to San Juan Harbor, at the high point of El Morro Castle, 138 feet above sea level. (Today the terreplein of Austria Bastion is about 140 feet in elevation.)



Figure 41. 1846 Spanish lighthouse relocated to Ochoa Bastion. (SJAFU HHS files.)

On April 16, 1845, an agreement was initiated with Dunham and Company of New York City, owners of the foundry. The agreement called for a tower and lantern of cast iron. The tower was to be ". . . in an octagonal shape about 18 feet high, 10 feet in diameter at its top."[85] On the interior the stairs were to be made of forged (wrought) iron stringers with wooden steps. The exterior

of the tower was to be made of cast iron sheets joined with well aligned iron rivets. A ventilated copper cupola was to surmount the lantern. A lightning rod was then to be added to the top of the cupola. The lantern ". . . will be (about) six feet high by six feet in diameter," with the mullions made of iron, installing the glass plates ". . . like the ones used for similar lights in the United States."[86] The light was to be operated by a clock so that it would flash at one minute intervals. It was intended that the whole of the lighthouse ". . . be subject to approval by Winston Lewis who has been in charge of and has manufactured (almost all) the lighthouses for the United States in the last 35 years," or another person if so designated.[87] This agreement was signed on May 20, 1845.[88]

The base for the lighthouse tower was to be constructed of stone obtained from a stockpile outside the San Justo Gate. Built under contract, the base was to be complete in two months time so that the tower could be placed upon it. This contract was let to bid on June 18, 1845. An objection to the use of stone outside the gate was raised by the Commandant of Engineers but a reply was written in July, the disagreement settled, and the lighthouse constructed by August of 1846.[89] An inspection dating to August 1846 revealed some problems that required correction:[90]

1. The light continued to get stuck in its rotation, thus the flash signal identifying the light was incorrect.

2. The lightning rod was too short by 2 feet.

3. It was recommended that the lightning rod be capped ". . . in order that it can attract meteors." [?]

4. At its base, the lightning rod required attachment to ground.

5. The reflectors had lost much of their reflecting quality (this indicates that a Fresnel lens system was not purchased since the Fresnel lens did not require the reflectors, but concentrated light with lenses and prisms.)

6. Evidence indicated that the tower leaked.

Because of the reported corrosion of the reflectors, etc., it is assumed that the inspection report was done some months after the completion of the lighthouse. Therefore, it is assumed that the lighthouse was completed by early 1846.[91]

The earliest view of the lighthouse is in the elevations of the Castro drawings of 1861. These drawings show little detail. However, a drawing of September 10, 1867, shows the lighthouse, in detail, on its Austria terreplein base (fig. 44).[92] The British Sailing Directions for 1859, give the elevation of the light as 174 feet above sea level.[93] Considering that the terreplein has an

elevation of 140 feet and that the tower was to be 18 feet high and, scaling from the drawing in figure 44, the height of the stone base was approximately 7 feet and the focal plane of the light was about 4 feet above the tower top, the light would have been 29 feet above the terreplein or, 169 feet in elevation.*

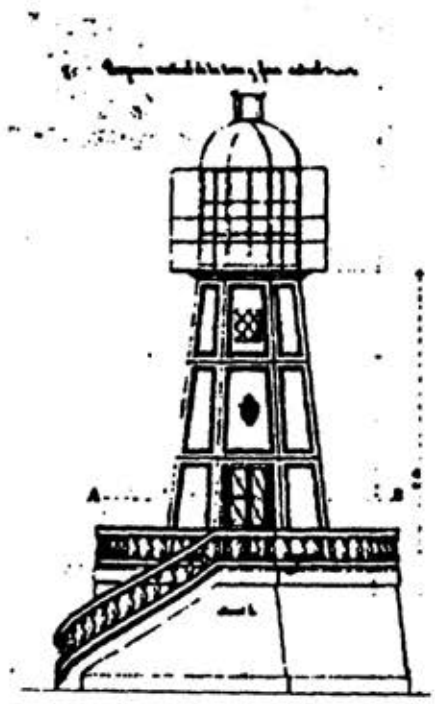


Figure 44. 1868 - Drawing of the lighthouse on its first base located on the Austria terreplein. (AHN)

In 1876, the lighthouse was relocated to the terreplein of Ochoa Bastion[94] where the present lighthouse now stands. Plans for this move were begun in 1868. A drawing dated July 27, 1868 shows the proposed base for the lighthouse as it was to be relocated on Ochoa Bastion.[95] Another drawing, dated March 22, 1878, shows the lighthouse in its new location (fig. 45). Here, the tower appears very much as it does in the photo in figure 43. By scaling the height of the tower in figure 45 a dimension of 18 feet is obtained, the same as that found in figure 44. The U. S. Hydrographic Office's Sailing Directions for 1877 and 79, refer to the tower as being "iron", and "new," standing 171 feet above sea level.[96] The reference to "new" may only mean the new location. An iron tower would have been relatively easy to move because it could be disassembled and moved more economically than constructing a new tower.[97] The base at the new location was 4.15 meters (13.7 feet) high and the focal plane of the light about 3 meters (10 feet) above the platform at the tower top. These dimensions give an elevation for the light of approximately 182 feet, a difference in elevation of about 11 feet to that given by the Sailing Directions. Drawing no. 988,[98] dated December 24, 1880, is a french drawing for the installation of the Fresnel lens. A reason for the difference in the elevation may be that in 1877 and 1879 the old lantern still remained on the tower with the light at a lower elevation. At the new location the tower was placed on an octagonal base made of brick (this base still remains). In addition to a new location, the tower was painted ". . . dark gray and white."[99]

On Austria Bastion, the old lighthouse base remained and a new semaphore tower was erected on it in 1885.[100] This is the same

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* **The 174 feet may indicate the top of the lantern; if measured in Spanish *pie* the figure would be higher.**

semaphore tower demolished by the U. S. Army in 1940 and shown in figure 31. The foot print of this structure remains on the Austria terreplein as a patch on the surface.[101] One side of this patch projects beyond the circular shape on the base, indicating the location of the stairs that went up on the outside of the structure to the level of the tower base. A similar base was duplicated, with the exterior stair, on the Ochoa terreplein.

During the bombardment by the American ships in 1898, damage was done to the Spanish lighthouse, necessitating its removal by the U. S. Army.[102] In its place a "56-foot octagonal brick tower" was constructed in 1899, having a light elevation of 171 feet.[103] (The 56 feet must have been to the top of the lightning rod as explained below.)



Figure 45. 1877 - Drawing of the lighthouse on its Ochoa terreplein base. (AHN)

A photograph of this tower exists (fig. 46). A 56-foot high tower, if built directly on the terreplein (140-foot elevation), placed the light at least 196 feet above sea level; even higher considering the light would be positioned 4 to 6 feet above the top of the tower. The lighthouse in figure 46 looks very similar, in height and detail, to the lighthouse in figure 43. The difference between the lighthouses is in the width of the platform at the top of the octagonal tower and in the solid crenelated parapet replacing the balustrade on the stairs and at top of the base. The structural pattern seen on the tower of the older lighthouse is gone from the tower of the American structure. A drawing prepared by the U.S. Army in 1905, shows this 1899 lighthouse on a sheet with the proposed new lighthouse.[104] A note on the earlier lighthouse states, "Present Tower as <u>rebuilt</u> [emphases added] in 1899 by the Navy Dept." The drawing shows the old tower having a crack just below the lower platform with the notation, "cracked entirely through and around tower." The height of the focal plane of the light, as measured on this drawing, is 42.5 feet above the terreplein (182.5 feet in elevation).

Figure 47 shows work being done on the American lighthouse. In this illustration the lantern is missing, but the other elements seem to be in place. The similarity in size and form of the 1899 tower to the earlier Spanish structure suggests the possibility



Figure 46. First American lighthouse, built on the base of the damaged Spanish lighthouse. (National Archives, 24-LG-42-13B.)

that a portion of the Spanish tower remained within the "rebuilt" American tower. This first American lighthouse lasted only a few years, proving to have been poorly constructed, and the present

square brick tower (fig. 48) was completed in 1909,* on the old 1876 base.[101]



Figure 47. Work being done on the first American lighthouse, ca. 1900. (SAJU NHS Archives.)

In 1910 the light was given as being "... 1st order, lenticular, (with a) 1875 French Sautter, Lemonnier & Cie lens installed in 1900."[102] The question is raised, "Is this the same light that was installed in 1876?" Fresnel lenses were expensive, and if the lens had survived the bombardment, would it not have been reused? If the 1876 lens had been damaged, and a new lens installed in the first American lighthouse, it would be expected that at least this lens would have been reused. It would appear that the 1875 Fresnel lens remains in use in the lighthouse today. In 1932 the earlier weight driven clock mechanism was replaced with a new electrically driven mechanism, and by 1947 the light was automated.[103] By 1937, the monochrome gray color scheme on the exterior had been changed and the lighthouse exhibited a new appearance of cream with brown trim.[104] Today it is painted a monochrome cream that is severely deteriorated.**

Conditions

The failure of the paint coating and roofing system has allowed water to penetrate the masonry. Because of the location of the lighthouse, the effect of sun and wind have created a rapid evaporation cycle. This cycle has caused a continuing deposition of salts in the brick masonry. In crystallizing, these salts expand and cause a fine breakdown in the brick, turning portions of the brick to powder. The wind in turn acts on the powder,

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* A plague on the lighthouse indicates a date of 1906.

** The lighthouse was polychrome earlier under the Spanish, see fig. 43.

blowing it away until the next rain causes the cycle to begin again.

The underlying reason for the brick deterioration, in addition to the paint failure, is found in the type of mortar used in the 1908 masonry. Similar deterioration does not occur in the 1876 brick masonry, although a loss of paint also has occurred on this surface. Brick with older mortar remains intact because the older mortars used lime for a binder, not the Portland cement found in the 1908 mortar. Lime based mortars are more permeable than the brick, allowing the moisture in the masonry to evaporate through the mortar, not through the brick. The Portland cement mortar is less permeable than the 1908 brick, forcing the evaporation to occur through the brick, not through the mortar joint. When evaporation takes place through the brick, salts are deposited in the brick. (The deterioration may actually be slowing down since much of the "softer" or more permeable bricks have long since disappeared.) This mechanism is the same cause of deterioration found in the north terreplain of Austria Bastion, and in the brick of banquettes, embrasures and parapets throughout the fort where Portland cement has been used for repairs.



Figure 48. Present el Morro lighthouse. (Photo by R.B. Oliver, 1990.)

In 1979, plans were prepared for the repair of the brick. A cost for the rehabilitation of the el Morro Lighthouse was estimated at $26,000.[110] Funds were transferred to the NPS by the Coast Guard in July. However, in August 1979, as part of the Section 106 compliance process, the State Historic Preservation Officer for the Commonwealth of Puerto Rico ". . . suggested that no action be taken on the proposed rehabilitation of the lighthouse."[111] Rather, it was recommended that a new structure be built, one that would be "less offensive architecturally."[112] As a result, the funds were returned to the Coast Guard for obligation

before the end of the fiscal year and nothing was done at that time.[112]

Today, the deterioration of the brick is extensive. In addition, rust jacking occurs where steel beams are inserted into the masonry. This jacking is exhibited by horizontal cracks that run along the joints below the parapet and near the bottom cordon of the square portion of the tower. This type of deterioration will occur at an accelerated rate because the cracks allow the entry of salts. As the width of the cracks increases, more salt-moisture can enter, resulting in an increase in oxidation. When oxidation occurs, the rust expands with great force (similar to ice formation or salt crystallization), causing stress cracking in the brick masonry unit. The alternatives for correcting these problems are dealt with in the section on **RECOMMENDATIONS** found in Volume I of this HSR.

NOTES

1. Ricardo Torres-Reyes, "Structural Development of El Morro: 1539-1600", an unpublished manuscript, p. 1. It is stated that the funding for the work at the promontory was approved on April 18, 1539.

2. Ibid.

3. Sepúlveda Rivera, A.; San Juan, Historia ilustrada de su desarrollo urbano, 1508-1898 (San Juan: 1989), p. 74. A similar drawing is found with this illustration.

4. See the 1765, Thomas O'Daly Plan reproduced in Volume I, Historic Drawings, no. 6. (Servicio Histórico Militar-Madrid)

5. An exact correlation to our present foot is difficult to determine since both the English and Spanish foot varied slightly over time. The following information is taken from Chambers' Cyclopedia of Arts and Sciences, 1752. Chambers compares the units of measurements of various countries with the Paris ell, considered the international standard of measure in Europe, especially in the cloth trade. Such a standard was necessary considering the number of systems in use. Even within a single country, Spain had both a Castilian and Aragonese unit. A French or Paris ell was 3 royal feet, 7 inches and 8 lines (a line is equal to one 12th of an inch), or 3 2/3 pied (royal feet). Chambers expresses the vara (3 Castilian feet or pie) as 17/24 of a Paris ell. An English yard is expressed as 7/9 of the Paris ell. Expressed as a ratio, the relationship between the yard and vara is 51/56 (this is found by using the lowest common denominator for 24 and 9, 72 and, multiplying each numerator by the resultant of dividing 72 by the respective denominator, e.g.: 72/24=3, 3x17=51 and, 72/9=8, 8x7=56). This ratio, 51:56, for the yard and vara is the same for the foot and pie since both are 1/3 of their respective larger units. In other words, 51 feet is equal to 56 pies. Therefore, 51/56=0.9107, or one pie=0.9107′ (10.928") and a vara=32.785". Since both the foot and vara varied with location and time during this period, four decimal places assumes a precision that does not exist. It would be more realistic to say a pie equals 11 inches and, a vara equals 33 inches; 1 pie=11/12 foot, or 0.92′. This yields a variance in precision of about 0.01 foot, or one foot in a hundred. In addition, for purposes of this paper, a pie equals 0.279 meters. Other past comparisons between the pie and foot, or between the vara and inches, fall within a similar range:

The World Almanac (1949) source N.B.S.	pie=0.9142′ vara=32.910"
American Cyclopedia (1871)	pie=0.9273′

vara=33.383"

Appleton's Dictionary of Engineering (1852) pie=0.9195'
vara=33.36"

Gallier, The American Builder's Price Book and Estimator (1833) pie=0.9268'
vara=33.365"

6. Blanco, Juan; A Study of the Morphological Structure of the Systems of Fortifications of San Juan de Puerto Rico with a Special Emphasis on the Development of the "Frente de Tierra de San Cristobal", Unpublished manuscript (done as part of the research for this report), 1988, p. 75.

7. See El San Juan, 1519-1898, Mapas Y Planos En Los Archivos De España, San Juan, 1989, p. 28 for a schematic sketch of the el Morro tower. Torres-Reyes attributes this sketch to a priest, Ponce de Leon (p. 2), in 1582, and gives a description of what can be seen in the sketch. Since the sketch is not precise, and the physical evidence is not obtainable, such speculation is not important for purposes here.

8. Sepúlveda, San Juan, p. 25, for a photograph of this site.

9. Torres-Reyes, "Structural Development", p. 8.

10. Ibid., p. 11.

11. Singer, C. et al, eds. A History of Technology (New York and London: 1957), Vol. III, pp. 360-376 & 471-500.

12. Blanco, p. 112.

13. Ibid., p. 88.

14. H. Smith. "Archaeological Excavation At El Morro, San Juan, Puerto Rico," Notes on Anthropology, Vol. 6 (1962), p. 20. Article indicates that documents show that Cumberland demolished the land wall. However, Blanco states that this was not so (p. 109 & 112), that the only damage that occurred was from bombardment to the curtain wall. In any event, the wall was poorly constructed and was rebuilt.

15. Blanco, p. 114.

16. Smith, pp. 4-5.

17. Alexandre O'Reilly. Proposal of 1765, AGI-SD-2510. From "Translations of documents on SAN JUAN, PUERTO RICO from the Archives of the Indies," 1948-49, translated by Edward Hunter Ross, located in park archives.

18. "Grabado [engraving] de Manuel de Rueda," Museo Naval, No. 10128(2), Madrid, showing the access area on the north of the Low Battery, Separated from the main battery area by the curved screen wall.

19. Plan of the City of San Juan by Thomas O'Daly, August 31, 1772. (S.H.M.-Madrid Num. 5748) This plan shows no access area on the north side of the battery but does show the existing configuration of this battery.

20. Blanco, p. 262.

21. Ibid., p. 119, states in a description by Gonzalo Perez, in 1602, that a curtain wall connected Mercado to ". . . the high platform ending at the mouth of the bay . . ."; this would indicate that the enclosing of the tower and the creation of a high platform, must have taken place after de Salazar's sketch of 1591, which appears to show the tower with its four embrasures (or, at least a small platform containing four guns), and 1602, when the "high platform" exists. Torres-Reyes indicates that the high platform was built by Governor Menendez between 1582-87 (page 7). It is not certain that this high platform is the Santa Barbara Bastion that shows on the 1742 plan; what is seen on this plan, may date from the mid-seventeenth century.

22. Sepúlveda, San Juan, p. 81 (illustration).

23. Blanco, p. 257.

24. Ibid., p. 261.

25. See the 1742 Plan, figure 6. This drawing is attributed to de Abadia by Blanco on page 262.

26. Blanco, p. 115.

27. Ibid., p. 262.

28. Paul Kennedy. The Rise and Fall of the Great Powers, (New York: 1987), chapter 2, pp. 41-55.

29. Alexandre O'Reilly. Proposal of 1765, AGI-SD-2510.

30. Blanco, p. 530.

31. O'Reilly.

32. Felipe Ramirez, drawing, 16 November 1793 showing proposed ravelin. (Servicio Geográfico del Ejército, Madrid. Cart. Ultr. X, cat. 68.)

33. Blanco, p. 258. Indicates that de Vargas stated (1647) that the walls facing the sea were the only ones resting on rock.

34. See "Translations of documents on SAN JUAN, PUERTO RICO, from the Archive de Indies," Edward Hunter Ross, trans. located in SAJU NHS Archives.

35. Juan Mestre, Proposed Plan of el Morro and the Western City Walls, 28 February 1784. (Servicio Histórico Militar.) Proposes the increase in height of Ochoa Bastion.

36. Blanco, p. 533.

37. Thomas O'Daly. Letter dated January 9, 1776, AGI-SD-2506, trans. EHR.

38. Blanco, p. 528.

39. Ibid., p. 501, indicates that Granados Battery had been abandoned because of damage by wave action.

40. Ibid., p. 525.

41. Ibid., p. 534.

42. Ibid., p. 536.

43. Albert Manucy, Ricardo Torres-Reyes. Puerto Rico and the Forts of Old San Juan, (Old Greenwich, CT: The Chatham Press, Inc., 1973), p. 62.

44. Blanco, p. 744.

45. Ibid., p. 745.

46. Ibid., p. 754.

47. Ibid., p. 776.

48. Blanco, p. 776, indicates funding was approved for new guns at Santa Barbara Bastion in 1848.

49. Servicio Histórico Militar-España, Madrid, drawing # 033-074.

50. A copy of a drawing dated 9 October 1886 showing the addition of this wall, was found in the park files. This drawing is entitled: "PLANCHA Y CORTES DE LA BATERIA BAJA DEL CASTILLO DEL MORRO."

51. Smith, p. 52.

52. American Cyclopedia. (New York:D. Appleton and Co., 1873-76), p. 795.

53. Servicio Histórico Militar, Madrid. Drawing # 033-077 and # 033-078, dated 1876, depict the installation of five 24 cm. cannons on the high wall terreplein; these are breach-loading rifles because a loading crane is shown at the breach. Also, see Blanco, p. 778.

54. Blanco, p. 790.

55. A copy of a drawing found in the park files, dated 1897, details the installation of gun emplacements on Ochoa and Austria Bastions, and the high wall terreplein. This drawing is entitled:"Proyecto de Baterías en el Castillo del Morro de 3 CHE de 15.cm y 2 O.H.S. de 24 cm y 3 O.H.E. de 15 cm en al baluarte de San-Antonio."

56. The earlier date for these emplacements is based on the lack of an indication for their installation on the 1897 drawing and the indication by Blanco that emergency work was begun in 1894, see endnote 53.

57. Edwin C. Bearss. Historic Structure Report Historical Data Section: San Juan Fortifications 1898-1958. (San Juan: Department of Interior, NPS, 1979), p. 30. Blanco, who relies on a remembrance (page 779), states that most damage from 1898 was "...refilled shortly after." However, there exists a drawing of the damage resulting from the 1898 bombardment, prepared by the U.S. Army, that shows numerous areas of damage, and was used for the 1929 repairs.

58. Ibid.

59. Ibid., pp. 74-75.

60. Ibid., p. 81.

61. Ibid., p. 89; a copy of a drawing from the National Archives (107-5-1) dated June 4, 1900, located in the park files, shows this proposed work.

62. Ibid., p. 127.

63. Ibid., p. 262.

64. Ibid., p. 131.

65. Ibid., p. 133.

66. Ibid., p. 149.

67. Bearss, HSR, p. 345.

68. Ibid., p. 218.

69. Ibid., pp. 221-222.

70. Ibid., p. 249.

71. Ibid., p. 260.

72. Ibid. This information is taken from "Section XI," pages 249-301, which describes work proposed, and work performed.

73. Ibid., p. 268.

74. Ibid. p. 263.

75. Ibid., pp. 346-347.

76. Ibid., p. 367.

77. Ibid., p. 368.

78. Ibid., p. 370.

79. Ibid., p. 372.

80. Ibid., p. 407.

81. One of the authors (Cliver) was working in San Juan at this time and participated in some of the planning.

82. Bearss, p. 419.

83. Ibid.

84. This document was transmitted to the region by the park superintendent in a memorandum dated April 10, 1981. This is the only information we have on the document.

85. Reference the above manuscript, page 40.

86. Ibid.

87. Ibid.

88. Ibid., p. 41.

89. Ibid., p. 165.

90. Ibid.

91. Edwin C. Bearss. "Brief Chronological History of the San Juan Point (El Morro) Lighthouses" (San Juan: U.S. Department of the Interior, NPS, February 1979). This was the first lighthouse in Puerto Rico, lighted in January 1846.

92. Bearss, "Lighthouses."

93. Ibid.

94. Ibid.

95. Archivo Histórico National (AHN), Ultr PR Carp 33, Drawing no. 967.

96. Ibid.

97. This conclusion is also indicated in an unpublished manuscript by Enilda Cabrera Chinea at the University of Puerto Rico. (Translated by Richard Crisson, NPS, NARO, BCB.)

98. The sequence of Spanish lighthouse drawings were obtained from the Spanish Colonial Research Center (SCRC), NPS, located at the University of New Mexico in Albuquerque, and were researched by Dr. Joseph P. Sanchez at AHN, Ultr PR Carp 33.

99. Bearss, "Lighthouses."

100. Revista del Instituto de Cultura Puertorriqueña, 450 Aniversario San Juan, No. 53, October-December 1971, p. 53. This information came from a marble plaque, location now unknown. (R. Crisson, trans.)

101. A drawing (AHN Ultr PR Carp 33 No. 973) exists of this tower showing a structure very similar to that seen in the later general photographs of the fort.

102. Bearss, "Lighthouses".

103. Ibid.

104. A copy of this drawing is found in the park files.

105. Bearss, "Lighthouses".

106. This information is taken from a National Register Nomination form for "The Lighthouse System of Puerto Rico, 1846-1976," prepared by Dr. Benjamin Nistal-Moret, August 21, 1979.

107. Ibid.

108. National Register Nomination. Paint Chart detailing the lighthouse chromochronology included below.

PAINT CHART
(Chromochronology)

El Morro Lighthouse

Date	1876 Base		1908 Tower	
	Bot. Border	Ext. Brick	Ext. Brick	Ext. Trim
1876	Black	Red		
	Black	Red		
	Black	Red		
	Black	Red		
1908	Black	Dk. Gray	Dk. Gray	White
	Black	Lt. Gray	Lt. Gray	White
	+	+	+	+
	+	+	+	+
	+	+	+	+
	+	+	+	+
	+	+	+	+
	+	+	+	+
	+	+	+	+
	+	+	+	+
	+	+	+	+
	+	+	+	Gray
1937	Red	Lt. Yellow	Lt. Yellow	Yellow
	+	White	White	Cream
	+	Yellow	Yellow	Yellow

109. Letter to the Commander, Seventh Coast Guard Division from the Regional Director, Southeast Region, July 20, 1978, enclosing an estimate prepared by Frederik Gjessing.

110. Letter to Regional Director, SERO from the State Historic Preservation Officer, August 4, 1978.

111. Ibid.

112. Letter to Chief, Logistics and Property Branch, SCGD from Regional Director, SERO, August 8, 1978, with a copy of an accompanying purchase request (marked Cancelled, 8/23).

III. THE CITY WALLS OF SAN JUAN

San Juan National Historic Site
San Juan, Puerto Rico

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INTRODUCTION

One of the main features of San Juan, and one that gives it a sense of identity, is the 3 miles of walls, las murallas, virtually enclosing the historic city and integrating the two other components of this study: el Castillo de San Felipe del Morro and el Fuerte de San Cristóbal. The walls are massive, varying in height from 15 to 60 feet, and in width up to 25 feet. This section of the report provides the historical development of the city walls, placing an emphasis on the remaining 2.75 miles of walls that are under the jurisdiction of the National Park Service (NPS). Portions of the city walls not discussed in greater detail are the .3 miles of walls currently owned by the Commonwealth of Puerto Rico, for this study called the "Commonwealth." An in-depth discussion of the physical conditions and materials of the walls is included in the respective sections, **CONDITIONS SURVEY** and **MATERIALS**, in this HSR. Materials, deterioration types, and proposed treatments are, by virtue of construction similarity, an extension of the generic types of materials and deterioration prevalent at both el Morro and San Cristóbal; by extension, proposed treatments are applicable to all of the fortifications.

The defensive walls are believed to have been built originally as thick rudimentary masonry walls reinforced with batteries. They were eventually reinforced or reconstructed as triangular masonry bastions connected by straight sections of curtain walls. Most of these walls were thick and solid, battered, with sloping parapets and firing steps, and embrasures for heavy artillery. Batteries and bastions were carefully designed to avoid blind spots and to provide numerous gun emplacements directed outward. Now considered decorative, circular sentry boxes were placed at the appropriate salient angles to provide shelter for lookouts.

Many elements of the city walls were assigned religious names reflecting a custom of naming defensive elements of the fortifications in honor of religious figures. The belief being that the specific fortress, bastion, battery, or gate thus named was protected by the patron saint. Crucial defensive elements were named after more important saints: i.e., the main gate to the city of San Juan, la Puerta de Santiago, was named after Saint James. In history, Santiago was known as the military patron saint, and in Spain as conqueror of the moors.[1]

The fortified walls have been inspected and documented for hundreds of years. Still valid today is the 1925 description of the city walls by Colonel Ladue of the U.S. Army Corps of Engineers:

The old walls and bastions consist throughout of a facing of rough sedimentary coral rock blocks laid in courses from 18 to 24 inches high backed up by smaller pieces of rocks and bricks, the joints being wide and filled-in with smaller pieces of rocks and mortar made of brick dust, clayey sand and lime. Only the face of the coral blocks are dressed to a certain batter, the wide open joints on the outside being filled and smoothed off afterwards with mortar in which a larger percentage of lime was used.

The footings are built of coral blocks laid with very close joints and consist, generally, of two courses of large blocks projecting from 2 to 4 feet beyond the outer face of the wall and laid with some regularity.

The walls are surmounted by a parapet or breast wall varying in width from 12 to 16 feet with a declining slope outward and with frequent gun emplacements and embrasures. This parapet is constructed with a retaining wall in back and the area between the front and back wall is earth filled, surfaced with coral blocks, the interstices of which are filled with mortar.

The walls vary in height from 30 to 100 feet and follow the configuration of the natural bank or cliff which was available at the time they were built and which consists in its greater part of sedimentary rock in stiff clay and sand. In many places the walls are not retaining walls since in such places they sustain no appreciable lateral pressure, but are face walls laid with practically a uniform thickness of 3 to 4 feet, against the face of the bank which was thinned down to permit this method of construction. The walls were reinforced at certain points with counterforts, rectangular in plan, about 5 by 8 feet, constructed of coral blocks bonded into the main structure, and extending practically the full height of the wall." [2]

The development of San Juan's city walls can be said to have begun around 1540. This arduous task was to take more than 250-years, due to the sporadic nature of available money and manpower. Puerto Rico owed its defenses, in large part, to the generosity of the Spanish crown and to the fortunes obtained from South America, neither one of which was completely dependable. The history of San Juan spans a time period of nearly 500 years; the defensive city walls and its complementary fortresses exemplify one of the greatest and most extensive surviving examples of the Spanish fortification system in the world. The foreseeable task of the twentieth century is to maintain, preserve, and perhaps, restore, the city walls so that they may stand for future generations. In

order to facilitate the discussion that follows, the city walls are, for the most part, discussed chronologically and in a counterclockwise direction, beginning with the earliest section of walls on the west, Recinto del Oeste (West Precinct); proceeding south, Recinto del Sur (South Precinct); continuing east, Recinto del Este (East Precinct), and terminating with the most recent of walls to the north, Recinto del Norte (North Precinct).

EVOLUTION: THE SIXTEENTH CENTURY

The earliest fortifications in Puerto Rico were those defensive buildings constructed as casa fuerte (fortified houses) for the early colonizers. The best surviving example in San Juan is la Casa Blanca (the White House), built by the family of Juan Ponce de Leon shortly after the founding of San Juan in ca. 1520.* When constructed, the main defensive purpose of Casa Blanca was to protect its inhabitants from Carib Indian raids.[3] Casa Blanca was conveniently situated on a bluff that was eventually integrated with the city wall defensive system (the building today overlooks the curtain wall of San Agustín). More importantly, Casa Blanca overlooked the entrance to the harbor. San Juan harbor, measuring 3 miles long by less than 2 miles wide, was always considered a "safe harbor," because many ships could be anchored and protected from the rough seas. It was the only harbor on the north coast of Puerto Rico that afforded protection in all weather, since it was shielded on the north by the relatively high land mass of the Islet of San Juan, and on the south, east, and west by the mainland of Puerto Rico. (See figures 1, 2 and 3.)

Soon thereafter, between 1537-40, the first of San Juan's permanent fortifications was begun. La Real Fortaleza de Santa Catalina (Royal Fortress of Saint Catherine), known today as la Fortaleza, was also situated facing toward San Juan Harbor.** La Fortaleza originally consisted of a circular tower with a crenelated top, but was then subsequently enlarged (fig. 4). As described in the General Management Plan for San Juan National Historic Site:

> La Fortaleza's walls were about 2 meters thick. Its main gate (sally port), facing inland toward the town, was protected by a small demilune. On the shore side stood a circular tower (the present north one) that provided vantage points for defense. The south tower was added toward the end of the sixteenth century. The area between la Fortaleza and the shore was enclosed by a high wall prepared to emplace a cannon.[4]

Even before la Fortaleza was finished, its poor defensive location was harshly criticized. Notable visitors, including writer and historian Gonzalo Fernandez de Oviedo, denigrated the site and suggested instead that the rocky northwest point

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*Casa Blanca is under the jurisdiction of the Commonwealth of Puerto Rico.

**La Fortaleza is also under the jurisdiction of the Commonwealth of Puerto Rico.

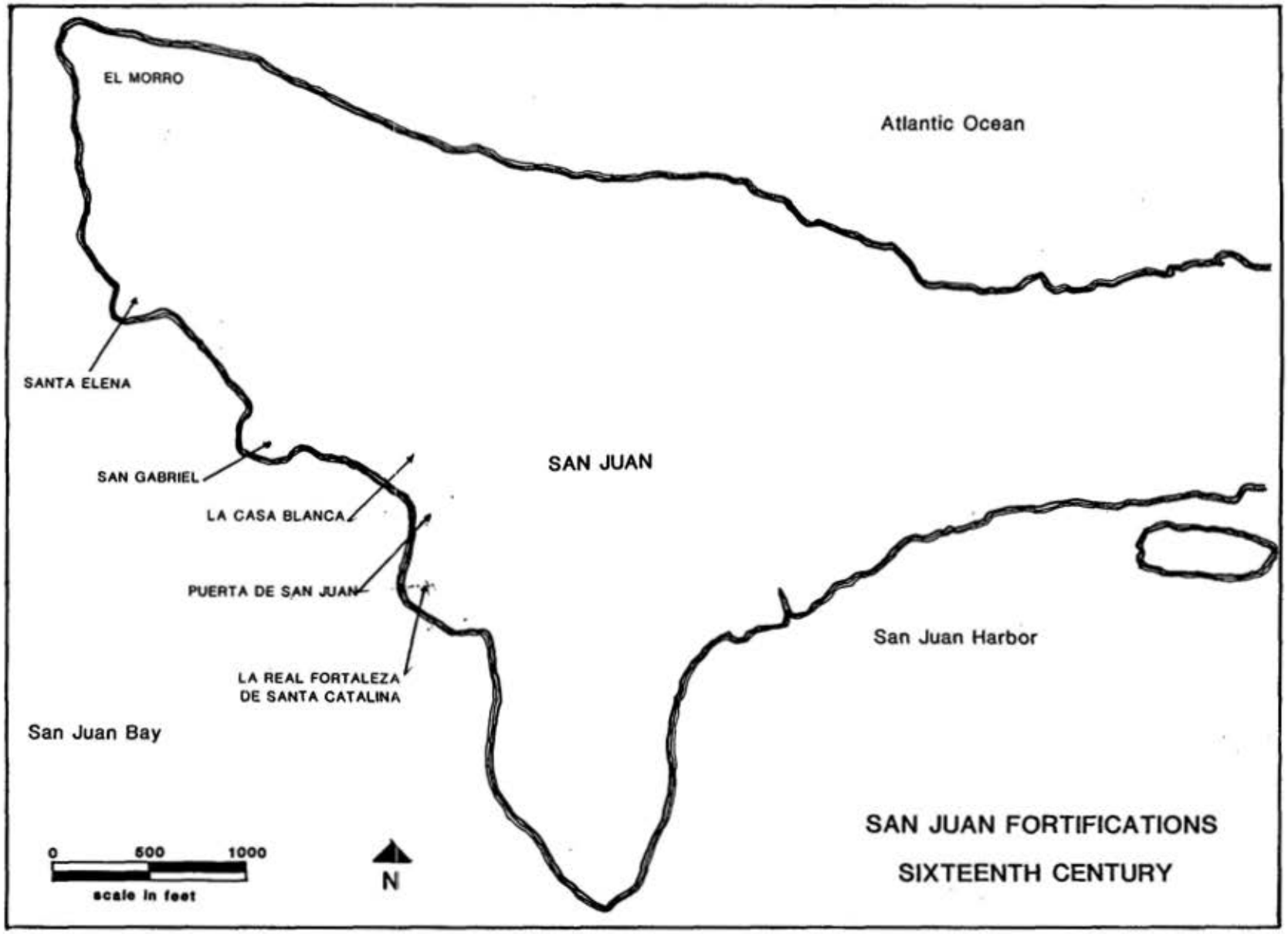


Figure 1. San Juan Fortifications in the sixteenth century. (Plan drawn by K. Faust and annotated by R. Crisson, 1991.)



Figure 2. West Wall - San Agustin salient angle near San Juan Gate, Casa Blanca in background, ca. 1904. (Capt. H.E. Cambell Collection, SAJU NPS Archives.)



Figure 3. Casa Blanca [West Wall] - overlooking San Agustin Bastion, ca. 1864. (Capt. B.K. Gambell Collection, SAJU NHS Archives.)



Figure 4. (West Wall) - Santa Catalina Bastion with San Juan Gate in foreground and la Fortaleza in background, ca. 1904. (Capt. R.E. Gambell Collection, SAJO NHS Archives.)

of the islet of San Juan, called el morro (the bluff or headland), be fortified. La Fortaleza soon lost its defensive purpose and by 1570 had acquired its non-defensive role as the official residence of Puerto Rico's chief executive.[5] La Fortaleza is today under the jurisdiction of the Commonwealth of Puerto Rico.

In 1539, the same bluff recommended by Oviedo was chosen as the site for el Castillo de San Felipe del Morro, commonly known as el Morro. El Morro evolved as a vertical fortress, designed to enhance the natural topography of the site and rapidly became the key defensive component of the walled city. El Morro is discussed in detail in Volume III of this report.

Recinto del Oeste

As noted earlier, the earliest portion of the city walls to be constructed was that facing west and toward the harbor entrance, between el Morro and la Fortaleza. This portion of wall was historically called el Frente Maritimo y Entrada del Puerto (Maritime Front and Harbor Entrance); later, when José de Navarro labeled the four quadrants of the city, the west precinct became Recinto del Oeste.[6] Today, the only evidence of the precinct's name, although abbreviated, is the short street called Calle Recinto Oeste, adjacent to la Fortaleza and directly in front of San Juan Gate.

The only feature of the west wall that dates to the sixteenth century is el Baluarte de Santa Elena (Bastion of Saint Helena). Dating to ca. 1586, it is commonly known as Santa Elena. Immediately south is a point of land that contained la Batería de San Gabriel (Battery of Saint Gabriel); San Gabriel was later reconstructed and renamed San Agustín. San Gabriel was considered "ancient" in plans of the nineteenth century, but its original date of construction is unknown. La Puerta de San Juan (Gate of Saint John), for this study referred to as San Juan Gate, is situated directly below la Fortaleza, and may have existed in some form as early as 1540. In the first sketch of the proposed site for San Juan, commissioned by Rodrigo de Figueroa and sent to the King of Spain in 1519, this area is designated as puerto (port).[7]

The city walls facing west were designed to enhance the defenses of the natural cliffs rising from sea level to the high bluff of el Morro. Some of the cliffs south of el Morro were considered impregnable due to the roughness of the terrain; thus, man-made walls were apparently not considered necessary. The west wall became a defensive entity as part of the 1588 plan of defense for San Juan. King Philip II commissioned Juan de Tejeda and the Italian engineer, Bautista Antonelli, to execute a master plan for shore defenses in San

Juan.[8] The quickly executed plan was in direct response to Sir Francis Drake's attack of 1585, whereby many of the Spanish islands surrounding Puerto Rico were attacked and invaded by the English.

The revamped San Juan defenses accomplished their mission to defend a sea attack when tested first by Sir Francis Drake in 1595. They were useless, however, three years later when Sir George Clifford, third Earl of Cumberland, attacked from land via the unfortified east front. Sir George held possession of San Juan between June and August of 1598, but was forced to abandon the city when dysentery plagued his troops. Nevertheless, the english troops left the city in ruins upon their departure.

Rebuilding work began in 1599 and proceeded rapidly; it concentrated mostly on refortifying el Morro and repairing the far easterly defenses (near the present-day San Geronimo Fort and San Antonio Bridge). Across the harbor entrance, the Spanish built el Fortín de San Juan de la Cruz (Fort of Saint John of the Cross)* usually known as el Cañuelo.[9] At the close of the eighteenth century, and much to the regret of the Spanish, no work had started on the south, east or north fronts of the city.

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* Situated on Isla de Cabras (Goats' Island), the original timber-constructed el Cañuelo was designed as an auxiliary fortification for the harbor defense system, capable of cross-firing its canons with those of el Morro. Though el Cañuelo is now under NPS jurisdiction, it is not part of the present study.

EVOLUTION: THE SEVENTEENTH CENTURY

The task of rebuilding the fortifications of San Juan continued in earnest until 1619; the work was soon put to test. Defenses proved ineffective in 1625, when Dutch General Boudewyn Hendrickzoon sailed into the harbor, past the guns of el Morro and the musket fire of Santa Elena. His troops ransacked and burned the city during their month-long siege.[10] This harsh lesson convinced the Spanish that they must enclose and fortify the city. The Spanish crown agreed to the great cost of the project because Puerto Rico was recognized for its strategic importance. King Philip IV of Spain remarked in 1645 that the Island of Puerto Rico "is the front and vanguard of all my West Indies, and consequently the most important of them all, and the most coveted by my enemies."[11]

Between 1630-60, the Spanish builders continued executing extensive repairs, reconstructions, and new construction (fig. 5). Both la Fortaleza and el Morro were rebuilt; city walls facing west, south, and east were either built or reconstructed; and el Cañuelo was rebuilt in its present square form as a masonry redoubt. San Cristóbal was begun in 1634 to serve as the bulwark of the easterly defenses.

The enclosing of the city began under the leadership of Governor Enrique Enriquez de Sotomayor, as directed by King Philip IV in 1631.[12] The defensive walls were described as having a terrepleined surface, with a scarped exterior wall battered in a 3 to 1 slope. The walls and embrasures consisted of an earthen wall covered with stones and stucco. The mix was a mezcla real (one measure of lime and one of sand). The walls typically measured 5.9 meters (approximately 17 feet, 6 inches) thick at their highest point and averaged 7.5 meters (approximately 22 feet, 6 inches) high.[13]

Recinto del Oeste

Although San Fernando Battery may have been constructed during this century, it was not until plans of the eighteenth century that its existence due south of el Morro overlooking the channel entrance is confirmed. Santa Elena, to the south of el Morro, was reinforced in ca. 1635. Farther south along the irregularly-shaped cove was the projecting bastion of San Gabriel, later known as San Agustín, reconstructed in ca. 1640. Farther south was the San Juan Gate curtain wall.

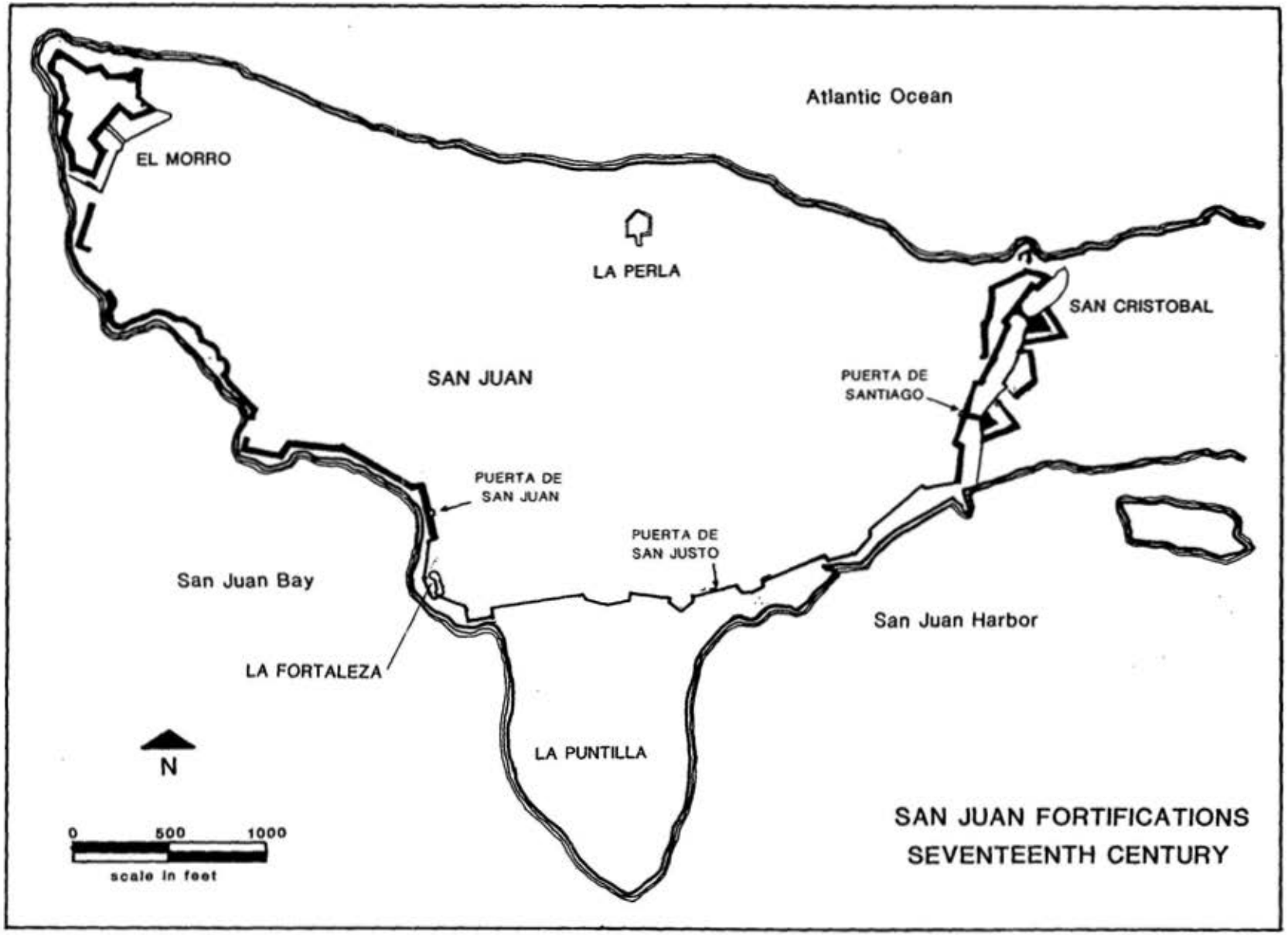


Figure 5. San Juan Fortifications in the seventeenth century. (Plan drawn by K. Faust and annotate by R. Crisson, NPS, NARO, 1991.)

The section of wall adjacent to San Juan Gate, may have been called la Cortina de Ochoa (the Ochoa Curtain Wall), after Governor Sancho Ochoa de Castro (1602-1608). A ceramic plaque (commemorating a long-forgotten fountain) is attached to the wall. The plaque was translated for this report, as follows:

> This fountain, built in 1600 and named the Ochoa Fountain, was constructed during the reign of Ferdinand King of Spain, and during the administration of Governor and Captain-General Sancho Ochoa de Castro, Lord of the Counts of Salvatierra in the province of Alva, in Spain."[5]

The symbolic entrance to the city was for many years San Juan Gate. The gate was probably constructed in 1635, under the leader-ship of Governor Enriquez de Sotomayor. Benedictum qui venit in nomini Domini (Blessed are they who come in the name of God) is the Latin inscription over the gate (fig. 6 and 7).



Figura 6. San Juan Gate, west elevation from Recinto Oeste. (Photo by R. Crisson, 1990.)

At the southwest section of the city wall was el Baluarte de Santa Catalina (Bastion of St. Catherine), generally known as Santa Catalina. Dating to ca. 1640, the bastion was designed to protect la Fortaleza.[6]

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[6]Today it is under the jurisdiction of the Commonwealth of Puerto Rico.



Figure 7. San Juan Gate, ca. 1904. (Capt. E.E. Gaskell Collection, SAJU NHS Archives.)

Recinto del Sur

The south-facing wall of San Juan was originally part of el Frente Marítimo (Maritime Front), that also included the west wall. Later, the south precinct was separately referred to as el Recinto del Sur. Most of the south wall was constructed during the seventeenth century and faced both the inner harbor and the small peninsula of la Puntilla (the Point). Early plans of San Juan portrayed la Puntilla as partially submerged and forested, indicating the existence of mangrove swamps.A t the southwest corner of the south wall was el Baluarte de Nuestra Senora de la Inmaculada Concepción (Bastion of Our Lady of the Immaculate Conception), usually known as la Concepción. The bastion dates from ca. 1640. Adjoining la Concepción is the large expanse of wall known as la Cortadura de las Palmas de San José (Parapet of the Palms of Saint Joseph), dating to ca. 1630-38. At the other end of this wall is el Baluarte de las Palmas de San José (the Bastion of the Palms of Saint Joseph). Though it is sometimes known as San José, it is more commonly known as las Palmas. Of the same period, 1630-35, was the adjoining small bastion known as el Baluarte de la Derecha de San Justo y Pastor (the Right Bastion of Saint Just and Saint Pastor); it is commonly known as San Justo.*

The remaining features of the south wall included la Puerta de San Justo (the Gate of Saint Just), ca. 1630-39. Based on nineteenth-century photographs, this was an imposing gate with a pedimented gable supported by large engaged columns (figs. 8 and 9). It stood at the foot of the present-day Calle San Justo. Like the other two original gates, it also was embellished with a motto above the doors. Here it said in Latin: Dominus mihi adjutor quem timebo? (If God is my helper, who should I fear?).[15] Farther east was the other bastion that defended this gate, el Baluarte del Muelle (the Bastion of the Wharf), dating from the same period. The final portion of the south wall was a curtain wall of ca. 1630-39, extending eastward; it may have been called la Cortina de San Rafael (the Curtain Wall of Saint Raphael). At the southeast corner of the south wall was el Baluarte de San Pedro Martir (the Bastion of Saint Peter the Martyr), but most often called San Pedro; it was constructed between 1634-50.

Recinto del Este

The east-facing walls of the city included some features that were part of el Frente Marítimo Portuario (the Harbor Maritime Front) and others that were part of el Frente

*Also under the jurisdiction of the Commonwealth.



Figure 8. Area of Puerta de San Justo in 1862, detail of plan by M.J. Castro and J. López Hagó. (Servicio Geográfico del Ejercito, no. 46, Madrid)



Figure 9. Puerta de San Justo in 1884. Engraving in La Ilustración Española y Americana. (Repro. in A.S. Alvera's San Juan, 1989.)

Defensive de Tierra (the Defensive Land Front). The east wall later became known as el Recinto del Este (the East Precinct).

Facing southeast was the large bastion known as el Baluarte de Santiago (the Bastion of Saint James), clearly delineated in the Luis Venegas Osorio plan of 1674.[8] Proceeding northward was a wide expanse of curtain wall known as la Cortina de Santiago (the Curtain Wall of Saint James), broken at its middle by la Puerta de Santiago (the Gate of Saint James), built ca. 1635. The Latin inscription of this, the third of the original gates, said: Nisi Dominus custodierit civitatem, frustra vigilat qui custodit (If God does not guardthe city, in vain watch those who guard it).[9] The square facing this important gate was originally called la Plaza de Santiago (Fig. 10). Today the square is called la Plaza Colón, in honor of Christopher Columbus. At the northern end of the curtain wall was the lower extension of San Cristóbal, sometimes designated el Baluarte de la Cortadura (the Bastion of the Parapet). In front of the city gate, and designed to protect this vulnerable entrance into the city, was the imposing ravelin known as el Revellín de Santiago (the Ravelin of Saint James), later known as el Revellín del Príncipe (Ravelin of the Prince). The ravelin contained la Puerta de Tierra (the Land Gate), and was the main access to the open countryside. A wide dry-moat extended northward from Santiago (including the area protected by the ravelin), and terminated with the main moat of San Cristóbal. The moat, in effect, formed a wide north-to-south cut from the harbor to the Atlantic Ocean.



Figure 10. West elevation of Puerta de Santiago, ca. 1890. Photo by Feliciano Alonso. (Repro. in A.E. Rivera, 1989.)

The defensive highlight of the east front in the seventeenth century was the forerunner of the fortress known as el Castillo de San Cristóbal.[10] As with el Morro, San Cristóbal and its outworks are discussed separately in another section of this report.

Recinto del Norte

In the seventeenth century there were practically no defensive structures facing north toward the Atlantic Ocean. None of the north wall was constructed yet. Because of prevailing winds and the ocean currents, most sea attacks were expected to come from the northeast. The north coast was rocky and steep and believed to act as a natural barrier to any enemy trying to land ashore. Crossfire artillery from el Morro, at the northwest, and from San Cristóbal at the northeast, was expected to protect the coast. The only defensive element in the area was the small redoubt named el Fortín de la Perla (the Fort of the Pearl), constructed between 1634-50.[19]

EVOLUTION: THE EIGHTEENTH CENTURY

The first half of the eighteenth century was politically calm for San Juan, particularly from 1701 on when the French Bourbons and the Spanish kings were politically aligned. Puerto Rico remained an almost forgotten colony. Correspondingly, little work except for a few improvements made around 1740, can be documented for this period. Complacency ended, however, with the conclusion in 1763 of the Seven Years' War and the reforms inaugurated by Charles III in 1759 when he became King of Spain. Impending conflict between Spain and England signaled that improvements had to be made to the fortifications of San Juan. (See figure 11.)

Charles III declared San Juan a "Defense of the First Order" on September 25, 1765. The royal decree stated:

> San Juan in Puerto Rico shall be a city of the first order of support for the Island; bulwark of the Antilles; safeguard of the Gulf of Mexico; depository; point of acclimatization; port of call and naval station of the navigating fleets; favorable to foster and secure the commerce that will improve industry, agriculture, and art--the foundation of true wealth.[20]

The King approved a far-reaching plan designed by Field Marshall Alexander O'Reilly. The plan was executed by Chief of Engineers Thomas O'Daly and Juan Francisco Mestre.[21] Their plan forever changed the character of San Juan. It not only strengthened the existing city walls and fortresses, but also constructed the north city wall. O'Reilly's 1765 report of existing defenses in San Juan criticized that the only defenses were those built after the attack of 1625. The primary defensive front needed to be made toward the land front (east), rather than toward the ocean front (north). The military engineers prepared impressive sets of drawings accompanied by detailed explanations.

The succeeding decades of construction work created a tangible example of the newly-established "defense-by-depth system." The result was that San Juan became one of the strongest fortified cities in the Caribbean. By the 1790s San Juan had become a fully enclosed walled city and the fortifications had reached the apex of their development. Within the defensive walls, also called intramuros, military boundaries left about 62 acres for public or private building; even these were strictly regulated so that they would not interfere with any military operation. Lands outside the walls, called extramuros, were also controlled by military authorities in order to prevent obstructing the line of fire

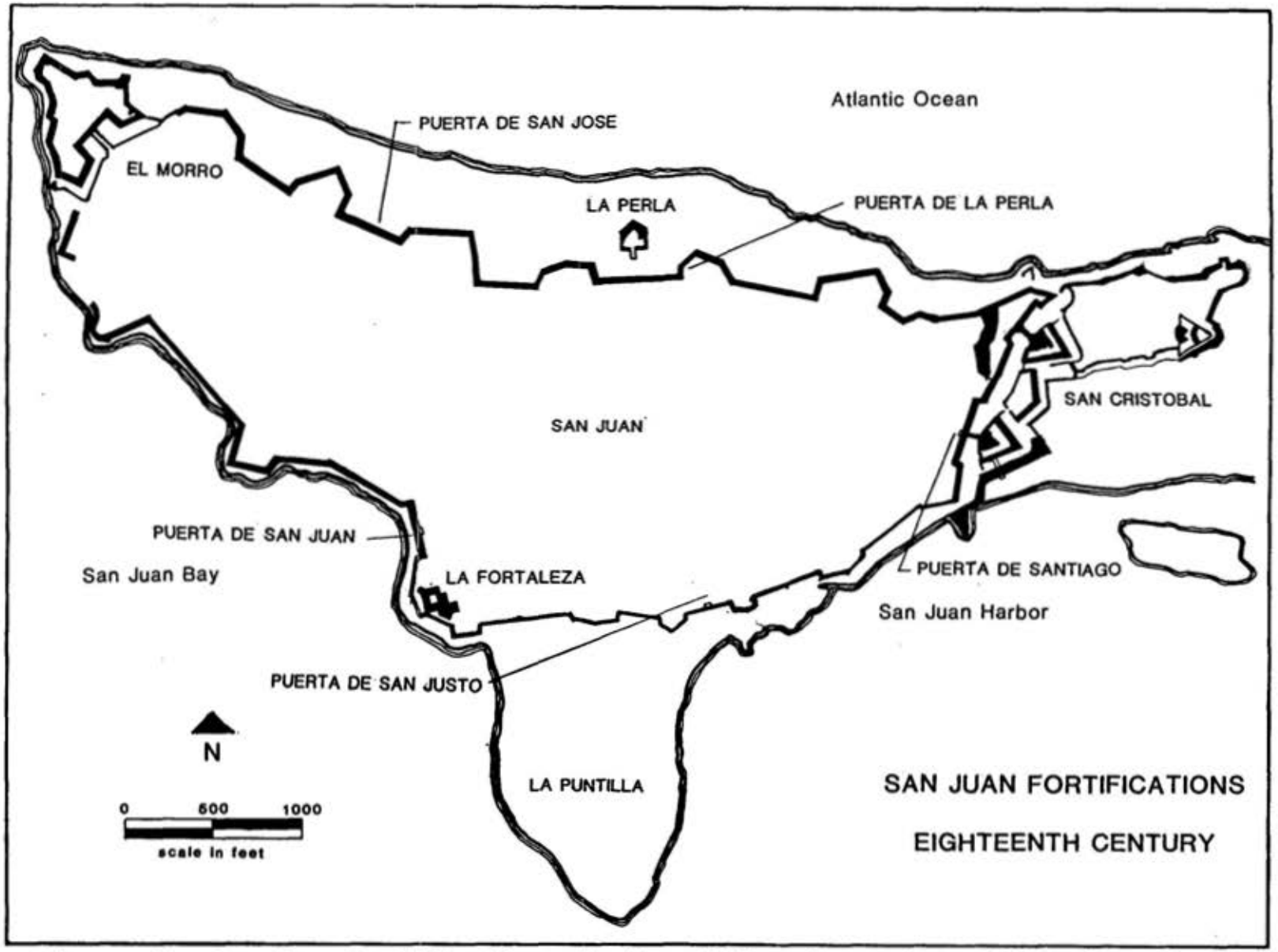


Figure 11. San Juan Fortifications in the eighteenth century. (Plan drawn by K. Faust and annotated by R. Crisson, NPS, NARO, 1991.)

in case of attack. The control by the military over the city and its constructions remained in effect for a century or more.

The newly-completed fortifications were almost immediately tested in 1797 when Sir Ralph Abercromby, leading his army of 7,000 soldiers and a fleet of 68 warships under Admiral Sir Henry Harvey, attacked. In spite of choosing the eastern front, the attack failed. The defense-by-depth system had proven its advantage even when challenged by more powerful land and naval forces.

Recinto del Oeste

The west walls were extensively redesigned and rebuilt during the reconstruction campaign of the eighteenth century. The first plan of significance is the 1765 plan by Thomas O'Daly. The translated title reads: "Plan showing with great exactitude the Castle of el Morro in San Juan, P.R. and its surroundings, surveyed with scrupulous attention to details by order of Field Marshall, Alexander O'Reilly."[22] The impressive construction work was done in short order, as verified by Mestre's various plans of 1781-1792. As the focus of the defensive front changed from sea to land during this same period, the west walls did not become as obsolete as one might think. Cautious as always, the Spanish engineers redesigned and reconstructed the west wall to conform to the principles of bastioned fortifications. The theory behind this was constructing a series of fairly straight curtain walls separating smaller, and generally triangular-shaped, bastions. The west wall was maintained due to its secondary function as a massive retaining wall.

The functions of both la Fortaleza and San Juan Gate evolved in the early-eighteenth century; the first as the symbolic residence for the colonial governor, and the second as the ceremonial entrance into the city. Between the eighteenth and nineteenth centuries, most visitors to San Juan disembarked at the dock below San Juan gate. Materials and supplies entered the city through San Justo Gate. Religious and civil ceremonies and processions would lead through San Juan Gate and up the steep Caleta de San Juan to the Cathedral of San Juan in order to give thanks for a safe voyage.[23]

The gateway probably acquired its present form during this period. Of the same period may be the pair of heavy, wood and bronze-studded doors, each 14 feet high by 6 feet wide (fig. 12). The doors are inscribed with the year 1749. The doorway (as it appears today), is of masonry with painted stucco, and is elaborately decorated with neoclassical moldings, square pilasters, and an arched recessed niche above. A depression in the center of the paved road provided drainage from Caleta

de San Juan toward the harbor. Outside the gate, a short section of masonry wall with an attached circular sentry box, blocked access to the harbor.



Figure 12. San Juan Gate looking west. (Photo by R. Crimson, 1990.)

As mentioned previously, the plan by O'Daly showed conditions as they existed in 1765. To the south of el Morro, and almost contiguous with the south moat was the "L-shaped" Bateria de San Fernando (the Battery of Saint Ferdinand), commonly known as San Fernando. Its narrow parapet was thickened and the eight embrasures reduced to six. Proceeding southward was a non-fortified section, depicted as a rocky shore on the plan. This was followed by the small triangular Fuerte de Santa Elena, at a point of land jutting into the harbor. Continuing south was a long stretch of curving wall, labeled "portion of cracked and collapsed wall." Further south was la bateria condenada de San Gabriel (the condemned battery of San Gabriel). O'Daly said of this battery that it was in need of repairs, as it was cracked and partially collapsed. After the reconstruction, it apparently became known as San Agustin (the bastion of Saint Augustine).

The reconstruction of the west wall was extremely well documented in two drawings by Juan Francisco Mestre. Plan No.1 (dated 1787), apparently demonstrated existing conditions in 1784. Many vertical sections on the same sheet showed the irregular topography and the varying elevations of the harbor-edge. Plan No. 2 (dated June 1, 1787), delineated the proposed changes, described in its translated title: "Plan No. 2 of the project which by Royal Decree of February 28, 1784 was ordered to reinforce the west side of the city of San Juan, from el Baluarte de Santa Catalina, site of la Fortaleza, to the counterscarp of el Castillo de San Felipe del Morro."[23] Another plan of the city, apparently from ca. 1797, makes it unclear if all of Mestre's proposed changes of 1787 had been completed prior to the English attack of 1797. On this plan, Santa Elena, its curtain wall, and San Agustin are still depicted as they appeared in 1784.[24] Nevertheless, nineteenth-

century plans indicated that the work was completed as suggested by Mestre's second 1787 proposal.

Proceeding south of el Morro was San Fernando. It was revamped by Mestre on the 1787 plan with a thicker parapet and no embrasures adjoining an angular section of wall. There is no documentary evidence that this southward extension of San Fernando was ever built; the rocky cliff existing today confirms this. Continuing south was a redesigned and curved Santa Elena with eight embrasures directed north to south providing almost 180 degrees of firing coverage. The earlier irregular wall south of Santa Elena was shown by Mestre in 1787 reconstructed as a straight expanse of curtain wall with twelve new embrasures facing north and south. Next, was a rebuilt San Agustín, with a wider parapet, banquettes, and four embrasures. The earlier irregular wall that traced the cove was redesigned by Mestre as a straight curtain wall, with seven new embrasures.

An acute angle formed the intersection with the realigned curtain wall containing the San Juan Gate. The curtain wall contained three new embrasures, and the gate was labeled la Puerta de la Mar del Puerto (the Gate of the Seaport).

Even the wall in front of San Juan Gate was redesigned in Mestre's 1787 plan; this feature was described as an "increase of the ancient wall." Strangely, the present sentry box is not shown on the drawing, even though its appearance today would indicate that it was built during this period (see fig. 12).[26]

Changes were also made in the 1787 plan to features south of San Juan Gate. The outer wall of Santa Catalina bastion was reconstructed with a straight configuration in plan. It is probable that the height of the bastion was increased to correspond with the higher elevation of the newly redesigned west wall.

Recinto del Sur

The best depiction of the south wall in the eighteenth century is found on the 1792 plan of the city by Mestre.[27] In general, the layout of the south walls remained substantially the same as they did in the seventeenth century. However, the walls at the southwestern end of the city must have been raised six to ten feet in order to meet the elevated west wall. Mestre distinguished the south walls from the other defensive walls by depicting them in his rendering slightly thinner and without embrasures; sentry boxes were depicted at the salient angles of the bastions.

At the southwest corner of the city, the bastion of la Concepción was depicted on Mestre's plan as having a chapel by the same name. Today most of the terreplein of the original bastion is taken up by the Convent of las Siervas de María and by the Hospital and Chapel of la Concepción. None of these structures appear to pre-date the twentieth century, although the Hospital and Chapel of la Concepción were first constructed ca. 1541 and later reconstructed after the Dutch attack of 1625.[28] Farther to the east, the curtain wall of la Concepción was distinguished by having a small structure superimposed on the wall. The small building, usually referred to as la Capilla del Cristo, was constructed during this period as la Capilla del Cristo de la Salud (the Chapel of the Christ of Good Health).[29] At the eastern end of the curtain wall lies the bastion of San José (formerly el Baluarte de las Palmas de San José). It is often referred to as las Palmas. Farther east and adjoining a small curtain wall, Mestre depicted the bastion of San Justo (formerly el Baluarte de la Derecha de San Justo y Pastor). It was followed by San Justo Gate, called by Mestre la Puerta de San Justo y del Muelle (the Gate of Saint Just and the Wharf). At the eastern end of the gate was the other bastion that defended the gate: el Baluarte del Muelle (the Bastion of the Wharf.) A longer section of curtain wall (formerly called la Cortina de San Rafael) terminated at San Pedro (the former bastion of San Pedro Martir). All of the above south-facing bastions and walls provided views toward the developing harbor-front, with two wharves jutting into the harbor and a rudimentary street pattern within the flat peninsula of la Puntilla, still considered part of the "extramuro."

The defensive function of the south city wall became obsolete almost as rapidly as the rest of the city's fortifications were enhanced. It was unlikely that the enemy would be able to attack the city from the south through the inner harbor by the time the south wall was finished.

Recinto del Este

The seventeenth-century easterly defenses were extensively reinforced between 1766-92. The east wall was overshadowed and almost entirely incorporated as part of the fortress of San Cristóbal; these features are discussed separately in this report. The southernmost battery of the east wall was an unusual new feature depicted on the 1792 plan on the site of the earlier Baluarte de la Cortadura. It was called la Batería Provicional de San Francisco de Paula (the Temporary Battery of Saint Francis of Paula), often referred to as San Francisco. This battery projected into the harbor and had a terreplein and parapet with four east-facing embrasures.

To the south of San Cristóbal were those bastions and walls properly considered part of the east city wall: the bastion of Santiago and la Puerta de Santiago, within the curtain wall of the same name. Outside and defending the curtain wall and gate Mestre depicted el Revellín del Príncipe (the Ravelin of the Prince), formerly called el Revellín de Santiago. The ravelin had its own gate, most often known as la Puerta de Tierra (the Land Gate). This section of San Juan derived its name from this gate and is known today as "Puerta de Tierra."

The work completed by Mestre succeeded in transforming San Cristóbal into a formidable fortress that by 1792 also included numerous outworks. By the end of the century the east front was finally complete, and must have appeared very imposing from the low-lying land to the east and the south. The English attacked from the east in 1797, and San Cristóbal is said to have fired its guns. However, the main brunt of the English attack was directed toward the small forts of San Gerónimo and San Antonio at the eastern end of the Islet of San Juan.[30] The entire east front illustrated the advantages of having a "defense-by-depth" system. San Cristóbal and its complementary east wall were safely located at the third line of defense.

Recinto del Norte

The north section of wall combined some portions that were historically part of el Frente Defensivo de Tierra and all of those elements included in el Frente Marítimo del Norte (the Maritime Front of the North). The north wall was constructed between 1766-92 and faced north toward the Atlantic Ocean. In a ca. 1765 plan (probably by O'Daly),[31] existing conditions in the area that was to include the north wall were depicted. In general, O'Daly and Mestre designed a system of curtain walls and bastions that united San Cristóbal with el Morro and integrated the seventeenth-century Fort of la Perla, which Mestre called an "ancient bastion" in his 1792 plan. A covered way was built along the top of the ridge; this was probably no more than a path connecting the various bastions protected by the north wall, but exposed on the south toward the city. East of the ravine was a section of wall with two connected bastions, called "the defensive wall of San José, that was temporarily built during the war to prevent an attack from a disembarcation."[32] The bastioned sections had 12 embrasures, and was situated at the approximate location of present-day Santa Rosa Bastion. Unfortunately, the plan did not include the area farther east, containing the Fort of la Perla, but it did portray the existing topography. Reports during construction in 1775 referred to stone being quarried not only from el Calvario, but from quarries at la Perla, at Casa Blanca (to the west), and at Isla de Cabras (site of el Cañuelo).[33]

In 1783 Juan Mestre provided the best depiction of the construction of the north wall on his "Plan showing the fortified city on the north coast in the area between San Cristóbal and el Morro."[34] A general plan of San Juan, drawn in 1792 also by Mestre, confirmed the revised appearance of the fortifications facing north. West of the entrance ramp of San Cristóbal, were the following features: a small section of parapet with five embrasures protecting the ramp; followed by the large Baluarte de San Sebastián (Bastion of Saint Sebastián). Usually called San Sebastián, it was built ca. 1772-83, with 17 embrasures. Next was el Baluarte de Santo Tomás (the Bastion of Saint Thomas), patron saint of builders and architects. Usually referred to as Santo Tomás, it was built ca. 1772-83, and included a gate. Known as la Puerta de Salida (the Exit Gate), the gate was also called la Puerta de la Perla (the Gate of the Pearl), probably in reference to the Fort of la Perla. By then, the fort was located outside of the north wall at the edge of the shore. After a section of curtain wall, was el Baluarte de las Animas (the Bastion of the Souls), usually called las Animas. With nine embrasures, las Animas dates to ca. 1778-83. Another curtain wall separated el Baluarte de Santo Domingo (the Bastion of Saint Dominic), apparently in reference to the founder of the religious order of Dominicans). Usually called Santo Domingo, the bastion was built ca. 1776-83, and had seven embrasures facing northeast. The adjoining curtain wall with four embrasures contained another Puerta de Salida (Exit Gate). Built in ca. 1760-83, it was often called la Puerta de San José (Gate of Saint Joseph). At the west end of this curtain wall was el Baluarte de Santa Rosa (Bastion of Saint Rose). Known as Santa Rosa, it was built ca. 1776-83 and had 17 embrasures. An additional segment of curtain wall contained four embrasures. The last bastion before el Morro, and the largest, was el Baluarte de San Antonio (Bastion of Saint Anthony). Known as San Antonio, the bastion was constructed ca. 1776-83 and contained six embrasures.

At the close of the century, with the completion of the north wall, the entire city of San Juan was now enclosed. The massive undertaking had taken nearly 250 years. Luckily for the Spanish, the English troops soon experienced the resulting strength of the "defense-by-depth" system. Sir Ralph Abercromby (1797) was to say that the fortifications of San Juan were "both by nature and art, very strong."[35]

EVOLUTION: THE NINETEENTH CENTURY

Even though warfare and political forces changed considerably during the nineteenth century, neither of these changes affected the fortifications of San Juan as much as the socio-economic forces (fig. 13). The threat of war had diminished, and by 1830 only Cuba and Puerto Rico remained under Spanish dominion in the Caribbean. This century is best described as a period of repair and maintenance at the fortifications; many of these repairs may have been needed as part of regular maintenance, but others may have been to correct damage caused by the 1797 British attack. Records allude to repairs and replastering of many fortification walls in the period 1824-35. Artillery and gun emplacements were routinely upgraded during the century. Military engineers continued to depict the city and its defensive features in overall city plans from mid-century onward. (See Historical Drawings, Volume I.)

The urbanization of San Juan continued, until it became apparent that the fortifications that had defended the city so well and so long were choking it economically. The walls, it was thought, prevented the city's expansion eastward, the only direction possible. Low-lying lands in the inner harbor and at la Puntilla were in-filled. Public and governmental leaders clamored for the removal of the south and east walls, and after nearly 40 years of debate with military authorities, portions of the south and east walls were taken down in 1897.[36] The political changes brought about by the Spanish-American War in 1898 did little to physically alter the surviving fortifications.

Recinto del Oeste

The west wall was discussed in a number of documents beginning in 1808 and was portrayed in general city plans dating to mid-century (fig. 14). A report written by Ignacio Mascaró for the years 1808-11, made reference to many overall repairs. The report stated, in reference to the curtain wall of Santa Elena, that "part of the wall was undermined due to the onslaught of the sea, and hewn and rubble stone were being stored until repairs could be made."[37] The report also stated that the San Juan Gate was rehabilitated in ca. 1809. A ca. 1887 plan[38] titled "Plano de la Plaza de San Juan de Puerto Rico" labeled all of the features of the west wall (fig. 15). It also documented the wall failure and the poor conditions of the west wall. Some of these failures continued throughout the nineteenth and twentieth centuries.

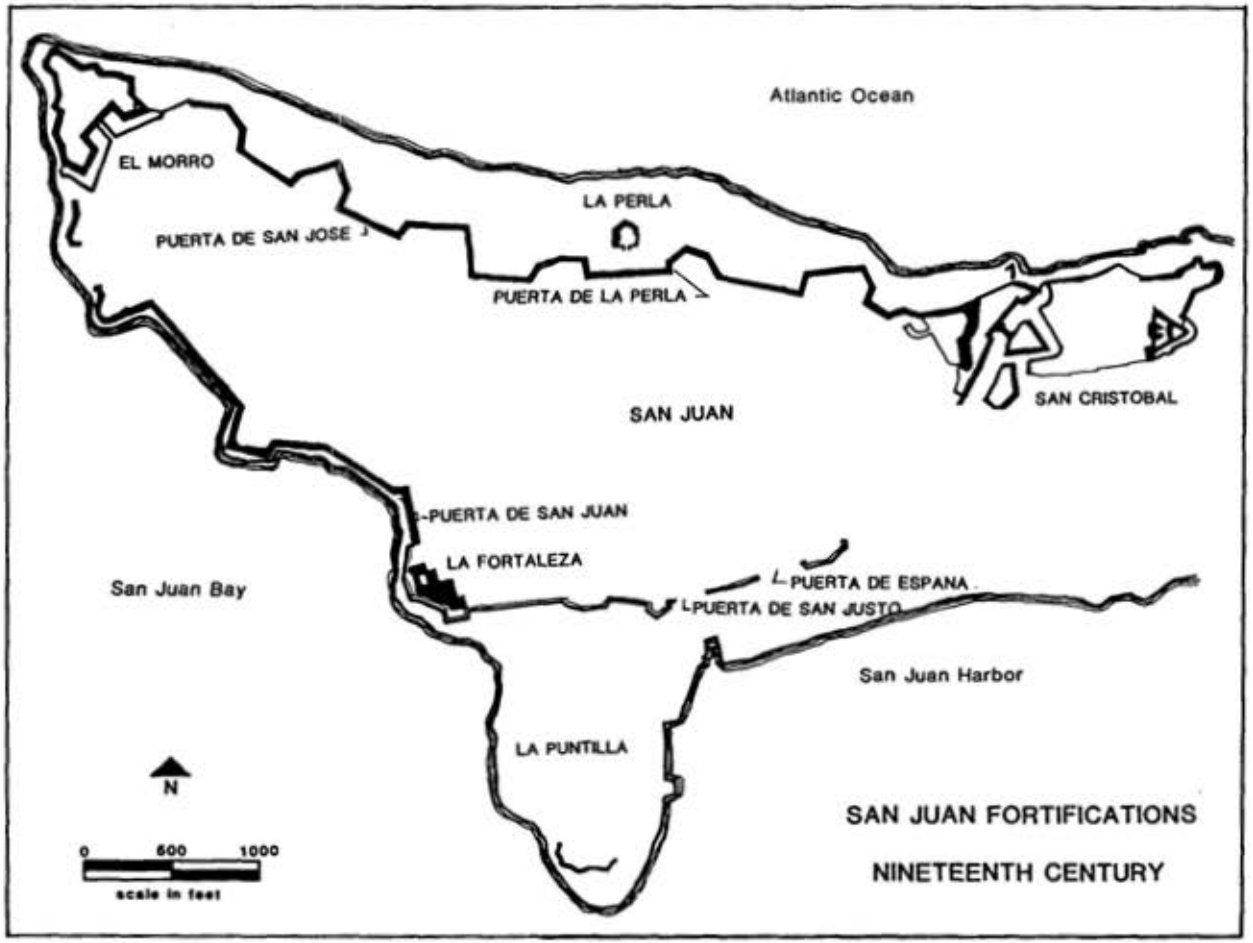


Figure 13. San Juan Fortifications in the nineteenth century. (Plan drawn by K. Faust and annotated by R. Crisson, 1991.)



Figure 14. "Plano de la Plaza de San Juan de Puerto Rico," by R. Roldán y Navarro, 1857. (SGE, cart. ultr. cat. 44, Madrid.)

The northernmost element of the west wall was the battery of San Fernando. According to a report by José de Navarro dated December 20, 1818,[8] San Fernando was deployed with five infantry soldiers, and no artillery. By 1818, when Juan Dávila[9] reported on the status of the artillery in San Juan, San Fernando was not mentioned. Apparently, it was no longer in use as a defensive feature. It was likely that around 1888 (when other work of this kind was done) four 21-cm muzzle-loading mortars on front pintles were installed on a concrete platform separated by earthen traverses. As a result of an official inspection performed by Colonel Goethals and Major Crosby in late 1898, San Fernando is described as having these same four howitzers, behind an earthen parapet with a concrete revetment. At this time a Spanish officer said the battery had not been improved since it was used only as a drill area.[10]

Santa Elena lay south of San Fernando and according to Navarro was deployed with 20 infantry soldiers in 1818. By 1819, Dávila indicated that Santa Elena had two 24-cm cannon, one bronze and one iron. Santa Elena remained strategically important, being close to the shipping channel, and was subsequently modified in ca. 1897 (Fig. 15). By 1898, Colonel Goethals and Major Crosby described Santa Elena with:



Figure 14. Santa Elena Bastion with Spanish cannons, ca. 1898. (SAJU NHS Archives.)

> three 12-cm breech-loading rifles, mounted on obsolete center-pintle carriages . . . these pieces were serviced from a small concrete magazine with a thin earthen cover . . . the parapet fronting the guns was ten feet across the superior slope.[11]

Farther south was San Agustín, deployed in 1818 with 11 infantry and one piece of artillery. By 1838, this bastion was deployed with one 12-cm and one 24-cm bronze cannon. In 1877 work was proposed for San Agustín. The rehabilitation project was titled: "Proyecto de Explanadas para la Batería de San Agustín." In the ca. 1887 plan the San Agustín curtain wall was shown with a cracked and collapsed section of wall.

The 1898 Goethals and Crosby report described this revamping as follows:

> two 21-cm muzzle loading mortars were mounted in this battery behind a straight parapet facing the harbor . . . nearby were two 15-cm breech-loading rifles. The first . . . on a center-pintle mount . . . shielded by a semicircular wall of concrete, backed by twenty feet of earth. The second rifle was positioned on a front-pintle carriage, behind a straight reach of the old parapet whose embrasures have been filled. These two guns were sixty feet apart and commanded the harbor entrance and the ocean west of el Morro.[41]

Farther south were the combined features of the San Juan Gate and el Palacio de la Real Fortaleza (the Palace of the Royal Fortress), on the bastion of Santa Catalina. Navarro in 1913 indicated that the San Juan Gate and battery had 15 infantrymen and one piece of artillery. Goethals and Crosby indicated in 1898 that the Spanish had modernized "la fortaleza battery" with a 15-CM Ordofias rifle and the parapet had been reinforced by constructing a parallel wall 10 or 15 [feet away and [by] filling the space in between with earth.[42] It is clear that the west wall had taken a renewed defensive role in preparation for the war with the United States; however, none of these positions were used during the 1898 conflict. (See figure 16.)



Figure 16. La Fortaleza and Santa Catalina Bastion, ca. 1898. (Repro. in A. Sepúlveda Rivera, 1989.)



Figure 17. Panoramic view of San Juan, 1842. (Repro. in A. Sepúlveda Rivera, 1969.)



Figure 18. Puerta de España, 1675. Drawing by José Laguna Y Saint Just. (AGPR, Fondo:MSJ, Serie CM, Req. 78.)

Recinto del Sur

Though the south wall continued to be repaired and maintained, it became defensively obsolete in the nineteenth century (fig. 17). The only exception to this was the portionof wall containing the bastion of la Concepción, which by its geographic location at the southwest corner of the city, was considered to be of defensive importance. Most documents late in the century began considering la Concepción as an extension of Santa Catalina bastion. Goethals and Crosby listed the batteries as one in 1898. Like Santa Catalina, la Concepciónhad a 15-cm Ordoñez rifle mounted on a center-pintle carriage. The gun emplacement was in a recess within a parapet, forming a 200 degree arc and commanding San Juan harbor, the mainland to the south, and the shipping channel and el Cañuelo to the west. The installation of this rifle resulted in the removal of the sentry box at the salient angle of la Concepción.[45] Apparently no other artillery pieces existed on the south wall since none were mentioned in the 1898 report.

To the east of the adjoining curtain wall was the bastion of las Palmas (formerly las Palmas de San José) that in 1818 had five infantrymen and one piece of artillery. By 1838, its defensive role had apparently ceased because no artillery was listed by Navarro. Farther east was the small bastion of San Justo, without a defensive role as far as deployment was concerned. It was followed by San Justo Gate with 15 infantry stationed here in 1818. At the eastern end on the gate was el Bastión del Muelle (the Bastion of the Wharf). The pedimented San Justo Gate survived until ca. 1895. At that time plans were drawn by the military engineers in order to document it before it was demolished and to show a proposed new and larger gateway. The new gate was built one block east at the center of the curtain wall of San Rafael. The new gate was called la Puerta de España (the Gate of Spain), but was often referred to as la Puerta de San Rafael (fig. 18). At the other end of the curtain wall of San Rafael was San Pedro (the former bastion of San Pedro Martir). This bastion was shown in 1838 as having one 24-cm bronze cannon, while the curtain wall itself was deployed with five 14-cm bronze mortars. The entire section from San Justo gate eastward was demolished by 1897.[46]

La Puntilla, the peninsula south of the fortified walls was partially filled-in and developed as "la Marina" during the nineteenth century. A typical plan was that by José Laguna in 1879, titled Plano de la Zona Polémica del Recinto Sur (Plan of the Military Zone of the South Precinct). Though still considered extramuro, la Marina developed as a support station for the military. This was evident with the construction of the Arsenal and other related structures. The new and curving battery of Santo Toribio was built at the southern tip of la

Puntilla in order to protect the Arsenal complex. Santo Toribio appeared first in the 1835 plan by Manuel Sicardo, and Dávila's 1838 "State of the Artillery" listed Santo Toribio with two 8-cm bronze cannons.[47] It is clear that mounting economic pressures created the need to fill and add land both at la Puntilla and in front of San Justo Gate. The expanded harbor front developed with many blocks of warehouses and shipping docks.

Recinto del Este

In 1808-11 Mascaró provided the earliest nineteenth-century reference to the east wall. His report stated that the floor of Santiago Gate was in deplorable condition due to the porous quality of local construction materials and because of the excessive amount of traffic. To avoid continual maintenance, it was reconstructed using ausubo beams and planking. Exposed areas were covered with stone separated by ladrillo de sardinel (brick soldier courses).[48] In 1818 Navarro's report listed 21 infantry and one artillery piece at Santiago Gate. Dávila's 1838 description updated the artillery at various areas. At Santiago, two 12-cm bronze cannons and three 24-cm iron cannons were listed. At San Francisco de Paula, one 24-cm bronze cannon was listed. Three 12-cm bronze cannons were listed at el Príncipe. It is interesting to note that San Francisco de Paula, the bastion jutting south into the harbor, was shown in the 1887 plan as la Batería Baja de Santiago (the Lower Battery of Santiago), reflecting its close proximity and lower elevation to that of Santiago bastion. New uses, including the installation of barracks and a bakery, were proposed for this obsolete bastion in various plans dating ca. 1885-95.[49]

The most significant easterly defenses were those comprising San Cristóbal and its outworks. Unfortunately, every structure south of la Trinidad (at San Cristóbal) was demolished in 1897, including el Revellín del Principe and la Puerta de Tierra, the curtain wall of Santiago and Santiago Gate and Santiago Bastion.[50] (See figures 19 and 20.)

Recinto del Norte

The north wall was maintained and repaired throughout the nineteenth century. Military engineering reports and drawings continued to document the north wall. Ignacio Mascaró's report of 1808-11 is the first that describes recently completed work. The report stated:

> From el Baluarte de Santa Rosa to San Cristóbal, [the wall] had been covered with a fine smooth stucco to include all of the parapet interiors, embrasure sides,



Figure 19. View prior to demolition of East Wall, 1897. Puerta de Santiago on left. (Repro. in A. Nepolveda Rivera, 1989.)



Figure 20. View soon after demolition of East Wall, ca. 1900. (Photo archives, UPR, Rio Piedras.)

banquettes, esplanades; and the repair of the merlon cracks had been accomplished. A brick sentry box was constructed at las Animas, approximately four feet square by eight feet high; and the ramp floor was constructed of mampostería.[31] As new types of weapons with greater range and power were developed, much of the north wall became defensively obsolete.

As a consequence the north "extramuro" facing the Atlantic Ocean began to be randomly urbanized during this period. The ancient Fort of la Perla remained here, but was almost abandoned and in deteriorated condition.[32] The former Gate ofla Perla was renamed la puerta del Matadero (the Gate of the Slaughterhouse), in reference to the nineteenth-century slaughterhouse, north of and immediately below Santo Tomás. This area below the north city wall became haphazardly urbanized and soon acquired the name of "La Perla." (See Figure 21.)

The other significant intrusion into the north "extramuro" was the San Juan Cemetery. Tomás Sedeño prepared the layout for a proposed new cemetery in 1806. In 1814 Marcayo prepared the plan for the new cemetery at the base of the north wall between the bastions of Santo Domingo and Santa Rosa. The cemetery opened in May of that same year and was dedicated to its patroness saint, Santa María Magdalena de Pazzi (the name was derived from the Florentine nun and saint, María Magdalena de Pazzi).[33] The circular colonnaded chapel of Santa María de Pazzi was built in 1852, at the same time as the burial niche colonnade parallel to the curtain wall of Santa Rosa. Both were designed by City Architect Manuel Rivardo.[34]



Figure 21. View of the North Walls with San Sebastian in foreground and the beginnings of the urbanizing of "La Perla." Ca. 1906. (Repro. in A. Sepúlveda Rivera, 1988.)

Navarro's 1819 "State of the Artillery in Times of Peace" listing the revamped deployment at this time can be used to



Figure 22. View of San Juan Cemetery and Chapel, curtain wall with San Antonio in background and el Morro far in the distance, ca. 1900. (HAJU NHR Archives.)

follow the wall configuration. Adjacent to San Cristóbal was San Sebastián, assigned with 11 infantry soldiers. Next was Santo Tomás and the Slaughterhouse Gate with 15 infantry and one piece of artillery. Then, las Animas with five infantry, followed by Santo Domingo and San José Gate with 14 infantrymand one artillery piece.[43] This was followed by the bastionsof Santa Rosa and San Antonio, both having five infantry each. Hernán Dávila's report of 1818 updated the existing artillery at the north wall as follows: at Santiago, two 12-cm bronze cannons; at Santo Domingo, one 16-cm bronze cannon; and at Santa Rosa, three 24-cm bronze cannon, one 8-cm bronze mortar, and one 16-cm iron cannon.



Figure 21. San Antonio Guardhouse at San Antonio Bastion. (Photo by E. Crisson, 1990.)

As part of the various changes and improvements made by the Spanish just prior to the Spanish-American War in 1898 was the construction of the San Antonio Guardhouse ca. 1897 in the Bastion of San Antonio, and adjoining el Morro (fig. 23).[44] Evidently, the defensive role of the north wall was reduced in the nineteenth century, while el Morro and San Cristóbal were strengthened with far-reaching artillery. This was confirmed in the description of 1898 by Goethals and Crosby in which San Antonio bastion was the only reinforced element of the north wall. This battery, immediately east of el Morro, was close enough to the fort to be considered a defensive extension of el Morro. The 1898 report described it as having:

> four 15-cm Ordnes (breech-loading) rifles on front-pintle carriages . . . emplaced along the wall east of el Morro. The parapet had been reinforced by concrete. These pieces faced and had a good command of the sea near the harbor entrance.[45]

In spite of years of premonition and months of preparation, the Spanish apparently did not anticipate the attack by the American fleet under the command of Rear Admiral William T. Sampson. On May 12, 1898, the Spanish fortifications received

their first significant challenge since the English attack nearly 100 hundred years before. The only damage reported to the city walls as a result of the Spanish-American War was to one of the breech-loading rifles at San Antonio bastion: "It was knocked out by a shell striking an opened breech block and tearing it off its hinges."[58] El Morro and San Cristóbal were both engaged in combat, but only el Morro suffered damage. During the three-hour battle, at least 1300 American projectiles were fired and 400 Spanish projectiles were fired in response. In spite of this, the only war casualties in Puerto Rico were 57 wounded and seven dead.[59] The United States took formal possession of Puerto Rico on the eighteenth of October.

EVOLUTION: THE TWENTIETH CENTURY

In preparation for the work that would be needed in the twentieth century, U.S. Army engineers soon began to document the extent and conditions of the defensive walls. The first of many plans prepared in the twentieth century was dated 1900 (fig. 24).[60] In five short months the aggressor became the

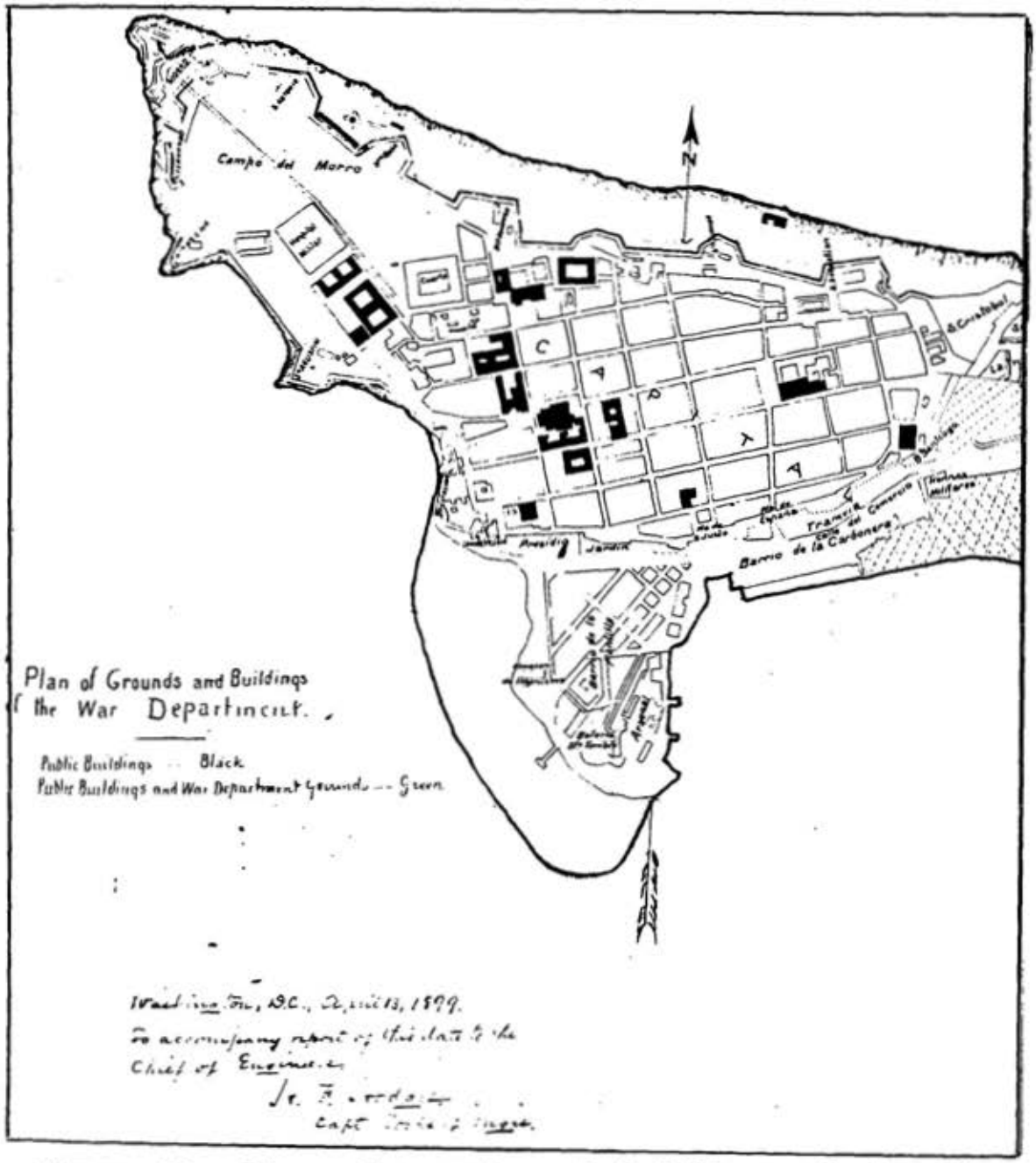


Figure 24. Plan of grounds and buildings of the War Department, 1899. (SAJU NHS 0543-1864.)

preserver. The U.S. military engineers considered the entire city as a defensive entity, and many projects did not differentiate between north, south, east, or west walls. Thus, the discussion for the twentieth century will be addressed chronologically, and where possible will follow the counterclockwise direction of the previous centuries discussed. Most documents of this century made little distinction between the "walls" and the "city walls" since they were all considered defensive features. Major Crosby and Colonel Goethals, accordingly, reported that the "walls" were in generally good condition, but that some areas were crumbling. The walls were described as:

> Composed . . . of a coarse concrete faced with cement mortar and having brick copings. It appears to be about a meter thick near the top where it is formed into a parapet . . . strengthened in many places by having a second wall built inside and parallel to it and the space between the two filled with earth and covered with a thin layer of concrete.[61]

Shortly thereafter, the transfer inventory for the San Juan fortifications provided an appraisal and conditions summary for all pertinent features.[62] The summary labelled the west precinct as the "South Front" and reported that Santa Elena was armed with three 15-cm guns. San Agustín had two 15-cm guns and two 24-cm howitzers, while Santa Catalina contained one 15-cm gun. The south precinct was shown as the "South Front" in the report, and noted Concepción Battery armed with one 15-cm gun. The south wall was described as being a masonry wall, 1,000 meters long, averaging 7.5 meters high, and 4 meters wide. It was separated by intermediate bastions.[63] The north precinct, labelled "Precinct North of Garrison" in the report, consisted of a masonry wall extending between el Morro and San Cristóbal, also with intermediate bastions. The north wall was described as being 2,000 meters long, 7.5 meters high, and 4 meters wide.[64]

Captain Flagler indicated very precisely the conditions of the city walls, bastions and artillery pieces found at el Morro and at the city walls of San Juan.[65] Captain Flagler noted on his plan that the walls were in "fair condition," except for the curtain walls of Santa Elena and San Agustín, that were described as having the "outer surface of the wall . . . weather worn and chipped but quite solid."[66] Flagler noted the conditions of the west wall in front of San Fernando, where "the cliffs show bare layers of sand [with] no damage now but eventually there will be." Flagler allowed his feelings to show when he added "don't see how in the hell to fix it!" At Santa Elena he wrote "no protection [was] necessary." Immediately south, where the rocky cliff was exposed, he added "some protection necessary, cliff is being eaten away, no

immediate danger." The curtain wall of Santa Elena, where the sandstone cliff sat on a rock and sand base, he noted that there were areas of "undercutting" and other areas that appeared fine. He noted a large drain to the north of the curtain wall and added that a "2 foot section of wall is breaking away here." He also indicated a large crack at the south end of the Santa Elena curtain wall. He wrote that "here the wall had been undermined in two places and about 12,000 to 15,000 cubic yards of fill had been washed out. The huge cavity thus formed was used by the San Juan garrison as a trash dump."[67] Continuing south toward San Agustín, Flagler said that "the rocky and sandy coast needed some protection from undercutting at the corner." The curtain wall of San Agustín he labeled "built on cliff and [on] remains of [an] old wall." At the toe of the wall he noted a "stone berm [and] undercut all along here." The curtain wall of San Juan gate appeared in fine condition as did the walls of Santa Catalina and la Concepción.

Flagler's plan can also be used to document the features of the south and north wall in 1900. He labeled the two surviving south-facing bastions of las Palmas and San Justo but he did not mention their condition. Flagler documented the north-facing features, again without noting their condition. These were the following: San Sebastián; Santo Tomás and the outline of the Fort of la Perla; las Animas; Santo Domingo; Santa Rosa and the Cemetery outside the curtain wall; and finally, San Antonio Bastion. The Fort of la Perla was in ruins and Captain Flagler was unable to justify that it be repaired. Of this fort he added that "the high wall in rear of the bastioned wall . . . was likewise in ruins and its maintenance was recommended to be abandoned."[68]

Despite the plans for work, the early decades of the twentieth century were characterized by periods of neglect and deferred maintenance. Sporadic attempts were made by the U.S. War Department and its engineers to maintain, restore, and reconstruct portions of the walls, notably parts of the west and north city walls. Some military documents early in the century considered the walls and fortifications to be historic and picturesque and worthy of visitor interest.[69]

Concerns were raised regarding the sanitary conditions of the walls during the 1912 bubonic plague epidemic in San Juan. The Insular Board of Health recommended that the walls be made "rat-proof" by parging with cement the lower four feet of the walls. Though this work was never carried out, Colonel Bailey K. Ashford's team noted later that the west wall was "more infested with rats than any other in the Military Zone, unless it be that portion of the wall that overlooks the section known as la Perla."[70] Colonel Ashford explained that the north wall "was pierced in every direction by tiny natural drains and

large artificial ones." By then, officers of the 5th U.S. Infantry were stationed in several houses constructed within the bastions of San Sebastián and Santo Tomás (fig. 23.). Ashford felt that the entire north wall was a health threat.[11] Another writer on the subject was Captain E. J. Dent, who on July 8, 1913 reported:



Figure 23. View of infantry housing at Santo Tomás Bastion, ca. 1914. (RAJU NHZ Archives.)

"(The) sanitation of the walls would be less costly than their demolition . . . in absence of urgent reasons for their removal, historical landmarks of this character should be preserved . . . from an aesthetic view, maintenance of the existing walls constituted an excellent treatment of the precipitous shores of the San Juan Island."[12]

President Taft's authorization of June 16, 1910 permitting the transfer of military property caused local military authorities to consider turning over lands and buildings not needed by the Army to the Government of Puerto Rico.[13] The jurisdictional problem was resolved in 1914 with a plan compiled by Colonel H. M. Black titled "San Juan Island showing Military Reservations, Walls and Fortifications." The Secretary of War assigned responsibilities to both the War Department and the Government of Puerto Rico, and said that "the sections (of walls) under their respective charge were to be kept in repair and sanitary condition."[14]

Military thinking progressed to the point of asking for War Department appropriations during the 1913-14 period, backed by leaders such as Colonel Black. Black was considered an expert on Spanish masonry defenses, having had experience with the fortifications in St. Augustine and Havana. He stated that "stucco work and painting with a cement was not only unnecessary, but was a little better than vandalism." Black further voiced his preservation-minded view by saying:

> This work of repair and restoration should be done in such a manner as to cause the new work to harmonize as

closely as possible with the appearance of the old work . . . the work should be carried on by someone having a sympathetic feeling for the beauty which comes from age.[75]

Unfortunately, World War I prevented further preservation efforts from taking place. The section of wall between Santa Elena and San Agustín, described in 1913 as "the San Agustín break" was reported to be cracked and almost settling into the harbor.[76] The War motivated the defensive reactivation of the San Juan fortifications. Only one of the three modern gun emplacements installed ca. 1918 affected the city walls. At Santa Elena a 4.72-inch Armstrong gun mounted en barbette was designed to protect the harbor entrance. The change required by this gun consisted of:

building up a platform of sufficient size to allow working room and to take care of the reaction from the discharge of the gun and the construction of a blast apron and filling in front of the parapet wall.[77]

Armistice, on November 11, 1918, insured that the Armstrong gun was never used at Santa Elena. Once conditions returned to normal, military engineers continued to investigate the conditions and historic methods of construction. In 1922, Colonel H. C. Newcomer's "Memorandum to the Chief of Engineers," theorized that the walls were not actually retaining walls, since they sustained no lateral pressure, but were constructed as a "facewall" reinforced with counterforts 4-foot deep. Newcomer had been able to investigate the section of the west wall between Santa Elena and San Agustín that had finally collapsed in 1918. He recommended that the wall be rebuilt as soon as possible, before the exposed cliff eroded into the harbor. Near the San Juan Gate and curtain wall, a new break occurred in 1921. This was an area considered previously in good condition. Newcomer described the walls and bastions as being constructed of:

rough sedimentary coral rock blocks, rarely exceeding three feet, laid in irregular courses, the interstices filled with smaller pieces of the rock and a mortar made of lime, sand, and clay, to which in the more recent construction, powdered brick dust was added. The coral rock, which is very soft and brittle, was quarried from a large quarry located within the northern reef line of the coast just east of Morro Castle.[78]

The military engineers continued studying the existing conditions and construction of the fortified walls. Colonel W. B. Ladue summarized it best in 1925 when he said:

> The old walls have withstood the ravages of time to a remarkable degree where the foundation was laid above sea level, except in the case of the break in front of Casa Blanca [the San Agustín curtain wall] where the foundations evidently crumbled due to the earthquake that occurred in October 1918, and a section of the wall about 55 feet broke its bond with the adjacent walls and slid down the face of the coral cliff on which it was constructed into the sea . . . At certain other points, although the foundation is in poor shape due to wave action and erosion that has taken place in back of the walls causing cracks to appear in the face of the wall and portions of the parapet, the aesthetic and utilitarian value of the walls can be preserved without undue expense.[79]

Early in February of 1922, a letter from Governor Towner of Puerto Rico stated that the walls should not only be "preserved for their great historic value and beauty, but also for their use, in part, as retaining walls."[80] As a consequence, the first significant repairs to the fortification walls under the U.S. Army were authorized in 1924 and 1925. The section chosen was the west wall between San Agustín and San Juan Gate. Robert R. Prann successfully bid on the specification titled "Reconstructing and Remodelling Sections of the Wall East of San Agustín Battery." The total cost was $27,825.00.[81] The specification noted that the coral blocks should be salvaged from the collapsed wall at Santa Elena and San Agustín. The bedding mortar was to consist of "one part cement and three parts of clean screened sand." The pointing mortar was to consist of "equal parts of clean screened sand and portland cement."[82]

A contract was awarded in 1925 to continue repairs to the west wall. The contract, awarded to Luis Rexach, included taking down the curtain wall west of San Agustín to a uniform height. The successful bid was for $15,925.00 and the work was completed in November of 1925.[83] In December new breaks and additional deterioration had surfaced in new locations. Colonel G. H. Estes, of the 65th U. S. Infantry, inspected the walls and reported the following:

> Section A, Between San Justo Bastion [the south wall] and San Juan Gate. The wall was generally in good condition, but in many places there was a heavy growth of small trees and vines, particularly near the top of the wall . . . there was a crack under the sentry box at San Justo Bastion and two small trees. The superior slope and breast-height wall [las Palmas Bastion] had been split by the growth of trees and a short section must be replaced. In front of la Fortaleza, a small break at the bottom of wall should be repaired, and under the bastion,

Plans and specifications were prepared in 1927 to take care of the above problems. The four contracts were titled "Preservation of Historical Fortifications," and included repointing 1600 square feet of the south wall and grouting and repointing 500 square feet of the Santo Domingo bastion on the north wall. The extensive work at las Animas bastion, also on the north wall, was described as follows:

> Take down the broken section of the old wall and construct a gravity section concrete retaining wall, bonding it into the adjacent walls and back fill; repair a cavity at the bottom of the wall easterly of the gravity section and reinforce with concrete; and grout or point up all cracks and joints where necessary [including 350 feet of wall faced with coral blocks].[85]

Additional work was accomplished in 1930 at Santo Domingo bastion that included removing vegetation from the top and face of walls, repairing the top and vertical faces with concrete, repointing cracks, reconstructing merlons using concrete and salvaged coral blocks, and repairing the storm water drain at the southwest base of the bastion. This was accomplished by cleaning the drain, filling the cavity with concrete, and repointing and facing the wall with salvaged coral blocks.[86]

One of the first projects to be considered "restoration" in nature was funded in 1932 when the Corps of Engineers reconstructed four sentry boxes at a cost of $1,493.58. (See figure 26.) The money was contributed by Insular funds made available by Governor James Beverly. Three of the sentry boxes were in sections of the west wall, including one at San Agustín, one at the curtain wall east of San Agustín, and another at Santa Catalina (within the grounds of la Fortaleza). The model used to reconstruct the sentry boxes was an original sentry box considered "well preserved" located in the grounds of la Fortaleza. The work was summarized by Associate Engineer W. J. Truss, as follows:

> Material used in reconstruction is concrete, in the form of hollow blocks . . . to simulate the grey-brown appearance of the old walls, mineral coloring matter (brown oxide and lamp black in equal parts) was added to the mix in an amount equal to 8% (by volume) of the cement. . . . Reconstructed boxes, in all cases, were erected on existing bases, remaining from the original construction.[87]

A letter from Lieutenant Colonel R. T. Ward to Truss provided insight into the source of the hollow concrete block system devised for the sentry box construction. Ward attributed this idea to a Mr. Letts, who thought that it was

system devised for the sentry box construction. Ward attributed this idea to a Mr. Letts, who thought that it was "the cheapest and most satisfactory method," and the system "in common use in Panama on military work."[88] The work apparently satisfied some of the local critics, as evidenced by comments in an article that appeared in a San Juan periodical and titled "Just Off the Boat:"

> Several sentry boxes are being replaced, to restore the walls along the harbor entrance to their former beauty. Over a period of years a half dozen sentry boxes, the most picturesque and romantic details of the century old walls, have disappeared . . . Aged and weathered it is a thing of beauty, a relic of an age gone forever. Sight of it does more to bring back to mind legends of the days of the conquistadors than all the massiveness of the fortifications themselves.[89]

Federal appropriations lagged and Lieutenant Colonel Ward reiterated the consequences of deferred maintenance when he sadly noted that the budget request to cover wall repairs had been deleted from the 1933 Congressional budget. Ward's view of the historical repairs was partially correct when he said:

> The Spanish took particular care in providing for drainage. During Spanish times there was little deterioration due to the fact that the fortifications were kept under constant observation and slight breaks and failures were repaired as soon as they developed. Since the American occupancy, the walls have deteriorated to a considerable extent, funds have not been available for current minor repairs and such work as has been done upon the walls have been largely major repairs, many of which might have been prevented if repaired in the early stages of deterioration.[90]

Despite the lack of funding, military engineers were clamoring to make repairs to the fortifications. Local preservationists were demanding that the work be done with sensitivity toward the materials of construction. Political leaders were insisting that both Federal and Insular funds be secured to accomplish the work as soon as possible.

Mrs. Franklin D. Roosevelt travelled to Puerto Rico in 1934.[91] Either coincidentally, or as a consequence, NPS officials were sent to investigate the significance of the San Juan fortifications. They found that the San Juan fortifications were of national significance but in danger of succumbing to systemic dilapidation and decay.[92]

One of these NPS officials was apparently researcher John Nagle, who visited San Juan in December of 1934. His report

attempted to convince the Department of the Interior that the military fortifications were important historically as well as defensively. His typewritten and profusely illustrated manuscript promoted, perhaps for the first time, that the fortifications and the fortified walls be preserved as a







Figure 24. San Agustin sentry box, August 1933. (SAJU NHS Archives.)

"park." The report also documented the extant conditions of many deteriorated sections of the City Walls.[93]

In response to public opinion and perhaps to the enlightened view of some military leaders, the U.S. Army attempted to document and make some of these much-needed repairs. The lack of budget appropriations for regular maintenance changed dramatically between 1938-40 when the War Department allocated regular funding to restore and preserve the fortifications. Since funding was limited to $100,000.00 the work was prioritized for the following sections: San Agustín bastion; sentry box reconstruction; and Santo Domingo bastion.[94]

Immediately afterwards, a more extensive project was undertaken to continue preservation and restoration work. A Completion Report titled the "Repair of Historical Fortifications" dated 1938-40 documented the project. Thetotal cost of the project was $858,817.59.[95] Only those portions of the specifications that affected the city walls are discussed here.

The work under Specification F 28-1 included relocating or installing 405 feet of 18-inch concrete storm sewer pipe. The work was apparently designed to prevent excessive storm water from going through the original drain holes of the west wall since the drains were close to the embrasures and were causing "disfigurement and unsanitary conditions."[96] The specification also included reconstructing 800-feet of the "old Bay Road" [now the San Agustín Road] on new fill, using macadam on a telford base. New concrete curbs were installed on the south side with new drainage outlets. The greater part of the work consisted of removing 100 feet of cracked and undermined curtain wall west of San Agustín. About 25 feet of the wall footing here was considered adequate to support a new poured concrete wall. The curtain wall 100 feet south of San Agustín remained in good condition, so it was strengthened with new concrete counterforts and metal tie rods. Nearly 400 feet of the wall toward the northwest had completely collapsed and was rebuilt, reusing the old foundations and adding new concrete counterforts (fig. 33). No counterforts were necessary where the "old sandstone cliff" remained. The work included reconstructing the embrasures destroyed earlier by the Spanish during the installation of the rifles en barbette (fig. 34).[97] The last and most visible part of the work was facing the new curtain wall with 23,900 square feet of irregular sandstone blocks, cut into 2 to 4 inch thick slabs, "backed with mortar and other stones" to form an 8 to 12 inch exterior wall.[98]

Specification F 28-2 included reconstructing eight sentry boxes that were removed by the Spanish in locations interfering with the line of fire. The Army engineers utilized the same cast concrete block system developed in 1932. The mixture had



Figure 27. Workers beginning to work on the collapsed curtain wall between Santa Elena and San Agustin. [West Wall], 1938. (SAJU NHS Archives.)



Figure 28. Demolished curtain wall between Santa Elena and San Agustin. [West Wall], 1938. (SAJU NHS Archives.)



Figure 29. New concrete foundation at NW corner of San Agustin Bastion. [West Wall], 1938. (SAJU NHS Archives.)



Figure 30. Nearly completed reconstruction of embrasures at San Agustin Bastion. [West Wall], 1939. (SAJU NHS Archives.)



Figure 31. New concrete counterforts for the curtain wall between Santa Elena and San Agustin Bastions, 1936. (SAJU NHS Archives.)



Figure 32. Restoration of embrasures at San Agustin Bastion, 1938. (SAJU NHS Archives.)



Figure 33. Curtain wall between Santa Elena and San Agustin Bastions, placing of stone facing on reconstructed wall, 1939. (SAJU NHS Archives.)



Figure 34. Santa Elena Bastion, reconstruction of firing steps, 1939. (Completion Report, SAJU NHS Archives.)

a colored admixture and the blocks were laid with mortar. The ogee dome was built of separately cast pieces, laid with mortar, and topped with a new cast concrete finial.[99] Among the reconstructed sentry boxes were several in city wall locations. They were as follows: "San Juan Gate" (actually at la Fortaleza), at San Sebastián bastion, at Santa Rosa bastion, and at San Antonio bastion. It was unclear which of the two historic sentry boxes noted in the 1932 project were used to replicate the new ones.

Specification F 28-3 was designed to restore the wall at the salient angle northwest of San Juan Gate, including the construction of new counterforts. It also included repairing walls, embrasures, and counterforts from San Juan Gate to San Agustín. Also reconstructed was the toe of the curtain wall. A new parapet with embrasures was constructed and faced with coral stone blocks. No doubt when the parapet was repaired, the sentry box (reconstructed in 1932) had to be repaired again.

Specification 28-4 called for the restoration of San Antonio Bastion by removing debris, patching the wall surfaces, and facing with sandstone sections of the walls, firing steps and embrasures. The work included the removal of several "unsightly structures of more or less recent construction."[100] Among these were the wall enclosing the bastion and the two masonry casemates within the same bastion, generally dating from ca. 1897. About 9,000 square feet of sod was installed on the terreplein of San Antonio. It is of significance that the stated purpose of the demolition was "to restore . . . to . . . original condition and appearance."[101]

Specification 28-5 concerned the restoration of Santa Rosa bastion and included patching 950 square feet of wall surfaces, firing steps, and embrasures and debris removal. The northwest corner of Santa Rosa was covered with a coat "sand, cement, and broken brick."[102] It also included patching the north wall between Santa Rosa and Santo Domingo (facing San Juan Cemetery); restoring the revetment wall on the north side of Santo Domingo with new reinforced concrete counterforts and facing this wall with 2,200 square feet of sandstone blocks (fig. 35). Finally, the work included restoring the wall and firing steps at las Animas bastion and along Boulevard del Valle (presently Calle Norzagaray), from Santo Domingo to las Animas, with 17,419 square feet of stone facing and 1,841 lineal feet of salvaged brick paving and edging.

Specification No. 28-6 was added in October of 1939 to include miscellaneous items not covered in previous specifications. The summary description included: cleaning 52,000 square feet of the west wall between San Agustín and San Juan Gate and of the south wall between San Juan gate and

the curtain wall between La Concepción and las Palmas; and 8,000 square feet of patching and stone facing of the same walls; removing debris and "remains of old wall" northwest of San Juan Gate to form a revetment at the base of the San Agustín curtain wall. Work on the north wall was also included: at San Sebastián, repairing embrasures by installing 1,500 square feet of the merlons, 3,000 square feet of stone facing, and 1,500 lineal feet of brick edging; at Santo Tomás, repairing two embrasures, installing 2,000 square feet of merlons, 500 square feet of stone facing, and 1,200 lineal feet of brick trim; and at las Animas, repairing two embrasures with 1,000 square feet of stone facing, cleaning, pointing and patching the interior and the exterior of the sentry box, and replacing the broken finial, presumably with a cast-concrete finial. Although the materials list itemized 169 of the precast concrete blocks for sentry boxes, the cryptic notation "repairs to sentry boxes"[105] did not indicate if the work included additional sentry boxes to the one at las Animas.



Figure 35. Reconstructed scarp wall, Santo Domingo Bastion, May 1936. (SJNHS Archives.)

During the course of the above work the U.S. Army was authorized by the Government of Puerto Rico to excavate coral rocks off the cliff directly north of the Capitol building. Additional correspondence of the year 1939 indicated that Engineer Truss was supervising workers "hauling in rock from the Camp Buchanan (located in Bayamón, now part of the San Juan Metropolitan Area) quarry."[106] The purpose of these excavations was to ensure the authenticity of the repair work by using the same materials that had been used historically.

In spite of these efforts, preservationists and others in the local community were not pleased by the quality of work executed by the Army. Stuart Barnette, NPS architect, wrote a memorandum to Governor Leahy in 1940 making the observation that "the Army was approaching similar work in other historically important buildings in the same unsympathetic

manner." Barnette criticized the new sentry boxes as being "poor reproductions in concrete." In reference to the fortified walls, he added, "masonry of irregular sized solid stone ashlar was being replaced by a veneer composed of precast stone fragments and mortar in regular square forms." Finally, Barnette suggested that the San Juan fortifications be protected by another "agency empowered to act for their preservation," otherwise, these "architectural monuments unique in the Western hemisphere will be lost forever."[105] Governor Leahy responded to the Secretary of the Interior by dismissing Barnette's remarks as "unimportant" and having "little appreciation of the importance we attach to saving time and to the utilization of such funds and facilities as are made available to us."[106]

The changing priorities brought about by World War II halted further U.S. Army preservation-related activities. Maintenance work during this decade included installing new utility lines at the Non-Commissioned Officers' Quarters located in the terreplein of San Sebastián and Santo Tomás.[107] No other work was apparently documented during this period with the exception of emergency work required at las Animas in 1944. The road at the base of the bastion was regraded then and the work caused the exterior wall to crack. Army engineers, between 1944-45 stabilized the scarped wall by underpinning the footing. At the same time they regraded the road and reconstructed the sentry box and the adjacent parapet.[108] The same general area continued to be plagued with wall failures, as evidenced by more serious cracks that were reported in 1954. The Corps of Engineers attributed the partial failure to an unstable footing and a washout caused by a drainage hole on the northeast side. In 1955, the wall was stabilized and repaired using a "reinforced concrete pile wall extending five feet out and 10 feet below the footing."[109] The northeast corner was replaced with concrete. Large cracks were patched with concrete and the terreplein was regraded to include a drainage ditch and a concrete culvert. The catch basin was repaired, and the existing drain was cleaned out.[110]

The next series of repairs occurred on the west wall but were apparently poorly documented. The seawall and road at the base of Santa Catalina Bastion, extending from the San Juan Gate southward toward la Puntilla, were reconstructed in 1950. In the fall of 1956, the seawall in front of the San Juan Gate was reported to be undercut. The wall was partially reconstructed and reinforced in order to prevent the sentry box at San Juan Gate from collapsing into the harbor.

A much more serious problem was caused by a storm on December 2, 1951. A 10 by 40 foot section of the west wall in front of San Agustín collapsed. Subsequent undermining caused a much larger section to crack severely. Franz Loesche, NPS

consultant, reported that the rest of the wall was in danger of collapsing into the harbor and that a washout, nine feet wide, had exposed clay and sand behind the wall and soft sandstone at the base of the wall.[111] Loesche recommended removing the collapsed wall as well, in order to underpin all of the cracked wall sections. He further suggested building a temporary cofferdam to prevent further washouts and rebuilding the exterior wall similar to the original. Fred D. Mendenhall of the Corps of Engineers, reported that the damage consisted of a separation between the upper and lower wall, leaving an exposed cavern at the base. He found the wall constructed of stone veneer, 8 to 18 inches thick, 12 inches high and 12 inches wide, bonded to the sandstone and limestone with mortar. "The veneer and backing were very soft, poor grade sandstone and limestone with traces of iron in it making it resemble clay in coloring."[112] A complicating factor was that the bastion wall sat on sand that was being continually washed out by the action of the waves. Repair work was carried out by the Corps of Engineers in 1953.[113]

In February 1956, el Club Cívico de Damas (the Ladies' Civic Club) donated funds for the restoration of the San Juan Gate. NPS Architect Fred Gjessing prepared the contract documents. A controversy arose between the Eastern Office of Design and Construction (EODC-NPS) and the Superintendent. EODC questioned whether there was enough documentation to "restore" the gate. Superintendent Hubler stated that the work was intended to "repair and preserve the existing character."[114] Nevertheless, the work was done and included: patching the cobblestone-paved road; repairing the wooden doors; removing vegetation; restuccoing the walls; removing exposed wiring and conduit; and landscaping. Apparently, the doors were replaced since the documentation said they were restored using "the same type of lumber . . . as in the extant doors" and "all new hardware was to be patterned on extant hardware, but wherever possible the original hardware would be salvaged and used." The contract price was $5,980.00 and the work was executed by F. W. Loesche.[115]

Work of a magnitude not seen for centuries was proposed by the Jacksonville (Florida) Engineer District of the Corps of Engineers in a 1956 report titled: "Survey Report on Fortification Walls, Fort Brooke, San Juan, Puerto Rico." The report presented overall conditions with recommendations for the repair, rehabilitation, and maintenance of the fortifications. The general conditions were described as follows:

> The huge complex of structures presented a varied picture of disrepair and erosive action shading from good condition through conditions requiring complete new stonework and facing, to deeply eroded foundation rock

> requiring extensive and costly repair and protective work. Vegetal growth was relatively heavy on the superior and exterior slopes of many walls. This vegetation was general over the area and ranged from lichens and grass to Australian pines, with most of the growth consisting of a tough, broad-leafed vine which can establish itself in almost any small crack in the wall.[116]

This report was the first time in decades that the entire fortification system was inspected as a whole, (at least for those areas that were administered by the Federal Government). The report was divided in sections covering the west, south, and north city walls. The work was prioritized with "Priority A" being the most urgent; indicative of possible structural failure if corrective action did not take place. "Priority B" was indicative of conditions causing gradual deterioration. "Priority C" was typical of neglected areas requiring periodic maintenance.

The conditions of the west wall were categorized under "Santa Elena and San Agustín" as having prevalent wall erosion and undermined foundations (figs. 36 and 37). The conditions were aggravated by broken drains and drains installed without scuppers, as well as by excessive vegetation. The condition of Santa Elena was considered to be of highest priority, and repairs costing $45,000.00 were made in 1957.[117]

The south wall was referred to as "San Juan Gate to San Justo Bastion" and was described as being accessible and structurally sound. They were described as having deteriorated stucco and mortar, and an eroded foundation base aggravated by poor drainage and excessive vegetation. Air-raid tunnels installed ca. 1940 at the lower level of las Palmas Bastion were considered to be in poor condition and it was recommended that they be sealed.[118] Top priority was also given to corrective work in the area in the vicinity of San Juan Gate.

The north wall was referred to as the "Coastal Wall System"in the summary report. Though considered relatively sound and easily accessible for maintenance, the wall was described as eroded and weathered. Considered in need of repointing and restuccoing, the condition was aggravated by excessive vegetation and water seeping through the wall.[119] The base of Santo Domingo was singled out as being heavily eroded, probably due to the regrading of the street. This area, however, was outside the jurisdiction of the Federal Government. Most of work necessary here was considered to be of the lowest priority.

In 1975 a follow-up study was undertaken again by the Corps of Engineers titled "Foundation Conditions, Appraisal and



Figure 16. Conditions prevalent between Casa Rosa curtain wall with San Agustin at left and Casa Blanca at center, ca. 1940. (SAJU HHH Archives.)



Figure 37. Condition of the west city wall in vicinity of the San Agustin (foreground) and Santa Elena (background) Bastions, ca. 1940. (SAJU NPS Archives.)

Improvements Recommended." It summarized the conditions and stated:

> The great complex of structures comprising the site presents a varied picture of disrepair and erosive action, indicating severe conditions of deeply eroded foundation rock requiring extensive and costly repair and protective work. Vegetal growth is relatively heavy on the face and top of many walls . . . Evidence of seepage through the masonry is present in some areas, thus contributing to the deterioration of mortar joints and parging. The masonry exhibits weathering of parget, masonry, and joints in small and large patches throughout the fortifications . . . Many of the conditions are considered critical from the viewpoint of imminent, or even early, failure.[120]

A number of contracts executed by the Corps of Engineers have been centered on projects located in the west wall between el Morro and San Agustín and in the north wall between el Morro and San Cristóbal. Although some drawings were located for this study, the complete project file for each specification was not found. Various projects directly affecting the city walls are of interest for this study. "Emergency Protective Works" at Santa Elena, dated 1977, was apparently the first of these projects.[121] The drawings show the placement of a rip rap revetment in front of Santa Elena, as well as doing borings along a stretch of this wall. This was followed in 1978 by a project titled "Foundation Treatment (and Access Trail)," in the area from San Juan Gate to Santa Elena. The drawings portray what is commonly known as the "jeep trail," extending northward from San Juan Gate to the base of Santa Elena. The jeep trail is situated above a rip rap revetment and allows access for maintenance of the west wall. The project titled "Stone Revetment from Santa Elena Bastion to South End of El Morro West Wall" was dated 1980, and included the continuation of the earlier revetment at the base of Santa Elena. A subsequent project "Subsurface and Structural Exploration at Casa Rosa Scarp" was dated 1981 (fig. 38. The drawings denote severe vertical cracks within the scarp wall and horizontal cracks along the merlons. The work of the project included removing the upper half of the scarp wall and its five embrasures flanking the sentry box. The sentry box was also removed and reconstructed. The final project of this series was titled the "Rehabilitation of Casa Rosa Scarp Wall." The drawings, dated 1983, included subsurface work and the installation of parapets, sentry box, stone facing, utilities and landscaping (figs. 39 and 40). The idea behind this project was to form a totally new "hollow" parapet, using a reinforced concrete wall faced with "2 inch sawed stone facing" and trimmed along the perimeter with brick. The interior of the parapet contained reinforced concrete counterforts behind

the face wall and a new reinforced concrete retaining wall was built parallel to the wall. Both walls supported a new "roof slab" terreplein consisting of precast concrete slabs topped with backfill and sod. The entire parapet was to be regraded and drained by means of new drain outlets.[122]

In more recent years, particularly since 1986, many areas of the city walls have been cleaned, patched, and repointed under the technical supervision of the NPS.

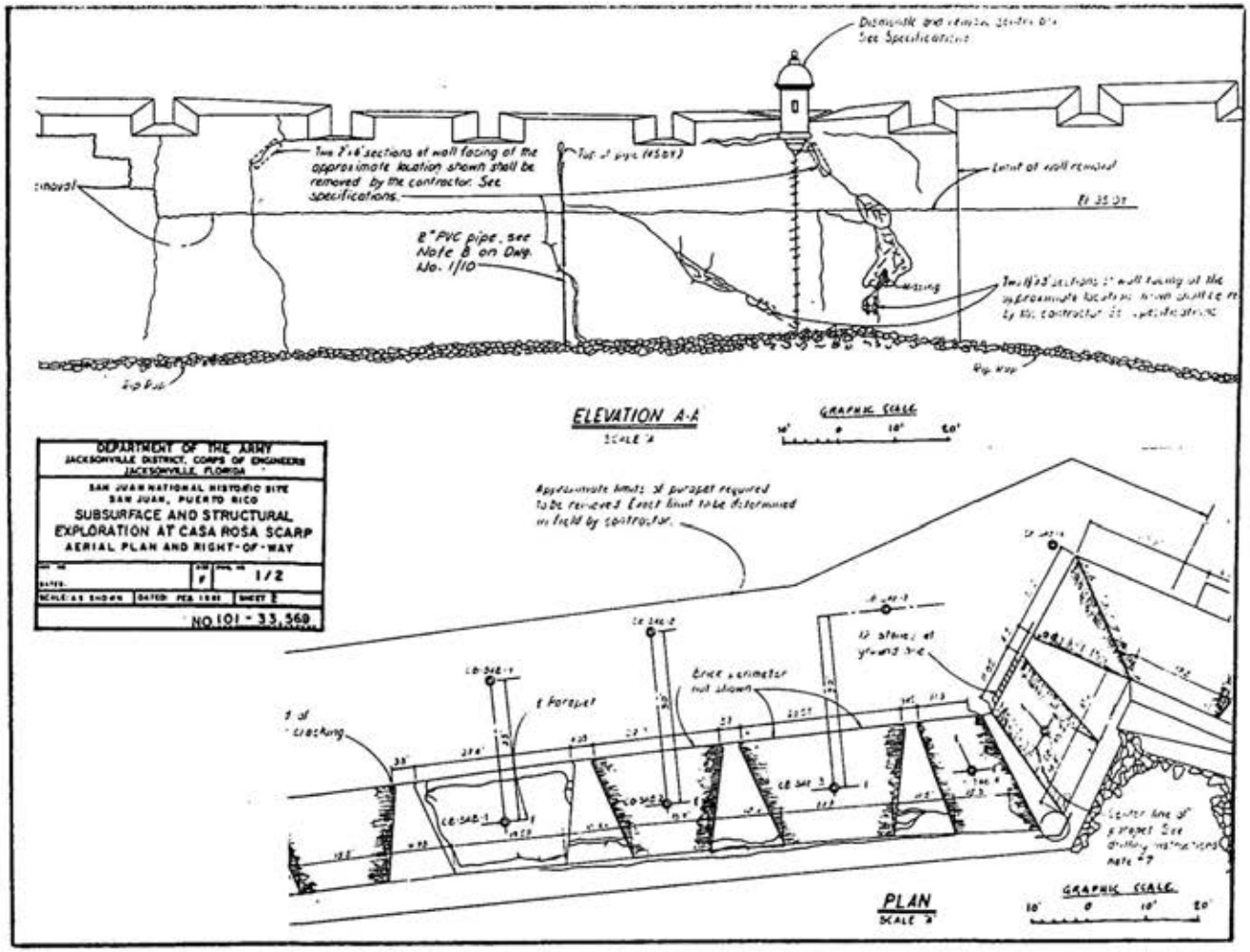


Figure 38. Elevation and plan of existing conditions in 1981 at San Agustín Bastion. U.S. Army Corps of Engineers. (Copies of drawings at SAJU NHS Archives.)

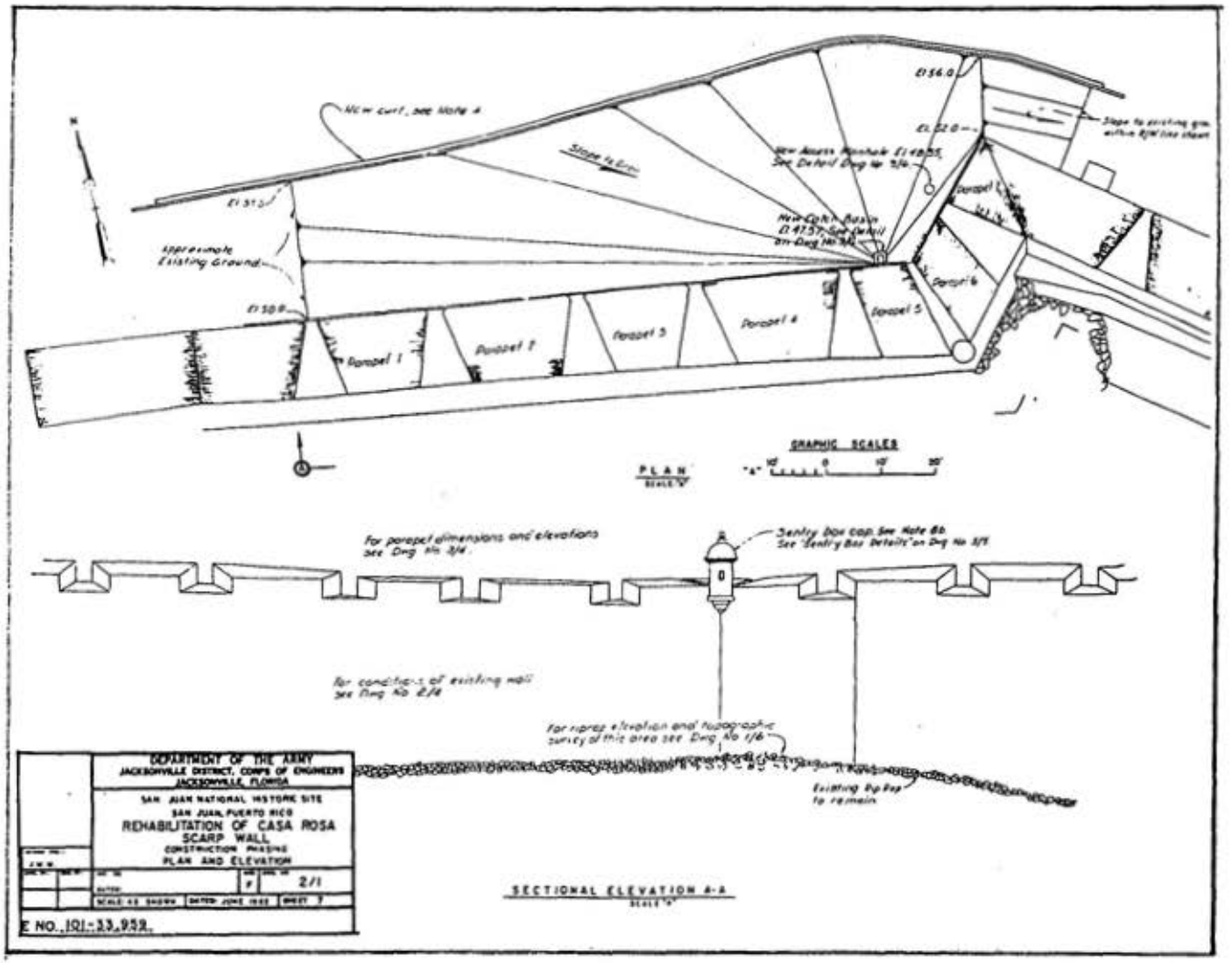


Figure 39. Elevation and plan of reconstructed wall, 1982, at San Agustín Bastion, U.S. Army Corps of Engineers. (Copies of drawing at SAJU NHS Archives.)

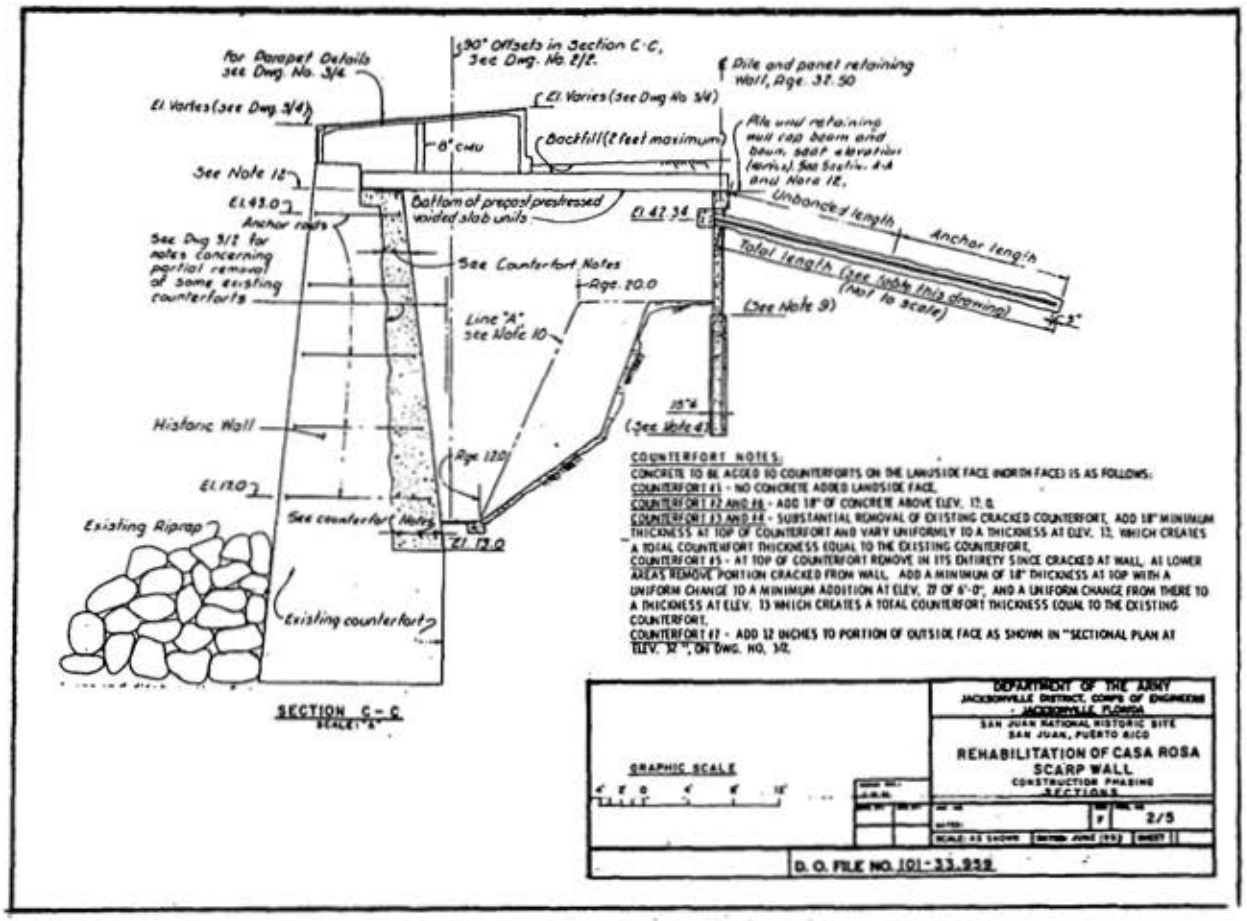


Figure 40. Section through reconstructed wall at San Agustín Bastion, 1982. Corps of Engineers. (Copies of drawing at SAJU NHS Archives.)

GENERAL CONDITIONS AND CONCLUSIONS

Deterioration-related problems of the city walls are related to problems caused by excessive vegetation, moisture penetration, undercutting by waves or ocean currents, and lack of proper preventive maintenance. A listing of the remaining fortified walls under the jurisdiction of the NPS, and their present condition, will serve as a summary to this section. The Boundary Map for the San Juan National Historic Site, (with shaded areas representing SAJU NHS holdings) may be used as a guide (fig. 41). Most of the embrasures of the city walls were documented and numbered in 1988.[123]

West Walls

San Fernando Bastion is situated south of el Morro (fig. 42). It has been greatly modified over the years and contains neither a sentry box, however, what may survive from a former embrasure is still evident (fig. 43). A modern chain-link fence separates San Fernando from the edge of the cliff. Further south is Santa Elena Bastion. Santa Elena is the only rounded bastion. It has no sentry box but contains 11 embrasures. The exterior walls are constructed of coursed, face-dressed sandstone rubble; the openings of the embrasures are of chamfered dressed stone. Horizontal surfaces of the merlons are brick-edged concrete, probably installed as part of the 1977 Corps of Engineers project. The embrasures exhibit various conditions of deterioration, including differential weathering and biological growth. Most of the flat wall surfaces are patched and have a number of surface cracks. All of the embrasures have iron fences placed approximately one foot away from the exterior face. Santa Elena is identified with a bronze marker on the wall.

Portions of the adjoining Santa Elena Curtain Wall have been reconstructed in the twentieth century. The curtain wall contains four embrasures. These are constructed of coursed, face-dressed sandstone rubble with other portions resurfaced with polygonal stone veneer (cast composite stone). Numerous rectangular holes, possibly caused by the scaffolding, penetrate the vertical face. Some of the embrasures have been closed with iron gates, and others have chain-link fencing. A large stone scupper exists near the northwest corner, and a terra cotta drain pipe is located near the southwest end. Conditions of deterioration vary widely. Large areas of patching and biological growth are evident, as well as surface cracking.

Farther south is San Agustín. The southern extension has been referred to in recent projects as the Santa Rosa Scarp

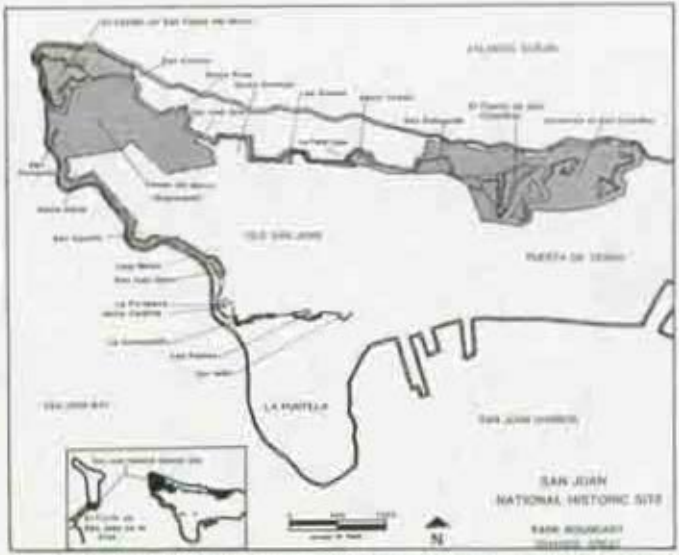


Figure 41. San Juan National Historic Site, Park boundaries (shaded areas). (Drawing by K. Faust and annotated by R. Crieson, 1991.) Based on official boundary map at SAJU NHS Archives.



Figure 42. San Fernando Bastion, view to southwest. (Photo by K. Crisson, 1990.)



Figure 43. Embrasure at San Fernando Bastion. (Photo by K. Crisson, 1990.)



Figure 44. San Juan Gate to San Agustin Bastion at far left. (Photo by R. Crisson, 1990.)



Figure 45. Reconstructed sentry box of San Agustin curtain wall. (Photo by R. Crisson, 1990.)

Wall (fig. 44). It has 20 embrasures and two sentry boxes that were both reconstructed in 1932. The southeasterly sentry was rebuilt a second time in 1982 (fig. 45). The conditions of the parapet walls include differential weathering, biological growth, and patching. Six of the southernmost embrasures were reconstructed since 1981. San Agustín is identified with a bronze marker on the wall.

The adjoining Curtain Wall of San Agustín has 10 embrasures and one sentry box that was reconstructed in 1938. The embrasures have severe biological growth, patches, and numerous cracks. The next feature is San Juan Gate and its original sentry box (fig. 46). Although not examined as part of the 1988 conditions survey, a cursory visual inspection confirmed that many of the wall surfaces have biological growth, cracks, patching, staining, and differential weathering. Adjoining San Juan Gate is Santa Catalina Bastion with la Fortaleza. Though this bastion is not part of this study, it is noteworthy for having three embrasures, a ca. 1932 sentry box, and an original eighteenth-century sentry box.



Figure 46. West elevation of San Juan Gate. (Photo by R. Crisson, 1996.)

South Walls

La Concepción bastion lies at the southwestern end of the City. It is largely inaccessible, with most of the terreplein occupied by the Convent of las Hermas de María. The bastion has no surviving embrasures, nor does it have its sentry box at the salient point (figs. 47 and 48). The bastion walls are coursed, face-dressed sandstone rubble, with many areas of weathered stucco. The condition of the bastion is similar to areas described elsewhere. The curtain wall of la Concepción



Figure 47. Salient of La Concepción with missing sentry box, south wall. (Photo by R. Crisson, 1998.)



Figure 48. Southwest corner of La Concepción Bastion showing location of missing sentry box. (Photo by R. Crisson, 1998.)

is in similar condition and is accessible from the city side of the wall. A large tree extends over the wall and appears to be causing excessive moisture. Most of the curtain wall comprises the area now designated as el Parque las Palomas (the Park of the Pigeons). Though picturesque, the many numbers of pigeons may be a source of harmful pollutants. The curtain wall is surmounted by the south wall of Cristo Chapel (fig. 49).



Figure 49. Curtain wall between la Concepción and las Palmas Bastion with Cristo Chapel above. (Photo by N. Criscon, 1990.)

Las Palmas Bastion is at the eastern end of the curtain wall (figs 50 and 51). It has two embrasures and an original eighteenth-century sentry box.[10] Part of the terreplein of las Palmas bastion has been converted into a pedestrian park with trees, pavement, lighting, and fixed benches. A bronze plaque on the wall denotes the bastion of las Palmas.[11] The remainder of the terreplein of las Palmas is occupied by a modern masonry structure known as the Chamber of Commerce Building. A modern utility pole has been located on the easternmost merlon. The embrasures fronting the Chamber of Commerce Building have been closed off with a metal railing and the terreplein has been paved with ceramic tile. The coursed, face-dressed sandstone rubble wall has been patched in many places, but appears neglected today. The parapet wall has three sealed, vaulted tunnels at the base of the scarped wall. The conditions include severe biological growth, differential weathering, patching, and staining.[12] Farther west is the severely deteriorated bastion of San Justo with its eighteenth-century sentry box.

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[10]The portion of the curtain wall containing Cristo Chapel is not under NPS jurisdiction.

[11]San Justo is administered by the Commonwealth.



Figure 90. South elevation of las Palmas Bastion. (Photo by K. Crisson, 1990.)



Figure 91. Gantry box at las Palmas Bastion, north elevation. (Photo by K. Crisson.)

East Walls

No features remain of the east wall except for San Cristóbal and its outworks, all of which are discussed separately as Volume II of this report.

North Walls

Immediately to the west of San Cristóbal is a section of fortified wall with embrasures that protected the entrance ramp to the fort. Embrasures were documented as part of the 1988 conditions survey. The wall is composed of coursed, dressed-face sandstone rubble, and dressed ashlar sandstone, and brick. Little stucco remains overall. The wall has been extensively patched in many areas. The conditions include differential weathering and minor overall cracking. A sentry box of unknown date exists here. Construction techniques suggests that it was rebuilt in the twentieth century (fig. 52).



Figure 52. Sentry box at base of north wall of San Cristóbal. (Photo by K. Crisson, 1990.)

The next element of the north wall is San Sebastián, with 15 embrasures (fig. 53). The bastion is constructed of coursed, face-dressed sandstone rubble, with dressed ashlar corners, and brick-edged embrasures; a large stone scupper is located at the center of the west scarped wall. The conditions vary from overall cracking in some embrasures, to patching and differential weathering in almost all the embrasures. Two vertical patches are indicative of inactive repaired cracks. Most embrasures are characterized by biological growth and loss of mortar at the edges of the merlons. Two embrasures have been modified, one partially infilled with brick and stone rubble and the other with concrete steps. San Sebastián has two sentry boxes, one reconstructed in 1939 and another, original, to the west. The latter is constructed of stone and

brick rubble, covered with stucco. This sentry box has severe cavity erosion below the cornice and at the dome, and has exposed brick and stucco patches (fig. 54).

Santa Tomás follows with 13 embrasures and an eighteenth-century sentry box (figs. 55 and 56). The bastion is constructed of coursed, face-dressed sandstone rubble and brick-edged corners. The sentry box is of brick rubble and stucco, on a sandstone base. The west flank of the parapet wall has been partially removed to permit overhead clearance of vehicular traffic through the Gate of la Puerta, the former exit gate. The embrasures are in generally good condition, except for biological growth, patching, differential weathering, and a few areas of minor cracking. One embrasure has been filled-in with a concrete wall, and the soil has been regraded to the top of the merlons. This condition is apparently causing moisture to seep through the wall.



Figure 53. San Sebastián Bastion. (Photo by R. Crisson, 1992.)

The next feature is that of las Animas, with seven embrasures and a sentry box that was reconstructed in 1945 at the salient angle. The terreplein contains the concrete base of a former communications tower and a concrete utility building. The bastion is constructed of coursed, face-dressed sandstone rubble. Two drainage holes are located on the east face; one near the bottom, and the other, with a scupper, near the top.

A modern concrete stairway is attached to the escarped wall of the bastion. The parapet wall has biological growth, surface cracking, and overall patching.



Figure 54. San Sebastián, original sentry box. (Photo by S. Crisson, 1990.)



Figure 55. Sentry box at Santo Tomás. (Photo by S. Crisson, 1990.)



Figure 54. Santo Tomás Bastion at right, las Animas on left. (Photo by H. Crisson, 1940.)

Santo Domingo follows with one eighteenth-century sentry box at the salient angle. The terreplein of the bastion is outside Federal jurisdiction and contains three twentieth-century masonry structures (fig. 57). The bastion is constructed of coursed, face-dressed sandstone rubble and dressed stone corners. The sentry box is stuccoed brick on a sandstone base.



Figure 57. Twentieth-century structure at west end of Santo Domingo Bastion. (Photo by E. Crisson, 1990.)

A large scupper is located at the western end. The embrasure conditions include patching, biological growth, and cracking. There is differential weathering and loss of mortar. Two of the embrasures have been blocked with a concrete wall. At the center of the curtain wall between Santo Domingo and Santa Rosa is the Gate of the Cemetery, the former Gate of San José (fig. 58). The tunnel and vaulted entrance are constructed of sandstone rubble with dressed stone corners and stuccoed brick.

Santa Rosa bastion lies farther west, with one sentry box at the salient angle that was reconstructed ca. 1939 on its original sandstone base (fig. 59). The bastion has 18 embrasures. The bastion is constructed of coursed, face-dressed sandstone rubble, with rubble joints, dressed stone corners, and brick-edged embrasures (fig. 60). Merlons are of brick rubble and concrete. The cemetery wall abuts the west flank of the bastion and various tombs are set into the base of the glacis wall. The embrasures are in generally poor condition, with many patches, differential weathering, surface cracks, and loss of mortar. A few embrasures have biological growth and cavity erosions. Santa Rosa bastion is identified with a bronze marker on the wall.

The last of the north-facing features is San Antonio, with seven embrasures (fig. 60). The sentry box at the salient angle was reconstructed ca. 1939 on its original sandstone base



Figure 56. North wall - Santo Domingo to the left, Santa Rosa Bastion at center, cemetery in foreground, Ballaja Barracks and city in background. Arrow indicates tunnel to the cemetery. (SEPO, San Juan, 1989.)



Figure 59. Santa Rosa sentry box. (Photo by R. Crimson, 1990.)



Figure 60. North walls with San Antonio Bastion in foreground, cemetery below. (Photo by R. Crimson, 1990.)

(Fig. 61). The bastion consists of coursed, face-dressed sandstone rubble with rubble joints, dressed stone corners, and brick-edged embrasures. A large stone scupper is located near the salient angle and has a large cast iron pipe leading down to the base of the scarped wall. The embrasures have cavity erosion and differential weathering. Most have been patched and have areas of mortar loss, while others have cracks and biological growth. San Antonio is identified with a bronze marker on the wall.



Figure 61. Sentry Box at San Antonio Bastion. (Photo By R. Crisson, 1990.)

Conclusion

It is apparent that the issue of maintenance and repair has plagued the defensive walls of San Juan during most of their history. This will continue to remain a dominant problem in the future. Still valid is a 1933 memorandum by Lieutenant Colonel H. T. Ward, of the Corps of Engineers. Ward summarized this issue when he stated:

> The Spanish took particular care in providing for drainage. During Spanish times there was little deterioration due to the fact that the fortifications were kept under constant observation and slight breaks and failures were repaired as soon as they developed.
>
> The deterioration of the walls, other than that resulting from wave action, is due to water getting behind or in the walls, to vegetation growing in the cracks and joints, and to breaks in the plastered surfaces, resulting in the rapid formation of holes through which the softer material in the walls is lost.

> The Spanish took pains to keep the drainage system in good repair, kept the gutters cemented and replaced the drainage pipes extending beyond the walls, when they were broken . . . they filled and repaired holes as soon as they commenced to develop. In other words, they provided for current maintenance and did not wait until the damage was great enough to warrant a special appropriation to do the work under a formal contract.[127]

It is remarkable that 60 years after this memorandum, the conclusions reached and the overall recommendations are still the same. The advantage now is that science and technology can assist preservationists to determine to what degree is intervention necessary in order to preserve the fortification system as a whole.

NOTES

1. Mrs. Jameson, Sacred and Legendary Art (London: Longman, Brown et al, 1857), p. 230.

2. Ordnance File at San Juan NHS. Description of the city wall by Colonel Ladue of the U.S. Army Corps of Engineers, 1925.

3. General Management Plan/Environmental Assessment (San Juan: Department of the Interior, NPS, September 1985), p. 103.

4. Ibid., p. 103.

5. Ibid., p. 103.

6. Jose de Navarro, "State of the Artillery of the Plaza of Puerto Rico in Times of Peace," 1818. (Servicio Histórico Militar, 4-1-7-13.)

7. Aníbal Sepúlveda Rivera, San Juan: Historia ilustrada de su desarrollo urbano, 1508-1898 (San Juan: Carimar, 1989), p. 32. Original plan is in the AGI, S.D. no. 1.

8. Albert Manucy and Ricardo Torres-Reyes, The Forts of San Juan (Greenwich, CT: The Chatham Press, 1973), p. 36.

9. Ibid., p. 50. See also unedited Spanish manuscript by Ricardo Torres-Reyes "La Plaza de San Juan de Puerto Rico (1765-1777)" (San Juan: Department of the Interior, NPS, July 1952). Copy at San Juan NHS Archives.

10. Ibid., pp. 53-62.

11. General Management Plan, p. 106.

12. Enrique T. Blanco, "Por el adarve de San Juan," Revista del Instituto de Cultural Puertorriqueña, no. 53 (October-December 1971), p. 53.

13. Adolfo de Hostos, "Historia de la ciudad de San Juan de Puerto Rico," Revista del Instituto de Cultural Puertorriqueña, no. 53 (October-December 1971), p. 31.

14. Enrique T. Blanco, p. 52. The plaque appears to be of the same style and manufacture as the two plaques affixed to the bastions of Ochoa (Tejeda) and Austria, at el Morro. The San Juan Gate plaque is a puzzle, since it mentions King Ferdinand instead of Philip III, King of Spain reigning in 1605.

15. Ibid., p. 54.

16. Engineer Luis Venegas Osorio was commissioned by the King of Spain to inspect the San Juan fortifications in 1678. Both el Morro and San Cristóbal, and the city walls were included in his plan. (Archivo General de las Indias: Mapas y Planos, Santo Domingo, no. 74.)

17. Enrique T. Blanco, p. 54.

18. Map of San Juan by Osorio, 1678.

19. Manucy and Torres-Reyes, p. 10. The name was probably taken from the name given to the adjacent sandstone quarry (now the site of the Cemetery of San Juan.)

20. Juan M. Zapatero, La Guerra del Caribe en el Siglo 18 (San Juan: Instituto de Cultura Puertorriqueña, 1964), p. 397.

21. Manucy and Torres-Reyes, p. 69. O'Reilly (1725-94) and O'Daly (1728-81) were very influential Irish-born military engineers who initiated the rebuilding of the San Juan fortifications; O'Reilly never returned to Puerto Rico after his initial visit, while O'Daly died in San Juan in mid-construction. Having collaborated with O'Daly since 1766, Mestre became his successor for the completion of the project.

22. Existing conditions plans of San Cristóbal and el Morro by Thomas O'Daly, 1765. (Servicio Geográfico del Ejército, Madrid. Cart. Ultr. X, cat. 68.) Copy of plans included in Volume I, nos. 6 and 7.

23. Adolfo de Hostos, Historia de San Juan: Ciudad Murada 1521-1898 (San Juan: Instituto de Cultura Puertorriqueña, 1966), p. 204.

24. Two drawings by Juan Francisco Mestre depicting proposed plan and existing conditions of the south and west city walls, 1787. (Servicio Histórico Militar, Madrid.) Copies of drawings included in Volume I, nos. 21 and 22.

25. Unsigned ca. 1797 plan of the city. The translation of the title is: "Plan of the city of San Juan, PR and the land up to the bridge of San Antonio, showing the fortifications and the temporary work executed during the war." The plan in undated, although it was apparently in reference to the 1797 war. The source of the copy made available for this report is also unknown; this copy is being donated to San Juan NHS.

26. It is assumed that most of the sentry boxes in San Juan were constructed during this period, and Mestre shows them in section in his drawing dated October 20, 1769 (original at AGI, Mapas y Planos, no. 367), as well as in the 1792 city plan. According to Historian Juan Manuel Zapatero in La Fortificación Abaluartada en América, sentry boxes were round, square, pentagonal, or hexagonal-

shaped in the sixteenth century, and were topped by a media naranja (a cupola). Two sentry boxes in San Juan (el Espigón and el Cañuelo) match this description. In the eighteenth century, the military schools of Barcelona and Brussels created rules of proportions that required sentry boxes to have a five foot base, and to be 15 feet high (three times the width). An engraving of 1768 (Zapatero, p. 178) portrays what was considered the "ideal" sentry box of the eighteenth century. It has an ogee-curved dome, a finial top, and an elaborate molded base--the whole considered to be of the "military baroque style." In fact, most of the San Juan sentry boxes match the engraving of 1768, except that they are circular rather than pentagonal in plan.

27. Plan of the City of San Juan, Juan Mestre, November 17, 1792. S.H.M., no. 5795. See Historic Drawings, Vol. I, no. 23.

28. Eugenio Fernandez Mendez, Crónicas de Puerto Rico (1493-1797), Vol.I (San Juan: Estado Libre Asociado de PR, 1957), pp.131 & 184.

29. María de los Angeles Castro, Arquitectura en San Juan de Puerto Rico (Siglo XIX) (Río Piedras: Universidad de Puerto Rico, 1980), p. 86.

30. Manucy and Torres-Reyes, p. 76. Today, the most distinctive surviving element of the first line of defense is the Fort of San Gerónimo, under the jurisdiction of the Commonwealth, and not part of this study.

31. The undated plan is presumed to be ca. 1765, since O'Reilly completed his survey that year, and O'Daly signed most of the plans of that period. The translated title is "Plan showing with great exactitude the Castle of el Morro of San Juan, PR and its surroundings, by survey, [and] with scrupulous attention to details, by order of Field Marshall Alexander O'Reilly." The source of the copy made available for this report is also unknown, but the copy will be donated to San Juan NHS.

32. Ibid.

33. Ricardo Torres-Reyes, Construction History of San Cristóbal: 1634-1800 (San Juan: U.S. Department of the Interior, NPS, 1965), p. 64.

34. Plan of the north city wall by Juan Mestre, September 13, 1783. (Museo Naval de Madrid, K-b-2-58.) Copy of drawing found in Volume I, Historic Drawings.

35. Manucy and Torres-Reyes, p. 76.

36. Ibid., p. 78.

37. Ignacio Mascaró, "Plaza de San Juan de Puerto Rico, 1808-11." Copy from the National Archives, Record Group 186, (Records of the Spanish Governors of Puerto Rico), with copies at San Juan NHS Archives.

38. "Plano de la Plaza de San Juan de Puerto Rico," is not signed or dated, but labeled as ca. 1887 in Aníbal Sepúlveda Rivera, Historia de San Juan Ilustrada, pp. 332-333. The original is at the Servicio Histórico Militar, Madrid.

39. José de Navarro, "State of the Artillery of the Plaza of Puerto Rico in Times of Peace," December 20, 1818. Archivo del Servicio Histórico Militar, Madrid.

40. Juan Hernán Dávila, "State of the Bronze and Iron Artillery," January 5, 1838. Archivo del Servicio Histórico Militar, Madrid.

41. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications 1898-1958 (U.S. Dept. of the Interior, NPS, February 1984), pp. 31-32, and 48.

42. Ibid., p. 32.

43. Ibid., pp. 32-33.

44. Ibid., p. 33.

45. Many other sentry boxes were removed as part of the artillery improvements during the late nineteenth century. They were subsequently reconstructed by the U.S. Army in the early twentieth century, with the exception of the sentry box at la Concepción.

46. Only a small part of San Pedro, the lower portion, survived the demolition, and appears to remain in existence today; it is under the jurisdiction of the Commonwealth.

47. Santo Toribio is now inaccessible; however, modern aerial photographs appear to confirm its existence today.

48. Ignacio Mascaró, "Plaza de San Juan de Puerto Rico, 1808-11." Copy at SAJU NHS Archives.

49. Proposed guardhouse, 1885; Proposed barracks, 1895; and Proposed bakery, 1895. Plans at Archivo del Servicio Histórico Militar, Madrid. It is unclear which, if any, of these proposals was adopted, nor when was the bastion destroyed.

50. María de los Angeles Castro, p. 379.

51. Mascaró, 1808-11 report. Although a ramp and a circular sentry box exist today, no evidence remains of a square sentry box.

52. The present site of the Fort of la Perla is inaccessible and not inspected as part of this report. However, on a site visit to San Juan NHS in November 1990, park staff indicated that they had been able to observe one or more walls that may have been part of this defensive feature, but were now integrated into a twentieth century structure. The entire neighborhood between the north wall and the Atlantic Ocean is now called "La Perla."

53. María de los Angeles Castro, p. 166. The site was chosen in order to adhere to the "new principles of hygiene," due to slope of the terrain toward the ocean, in order to drain properly.

54. Ibid., p. 286. Manuel Sicardó was the same architect who had executed the models of el Morro and San Cristóbal, now at the Museo del Ejército, Madrid. The curtain wall of Santa Rosa is under jurisdiction of the NPS and the burial niche colonnade and cemetery are owned by the San Juan Municipal Government.

55. After the installation of the San Juan Cemetery the San José Gate acquired its present-day name of la Puerta del Cementerio (the Gate of the Cemetery).

56. Depicted in the 1897 "Plano del Recinto Amurallado de la Ciudad de San Juan, PR Antes de Efectuarse el Derribo de las Murallas al Este de la Ciudad en el Ano 1897," in Aníbal Sepúlveda Rivera's San Juan, Historia ilustrada de su desarrollo urbano, 1508-1898 (San Juan: Carimar, 1989), pp. 334-335. Reproduced from a 1940 copy at the Department of Public Works, San Juan.

57. Bearss, p. 34.

58. Ibid., p. 16.

59. Ibid., pp. 12-13. and Angel Rivero, Crónica de la Guerra Hispano Americana en Puerto Rico (San Juan: Instituto de Cultura Puertorriqueña, 1972. Reprint of 1922 first edition.), p. 120.

60. This plan is titled "Defenses of San Juan: el Morro and Outworks," by Captain A. Flagler, December 31, 1900. SAJU NHS-9797.

61. Bearss, p. 28.

62. Ibid., p. 47. This document was called "Record of Delivery and Receipt of the Military Buildings Existing in the Garrison of San Juan, PR" and was found in Executive Documents, Printed by Order of the Senate of the United States During the 2nd Session of the 56th Congress, 1900-01 (Washington, 1901).

63. Bearss, p. 50.

64. Ibid., p. 48.

65. Flagler plan of 1900.

66. Bearss, p. 77.

67. Ibid., p. 157.

68. Ibid., p. 78. All of the features noted by Flagler were included in the description attached to the July 1903 General Order No. 97, signed by President Roosevelt, which established the San Juan Military Reservation.

69. Memorandum to Adjutant General from Commanding Captain of el Morro, ca. 1900. San Juan NHS Archives, U.S.Army Ordnance and Artillery File.

70. Bearss, p. 181.

71. Ibid., p. 183.

72. Ibid., 164.

73. Ibid. p. 161.

74. San Juan NHS: U.S. Army Ordnance and Artillery File, ca. 1915.

75. Colonel Black, request for appropriations 1913-1916. San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1916.

76. Bearss, p. 185.

77. Ibid., p. 149. The change made in 1918 describes the present condition of Santa Elena.

78. Ibid., p. 186.

79. Inspection study by Colonel W. B. Ladue, 1925. San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1925.

80. Ibid.

81. Bearss, p. 197.

82. Copy of Specifications. San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1925.

83. San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1925.

84. Bearss, p. 209.

85. Ibid., pp. 218-219.

86. Ibid., pp. 239-240.

87. Specifications and Completion Report at San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1932.

88. San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1932.

89. "Just off the Boat," Porto Rico Progress, XXXI no. 4 (January 26, 1933). San Juan NHS Archives, U.S. Army Ordnance and Artillery File, 1933.

90. Appropriation requests, Lieutenant Colonel Ward. San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1933.

91. Ibid., p. 255.

92. Ibid., p. 256.

93. John L. Nagle, "Report on Park Development and Tourist Trade Possibilities: Island of Puerto Rico," December 10-18, 1934. (Original manuscript at SAJU NHS Archives.)

94. Ibid., p. 285.

95. Completion Report for Specifications, 1938-1940. San Juan NHS Archives.

96. Completion Report, 1938-40; San Juan NHS Archives.

97. Bearss, p. 273.

98. The Materials section of this HSR provides information regarding this material, known as "cast composite stone."

99. Completion Report, 1938-1940; San Juan NHS Archives.

100. Completion Report, 1938-40; San Juan NHS Archives.

101. Completion Report, 1938-40;101. San Juan NHS Archives.

102. Completion Report, 1938-40; San Juan NHS Archives.

103. Completion Report, 1938-40; San Juan NHS Archives.

104. Official correspondence, W. J. Truss (June 19, 1939). San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1939.

105. Official Correspondence Secretary of the Interior Harold L. Ickes to Governor William D. Leahy, February 23, 1940. SAJU NHS Archives: U.S. Army Ordnance and Artillery File, 1940.

106. Leahy to Ickes, April 20, 1940. San Juan NHS Archives: U.S. Army Ordnance and Artillery File, 1940.

107. Bearss, pp. 318-325.

108. Bearss, 381.

109. Bearss, p. 382-386.

110. Ibid., p. 386.

111. Bearss, pp. 388-400.

112. Ibid., p. 394. Following World War II, the general consensus favored bringing the fortifications under the protection of the NPS. San Juan National Historic Site (SAJU NHS) was established by the Secretary of the Interior in 1949, although the last U.S. Army troop did not leave el Morro until 1958. Most of the fortifications remained under the control of the Department of the Army until 1961. Since 1961, the NPS has maintained and preserved most of the defensive city walls and fortifications. The remaining portions are administered by the Commonwealth of Puerto Rico. Specifications and other contract documents for repairs to the city walls have been prepared in cooperation with the U.S. Army Corps of Engineers.

113. Ibid., p. 394.

114. Ibid., p. 401.

115. Ibid., pp. 401-403. It is possible that the Club Cívico de Damas was assisted by another organization named la Sociedad para el Fomento y Conservación de San Juan, since both are credited with the restoration of the gate in 1956, according to a bronze plaque attached to the south wall of the gate. On the north wall, another bronze plaque states: "Gate of San Juan constructed about 1639. Wooden doors reconstructed 1749. Principal entrance to walled city. Walls surrounding San Juan erected 1635-1641. Tablet placed by Womans[sic] Civic Club of P.R. 1927."

116. Ibid., p. 405.

117. Ibid., p. 418.

118. The arched openings are visible today, and have been sealed with concrete.

119. "Foundation Condition Appraisal and Improvements Recommended," p. 9.

120. Report titled "Foundation Condition Appraisal and Improvements Recommended," [1975], SERO-NPS, was sent to OMB and the U.S. Congress in 1975 as part of the appropriations request. P. 6. The copy used for this HSR is owned by Richard Crisson.

121. Project Manual, 1977. SAJU NHS Archives.

122. Project Manual, 1983. San Juan NHS Archives.

123. Columbia University, Center for Preservation Research: "Conditions Survey of Embrasures," 1988. Copy at CRC-NPS.

124. None of the south-facing embrasures were included as part of the embrasure study conducted by Columbia University in 1988. The sentry box at las Palmas has a hemispherical dome similar to the one at San Juan Gate; the finial is a cast-concrete replacement.

125. The translation of the marker states: "Bastion of las Palmas de San José constructed in the XVII century after the Dutch attack of 1625 as part of the defensive system of the city of San Juan. The construction was credited to the Home Builders Association, 1968."

126. Farther east is the bastion of San Justo. The bastion is under the jurisdiction of the Commonwealth and portrays one of the most widely-cited examples of biological growth; a large tree with its exposed roots continues to damage the scarped wall and the cracked sentry box.

127. Memorandum by Lieutenant Colonel R. T. Ward, U.S. Corps of Engineers, 1932. San Juan NHS Archives: U.S. Army Ordnance and Artillery File.

III. AN INVESTIGATION OF THE MATERIALS USED IN THE FORTIFICATIONS OF SAN JUAN

San Juan National Historical Site
San Juan, Puerto Rico

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INTRODUCTION

A study of masonry materials of el Morro was made during the summer of 1988. A study of masonry materials of San Cristóbal and its outworks, and a study of all other building materials in the fortifications was made during the winter and summer of 1989. Materials were identified and their constituents and manner of use recorded.

During the three site visits, materials were examined in situ and samples extracted from the fortifications for analytical examination. All samples were taken from areas within easy reach of the conservator; upper walls were not sampled.

A great deal of information on materials was culled from archival sources. Also consulted was the morphological development of the fortifications discussed in this report and in a document prepared by Juan Blanco, Columbia University, for the Southeast Regional Office. The "Building Materials and Technologies" (of San Cristóbal) study prepared by Barbara Yocum of HPC was extremely helpful to the development of this report. The San Juan NHS archive provided photographs, drawings, plans, and documents. Documents written in English were consulted; some Spanish documents were translated into English and were consulted as well.

Initially it was assumed that different materials were used for different building campaigns. Thus, a study of materials would have led to the production of a key by which elements of the fortifications could be dated; hypotheses concerning construction dates would have had a basis in this key. However, the study determined that over the approximately 350 years of fortification construction during the Spanish tenure, there was virtually no change in construction methods and materials. It was only in the twentieth century that great changes were observed.

A knowledge of materials is necessary for understanding current conditions of the fortifications and assessing durabilities of materials. This is required for making preservation recommendations; the constituents and manner of fabrication and finishing of materials must be known for their replication for patching or reconstruction.

Materials have been grouped into five categories: masonry, wood, metal, glass, and bitumen. Modern materials used in office and interpretation space (including all mechanical systems) were not examined for this report. The greatest attention has been given to masonry predating the late-nineteenth century.

STONE

The predominant masonry material in the fortifications is stone. Both ashlar and rubble stone are used for foundations, walls, vaults, and paving.[1] Stone was used throughout the Spanish tenure; many twentieth-century repairs are also of stone. Information on stone was gathered from geological studies and *in situ* and laboratory examination.[2]

In an archaeology study, Pedro Gelabert described the geology of San Juan as consisting of cemented dune sand, beach sands, and beach rock. The cemented dune sand is: ". . . former dune sand, cemented by calcium carbonate. The sand is generally composed of well-rounded grains of calcite, quartz, volcanic rocks, and shell fragments." Beach rock is found in the intertidal zone and is "composed mainly of quartz, and calcite grains cemented by calcium carbonate or iron oxide." These stones are highly permeable and friable when freshly exposed, but with time, caseharden to form a dense surface crust.[3] The stone is generally light tan in color.

Several early sources mention the stone used in the fortifications. In a report of 1583, stone is included in the list of necessary building materials locally available for proposed construction.[4] In 1765, Alexander O'Reilly wrote: "On the island of Puerto Rico there is very good sandy stone [or sand stone, *piedra arenisa*] for the fortifications . . ."[5] In 1783, Juan Francisco Mestre described the local stone as soft (*piedra blanda*).[6]

Limestone found on the island of San Juan was used for the production of lime and is discussed under "Mortars" in this report. Ashlar or rubble limestone is not visible in the fortifications; it is not known if it was used in areas currently covered with stucco or otherwise hidden from view.

Information on quarrying, cutting, and finishing stone during the construction of the fortifications is sparse. It is probable that stone was taken from quarries situated near building sites; Thomas O'Daly's plan of 1765 indicates a quarry to the south of the present-day cemetery. Stone was also taken from demolished structures and reused for new construction. Reports from the late-eighteenth century discuss two sources for stone: the excavation work in the main moat of San Cristóbal (beginning in 1766) and the 1771 demolition (for the repair) of the Santiago Ravelin.[7]

In a report from 1783, Mestre mentioned that stone was cut from "the quarry of San Geronimo [at the east end of San Juan], which can be transported by water to the construction site in order to make the works more durable."[8] The fact that stone was transported by water indicates that not all stone came from

construction sites. It is possible that by this date, local sources of stone had been depleted and more distant quarries were required.

Identifying size, tooling, and bedding patterns of stone blocks is difficult and often impossible to determine due to the stucco covering. However, much of the deteriorated stucco has weathered and formed to the contour of the blocks beneath (especially at el Morro), revealing these characteristics. (See figures 1 and 2.) Almost all of the fortified walls are constructed with a slight batter. Rock-face blocks are generally 18 inches to 24 inches in height and 30 to 36 inches in length, with length varying more than height. Their depth cannot be determined without further investigation.

The different heights of the blocks seem to be a function of building period or location. Some walls are built with the larger blocks, some with the smaller blocks, and some with both (the scarped walls of Mercado and Carmen Bastions have blocks of two sizes). These different heights may be a result of different quarries (with different stone cutters) or different construction dates during the late-eighteenth-century building campaign. Some stone blocks are from earlier walls and are now in their second (or third) use. The retaining wall to the north of Ochoa Bastion, by the sea, is believed to date to the seventeenth century and is characterized by 18 inch high stones suggesting that this smaller size was used for early work.

Joints between stone blocks are generally 1 to 1-1/2 inches and chinked with stone or brick, the former being more common. (Brick chinking appears to be a repair material.) Chinking served both to fill spaces created by uneven surfaces and to prevent blocks from displacing mortar while it was still wet. Some chinking stones also function as tie stones, these are longer and anchor face stones back to an embankment. This is visible in the retaining wall to the north of Ochoa Bastion where some blocks are missing.

Within three passageways of el Morro (connecting Carmen and Mercado Bastions, at the base of the triangular stair under Austria Bastion, and leading to the magazine under Austria Bastion) stone blocks or slabs are used for the vaults. These blocks measure from 5 to 12 inches in width and from 26 to 43 inches in length; their depth is not known.

In addition to rock-faced ashlar, stone cut with a smooth face is found on door, gate, and window surrounds; sentry boxes; colonnades; cordons; and some salient angles. This smooth-faced stone will be called "cut stone" in this report. Cut stone that is more ornately sculpted embellishes gates and stair towers at el Morro and San Cristóbal, the ramps of el Abanico and San Carlos, chapel altars, and possibly chapel



Figure 1. North wall of San Juan, backing cemetery. Note use of ashlar with stone chinking (this wall has more chinking than other walls). Brick chinking and brick of merlons may be repairs. Photo by J. Jacob, 1989.



Figure 2. Santa Barbara Battery scarped wall above Water Battery. Lower wall is of rubble stone, upper wall is of ashlar. Both stone and brick chinking are present. Photo by J. Jacob, 1989.

entrances and bell enclosures. (Some cut stone does not have a stucco covering nor is there evidence that such a covering ever existed; this is discussed later in the text.)

Rubble stone construction is found throughout the fortifications and seems to be predominantly used for non-fortified walls. Casemate walls and counterscarps are generally of rubble stone. The scarped wall at the toe of Santa Barbara Battery is of both ashlar and rubble, with the former surmounting the latter (fig. 2).[9] Rubble stone was combined with earth in filling the interstices of walls. Rubble stone was most likely obtained from stone cutting and finishing locations, excavations, and demolished structures.

Stone pavers are placed in trapezoidal configurations fanning out from embrasures on el Caballero, San Carlos, and la Trinidad. They were undoubtedly used in other locations, but the resurfacing and patching of the terrepleins in the last century makes it impossible to determine the extent of their use.

The 1888 gun tracks are also made with stone pavers. Each paver is cut to form part of the semi-circular track which sits just above the terreplein level. Examples are located on Santa Barbara Battery and Carmen Bastion.

Square pavers of a dark stone are found throughout el Morro and San Cristóbal, especially for stair treads and copings. They measure 16 inches square and are a composite stone similar in color to dark gray slate. It is not known whether this is a natural or fabricated stone. Differences in wear marks, associated mortar, color, and composition indicate two dates of installation: possibly the late-eighteenth century and the mid-twentieth century.

Black and white marble pavers are found in the chapel at el Morro, in the vestry of the chapel at San Cristóbal, and outside the northern-most casemate of the Officers' Quarters under the arcade. These are 11 inches square and laid in a checker-board fashion. Marble grave stones are embedded at the base of the north wall adjacent to the San Juan Cemetery (fig. 1).

The north and east scarped walls of San Cristóbal and the adjacent scarped walls of Santa Teresa and San Carlos are characterized by stucco with small stones set in to create a decorative surface. The date of this work was not researched for this report.

In the late 1930s, portions of el Morro damaged in 1898, and other areas of degradation were repaired and patched by the U.S. Army Corps of Engineers. There were several different

patching materials and techniques used during this time, all using stone in some fashion. One such repair makes use of small polygonal stone blocks generally measuring no more than 100 square inches in surface area. Areas of degradation were apparently filled with mortar and faced with stone, producing a patchwork effect on the surface.[10] Polygonal stone slabs were used to face the newly constructed concrete walls of San Agustín Bastion. Cast composite stone, made of stone fragments and mortar, was used for many repairs by the U.S. Army and the NPS (discussed in greater detail under "Cast Materials" in of this report).

EARTHEN MATERIALS

Temporary works of earthen materials were employed extensively and played a key role in the structure of the fortification system in the early periods. Earthworks were most likely sculpted from the natural terrain, providing physical protection as well as visual protection to structures and activities behind. Earth coverings continued to provide protection in later years, disguising masonry structures from the sea.

For this report, earthen materials will be defined as those organo-mineral materials characterizing soil, and made up of clay, silt, sand, gravel, and cobbles (small stones) in any variety of proportions.[11] A soil analysis was not made for this study. Clay, silt, and sand are discussed under "Mortars" in this report.

In 1583, Menéndez de Valdés included "earth" in his list of building materials in close proximity to the proposed construction site of San Cristóbal.[12] In a construction document of 1771, O'Daly described the earth in front of el Morro.

> The terrain in front of the castle in the plan extends a distance of three hundred tuesas to the Convent of Santo Domingo. It is very uneven but reforming it is not expensive. The character of the ground is three or four feet of sand on a base of hard flesh-colored clay.[13]

The "flesh-colored clay" described above was the light red orange or tan fines found in mortars (discussed under "Mortars" in this report).

Earthworks were more-or-less abandoned when masonry became the preferred building material for fortifications. Earth however, continued to play a role in this construction, being used to fill the interstices of walls and merlons. As wall

faces were built up, earth and rubble were dumped into the cavity and tamped, or rammed, to form a cohesive and solid mass. (In some cases, walls from previous periods of construction may have been incorporated within this inner wall structure.)

One of the only locations where a wall interior is visible is within the magazine under Austria Bastion. A small tunnel, hollowed out of the south wall, extends back for about 10 feet. The walls and ceiling of this excavation are earth and rubble; the earth is red orange in color.

Ricardo Torres-Reyes documents the use of earth for filling walls.

> . . . The parapets and merlons [of San Cristóbal] were begun during the first months of 1766, but with the precaution of not pouring the earth fill of the merlons until their walls were consolidated [presumably referring to the setting of the mortar]. This slow method was continued along the South Bastion, as far as the beginning of the curtain.
>
> Precisely during those days governor Marcos de Vergara informed O'Daly about confidential news coming from Spain in connection with an evident war crisis between England and Spain, and a possible attack to the Island. Hard pressed by this news and the assurance in the stability of the old walls, the builders went on with the filling of the already constructed merlons and the continuation of the same work along the curtain. The new parapets and merlons were filled with earth as they were constructed. This was a violation of an important standard construction practice.[14]

By filling parapets and merlons as soon as the outer walls had been constructed, the mortar of the walls was greatly hindered from setting properly, and may be a contributing factor to deterioration today. It is quite possible that other areas were also constructed at this accelerated pace (and faulty manner).

In the fall of 1898, Major Spencer Crosby, an engineer with the United States Army, inspected the fortifications in San Juan. Excerpts from his notes describe the use of earth in construction, but are unclear as to the exact locations of his observations; the description below may be that of the embrasures that were filled during the late-nineteenth century.

> [The wall] . . . appears to be about a meter thick near the top where it is formed into a parapet. This is strengthened in many places by having a second wall built

inside and parallel to it and the space between the two filled with earth . . .[15]

A 1952 U.S. Army Corps of Engineers drawing of a section through the cavity behind the failed wall of San Agustín Bastion depicts a rubble masonry wall backed by an earthen fill (with no rubble mixed in). It is possible that the slumping of the fill caused differential internal stress resulting in the failure of the wall.[16]

Sod appears to have been frequently used in the fortifications. In 1772, O'Daly reported that the terreplein of Santiago Bastion was covered with sod to prevent the erosion of the earth beneath. Later, when the earth had settled sufficiently, the sod was replaced with masonry paving.[17] In 1783, Mestre described the terrain to the southeast of la Princesa as "covered with sod for its longer lasting."[18] Sod is still used as a covering in la Princesa, Santa Teresa, San Cristóbal, and la Trinidad.

In the late-nineteenth century, areas of the fortifications were altered to suit changing artillery needs. Edwin Bearss described many of these alterations.[19] Embrasures were filled with earth and covered with stucco, walls were reinforced with earth, and earthen covers were placed over magazines. Much of this work was later removed by the U.S. Army.

CERAMIC MATERIALS

Ceramic materials, primarily brick, are found throughout the fortifications and date to most building campaigns. In general, brick are used only in specific areas and not in general wall construction. Brick fragments are found in rubble work and in base layers of hormigón (poured cementitious paving). Brick dust is a constituent of some mortars (discussed under "Mortars" in this report). Glazed tile, roofing tile, and floor tile are additional ceramic materials found in the fortifications.

Prior to the late-nineteenth century, all brick were handmade. Their dimensions are those generally associated with Roman brick, being 10-1/2 by 5 by 1-3/4 inches on average. It is not known if they were locally produced or not. However, in 1765, O'Reilly noted that "on the island of Puerto Rico there is . . . good clay for bricks [ladrillo] and tiles [tejas]."[20]

The earliest brick extant are found within the tower at el Morro. Brick on the lower portion of the walls below the springing of the dome date to the ca. 1540 construction date;

brick above date to the late-eighteenth century when the tower was enclosed and covered for the terreplein of Santa Barbara Battery. Below the springing of the dome, brick are laid in alternating stretcher and header courses with 1 inch bed joints and 1/4 inch head joints (visible where stucco is absent). Due to the stucco covering on the dome, it is impossible to see brick size and coursing. Whether the original tower was of solid brick (at one of the former embrasures the thickness of the wall measures 6 feet), or if outer and inner walls face a void filled with rubble stone and/or tamped earth, is unknown.

The two ceramic (unglazed) plaques on Ochoa and Austria Bastions are inscribed with the date 1606 and commemorate the raising of Tejeda (now Ochoa) and Austria Bastions. It is assumed that they were installed in 1606, and then reinstalled when the hornwork was reconstructed.

Curved tiles, with profiles similar to roofing tiles, are found embedded in the north wall of the tunnel connecting the tower and lower level of el Morro (thought to be constructed at some time between the very end of the sixteenth century and the mid-eighteenth century). These tiles are placed in a row, concave side down, directly along the springing of the vault. They do not extend the full length of the wall and are absent from the other side. It is unknown if their placement here served a specific purpose, and whether similar tiles were used in other locations but remain hidden behind stucco.

It is difficult to ascertain the origin of brick used during all periods of construction. Late-eighteenth-century documents discuss the necessity for using brick and problems in their acquisition. O'Reilly noted the possible use of local brick in a 1765 document.

> A resident of Puerto Rico has offered to provide bricks at 12 pesos for 1,000 [brick]; as long as they are of the same size as the sample given to me and the brick is of good clay, well-shaped, well-burnt, then I do not consider it very expensive; it should [also] be examined if bringing [brick] from Spain is more convenient.[21]

This document indicates the possibility of local brick use, as well as imported brick use. It is possible that brick were also obtained from other Spanish colonies. It is also possible that brick were reused when structures were demolished. Differentiating between brick was not attempted for this study.

Beginning in 1766, O'Daly wrote a series of letters to Spain requesting skilled masons and brick. At that time, brick were being manufactured in San Juan, but in too little quantity for the planned construction. Eight masons were sent to Puerto

Rico following this request; it is not known whether brick were sent as well.[22]

Most brick is considered to date to the late-eighteenth-century building campaign. Brick are found edging merlons, banquettes, and gutters. Brick are used in vaults and domes. The stoves and latrines in el Morro are of brick.

An archaeological excavation carried out on the moat along the northeast scarp of Austria Bastion at el Morro revealed several courses of brick at the base of a rubble foundation wall. Further excavations in 1990 indicated that this brick was constructed as a footing for the rubble wall during the late-eighteenth-century building campaign.[23]

A document from the Real Maestranza de Ingenieros (date unknown, but probably around 1832) notes the use of a soldier or rowlock course of brick along sidewalls in San Cristóbal (the exact location is not clear).[24] Whether all brick edging dates to this period or to the late-eighteenth century is not known. Edges of banquettes are faced with canted bullnose brick. Where a bullnose brick has one rounded corner, these have one corner cut off on a 45 degree angle (fig. 3).

At one time brick paving may have been used in San Cristóbal and el Morro.[25] Brick are used for stair treads and risers; most are twentieth-century U.S. Army repairs. It is not known if they replaced brick or some other material.

Broken brick are used in rubble walls and as chinking in ashlar construction. Brick chinking appears far less frequently than stone and may indicate areas of repair (as on the northeast scarped wall of Ochoa Bastion).

The brick at Santa Teresa has the manufacture's mark stamped into it: "San Patricio." "MTC" is stamped into some brick at la Princesa. They date to 1897. Brick are used as levelling courses (every 20 inches) in the semi-circular rubble walls on Austria, Ochoa, and Carmen Bastions also dating to 1897.

The lighthouse of el Morro was built in two successive campaigns: in 1876 and 1908.[26] Brick are of modern dimensions. The two campaigns made use of different brick (and mortar), which is apparent today in the severity of the deterioration of the later brick.

Small gravel-sized chunks of brick are used in galleting.[27] The very edge of the ramp leading from the Plaza des Armas to Santa Barbara Battery is faced with paving brick. Imbedded in the strip of mortar running between the inside edge of these brick and the adjacent hormigón of the ramp are small brick chunks set 1 to 2 inches apart (fig. 4).



Figure 1. Canted bullnose brick along banquette on south side of Santa Barbara Battery. A decorative brick-dust stucco partially remains, covering brick faces. Photo by J. Jacob, 1989.



Figure 4. Northeast edge of ramp connecting the Plaza de Armas and Santa Barbara Battery. Brick galleting is located between brick and concrete. Photo by J. Jacob, 1989.

The roofs of the Officers' Quarters, North Casemates, and San Cristóbal Chapel are paved with rectangular quarry tile. The tile appears to be of different dates: some are more weathered than others and there are different sizes. They are all believed to date to the twentieth century.

Decorative floor tiles are used in the Officers' Quarters. In the three southern casemates (Casemates 3B, 4, and 5) are encaustic tiles in different colors and patterns. Black and white tiles (measuring 8 inches square) are laid in a checkerboard pattern in the chapel at San Cristóbal.

A group of twentieth-century glazed tiles depicting St. John the Baptist are situated over the San Juan Gate on the city side. Recently installed glazed tiles are also located in the bathrooms of San Cristóbal, el Morro, and the guardhouses at el Abanico and el Morro.

MORTARS

Various forms of cementitious materials are found throughout the fortifications. The term "mortars" will be used when describing these materials in general. The specific terms of "mortar," "stucco," "hormigón," and "cast material" will be used for the discussion of each individual use of mortars; these terms will be defined later in the text.

Until the last decade of the nineteenth century, lime was the principal binding material of mortars. Portland cement then replaced lime as the binding agent, although it is not known if it was used exclusively or in combination with lime. It is also not known whether natural cements were used. In the 1980s, cement-lime and lime mortars began to be used for repair work (patching and pointing). Mortars predating the late-nineteenth century (with a lime binder) will simply be called "mortars." Mortars with a predominantly Portland cement binder and dating from the very end of the nineteenth century through the 1970s will be called "cement mortars." Mortars dating to 1980's repairs containing both cement and lime binders will be called "cement-lime mortars." For this report, mortars predating the late-nineteenth century were given greater emphasis than those used later.

An attempt was made to classify pre-twentieth century mortars by building campaign for the purpose of dating architectural elements by the nature of their mortars (constituents and their proportions). Mortars were examined in situ and in the laboratory. The results of the analyses revealed the use of similar mortars throughout the fortifications from the sixteenth century to the end of the

nineteenth century, thus making the dating of pre-twentieth-century mortars independent of their location in the fortifications impossible.

The in situ examination of mortars noted use, location, overall color, and condition. These features aided in their characterization and enabled a better understanding of their specific uses in construction.

Selected samples of mortars were extracted from the fortifications and brought back to the HPC laboratory for more detailed examination. These samples were viewed with a reflected light microscope and subjected to chemical analysis by acid digestion. This analysis breaks a sample down into three components: aggregate (sand), fines (clay and silt size particles),[28] and acid soluble material (calcium carbonate, or lime and biological calcite); weight percentages and estimated volumetric proportions of components of the original mixes are obtained as well.[29] Thin sections of selected samples were prepared for examination with a polarized light microscope to identify the mineral constituent of the aggregate.

Examination of the aggregate alone reveals information on properties of grain shape that may influence mortar workability, as well as overall color and grade which can be used as a guide in replicating mortars. The examination showed that local sands of differing type and origin were used in mortars. In some cases, specific sands were used for specific purposes (i.e. for stucco or bedding mortar).

All sands are composed primarily of quartz grains. Sands were obtained from beach sources (beach sands) and from land sources (pit sands).[30] Sand samples were found to contain trace amounts of magnetite, feldspar, pyroxene, and volcanic rock. Traces of charcoal and brick (or other fired ceramic material) particles were found in some of the samples.[31]

Pit sands were described by Gelabert and by the U.S. Army Corps of Engineers. Gelabert identifies three categories of sand found in and around San Juan.

> [The blanket] deposits consist of sands, sandy clays, and clayey sands ranging in color from white to reddish-brown. Their thickness averages about 2 meters . . . but deposits as thick as 5 meters are abundant. In the San Juan area the blanket sands can be divided into the following classes: (1) the white to pale brown silica sands, (2) the reddish-brown to yellow clayey sands, and (3) the reddish brown or mottled red and white sandy and silty clays.[32]

A U.S. Army drawing from 1952 shows a wall section along the toe of San Agustín Bastion depicting different layers of sand and soil (fig. 5). The layers are labeled: "fine sand, generally white"; "coarse sand, orange and white"; "sandy clay, generally orange"; and "clayey sand, orange and white." These descriptions are not unlike sands found in mortar samples collected on the site.

Pit sands are characterized by quartz grains of predominantly subangular constitution with lesser amounts of angular and subrounded grains; they are moderately sorted. The quartz varies in color from clear to pale yellow to translucent white. Pit sands have a higher content of fines than beach sands which give the sand its "clayey" or "dirty" qualities.

Beach sands are characterized by subangular to subrounded quartz grains and a high biological calcite constituent;[33] they are moderately sorted. Gelabert described the beach sands in the San Juan area: "The beach deposits consist of loose, well-rounded, coarse to medium grained sands composed predominantly of quartz, calcite, magnetite, and volcanic rock grains."[34] The latter two constituents were found to be in a far lesser quantity than the former two.

Many samples subject to chemical analysis were found to have relatively high proportions of fines. This indicates the use of either a dirty or clayey pit sand, or a poor quality lime; the fines could also be, in part, the residue of the dissolved acid soluble material. It is more likely that clay was added, as an extender, to the mixes.[35] Lime can be considered an expensive commodity (time, fuel, manpower) and the addition of clay would have increased the quantity of mortars at little expense. This would have produced weak mortars, but as long as construction was slow, they could set and be structurally supportive. The stuccoing of walls would have ensured their longevity and protection from weathering. The fines were not analyzed for this report.

The lime used in mortars was most likely obtained from local limestone outcroppings. Gelabert wrote: "The Aymamón limestone is an excellent formation for the production of high-calcium lime" with a calcium carbonate content usually between 95-98%, a magnesium oxide content of less than 3%, and less than 2% impurities.[36] He noted that this limestone is available within the San Juan quadrangle. The Aguada limestone may also have been used; the uppermost part is of good quality and the lower part is "mostly composed of soft clayey limestone."[37] It is possible that these less pure limestones were used for the production of lime as well.

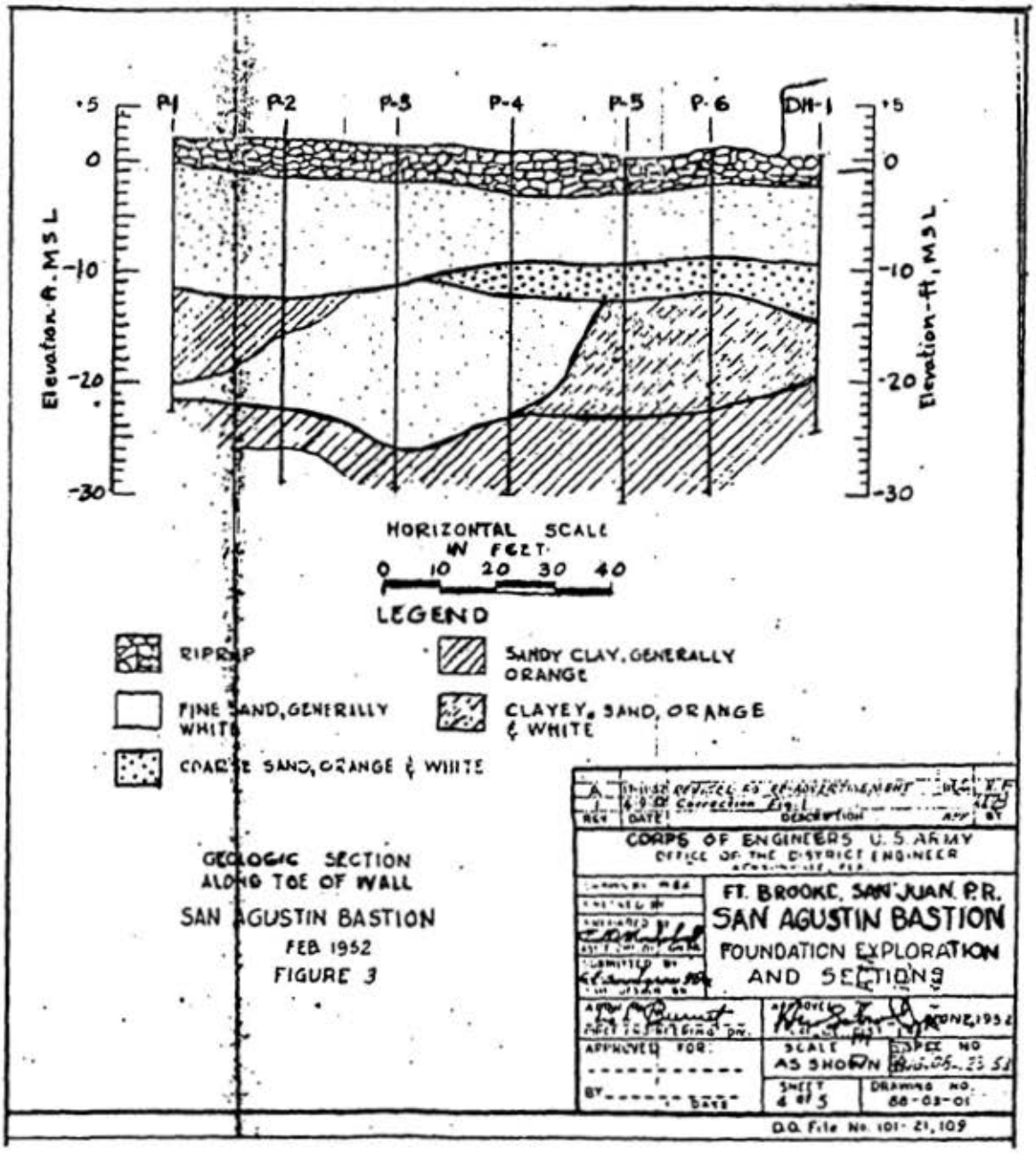


Figure 5. U.S. Army Corps of Engineers drawing, 1952. Wall section along toe of San Agustín Bastion. (San Juan NHS Archives.)

In 1583, Menéndez reported that lime was locally available.[38] In 1765, O'Reilly also reported lime to be locally available.[39] In 1772, O'Daly recorded his quality standards for lime as well as its origin and place of production.

> The lime had to be of good quality, white, well burned and cured. Delivery of the lime was taken at San Gabriel Battery [San Agustín], San Juan, San Justo and Santiago landing places [gates] while kilns had been set up on la Puntilla, San Juan and Santiago Gates. Lime deposits were found at "los Seborucos del Rey" at the mouth of Martin Peña Channel and San Jose Lagoon.[40]

Whether additives were used in mortars is unknown at this time. Such substances were not uncommon in historic mortars but their presence in a material is often difficult, or impossible, to detect microscopically or with rudimentary chemical analysis. Construction records examined for this report do not contain information on additives.

Fresh water is required for the preparation of mortar mixes. Fresh water is also necessary for cleaning the sand to be used in mortars; this washing removes salts from beach sand and dirt (excess fines and organic matter) from pit sands. The removal of these materials makes for stronger and more durable mortars. The island of San Juan has no readily available source of fresh water (the extent and use of springs was not investigated for this report) and therefore, precious water from cisterns or otherwise collected rain water would have been used. A report from 1594, written by Governor Suárez, documented the scarcity of water:

> El Morro has no water inside, which is so important, but because it is necessary to open the moats, cisterns can not be made, and there is nothing to build them with. It only has a large pond outside the citadel. The people of El Morro can not avail of the water if there are enemies; every time that water is collected, which is very little, it disappears, because the water is absorbed by the earth.[41]

Due to this scarcity, the washing of sand was, in all probability, not carried out. It can be assumed that water became more available in the following years, but the fact that so many mortars have a proportionally high content of fines and are typically neither strong nor durable, indicates that not all sands were washed.

Lime mortars used in the fortifications can be grouped into three categories based on overall color and constituents. The overall color is determined primarily by the fines and, to a

lesser degree, by the aggregate. These categories are white, red/beige, and brick-dust.

White mortars were generally used for stucco, both on interior and exterior walls. They were also used for bedding mortar, primarily for brick. White mortars are usually characterized by a beach sand component but white pit sand is also used; clay was not added to these mixes. White mortars vary in color from bright white to cream with fines ranging from white to light gray to cream.

Red/beige mortars are characterized by their color: light beige to orange to dark red orange. They fall within the Munsell color hues of 10 R, 2.5 YR, 5 YR, and 7.5 YR.[42] The sand characteristically contains iron oxide, and many of the quartz grains are in part coated with this. Some of the fines remain clumped together when the constituents were separated in analysis. The aggregate is of predominantly subangular constitution with some subrounded and angular grains. These mortars were either mixed with clay or used clayey pit sands; they are extremely friable. A majority of the red/beige mortars are not homogeneous in color but contain white clumps of unslaked lime and are usually marbleized with lime. Red/beige mortars were used primarily for bedding mortar and as stuccos, either as scratch coats or as former finish coats (discussed in greater detail under "Stucco" in this report).

Where differentiation in color between cream (white mortars) and light beige (red/beige mortars) may be difficult, categorization will be based on location. Because white mortars are found on walls (as stuccos) and for bedding brick, mortars that vary between cream and light beige in these locations will be classified as white. Mortar used for bedding stone will be classified as red/beige if the color is cream or light beige. In general, there is a distinct difference in color between all white and red/beige mortars.

Brick-dust mortars are pink to red in color and made with a pulverized brick component. Brick-dust mortars are found throughout the fortifications specifically in locations exposed to great amounts of water or where a decorative surface stucco was desired. When used for paving (hormigón), the brick component varies in grade: pulverized brick to gravel size brick fragments. When used for stucco, the brick component is generally pulverized. Frequently, brick-dust stucco on a wall is a continuation of the paving where a thin layer of the hormigón is brought up to face the lower portion of a wall. The use of brick dust as a component of hormigón will be discussed in the "Hormigón" section of this report and the use of brick dust in decorative stuccos will be discussed under "Masonry Finishes" in this report. Brick dust was not found to be a constituent of bedding mortar.

Portland cement appears to have first been used in the early- twentieth century for patching. It is not known if cement was produced locally or not. At least five different cement mortars are found in the fortifications. These are characteristically gray in color and extremely hard. Samples of these mortars were extracted from the fortifications but not subject to chemical analysis.

Mortar

The specific term "mortar" (as opposed to "mortars") refers to that material used in unit masonry construction. Mortar is used for bedding ashlar and rubble stone, brick, cast stone, and cast composite stone. Up until the twentieth century, bedding mortars were either red/beige or white. During the U.S. Army tenure and the early Park Service years, cement mortar was used for repair work; cement-lime mortar is used for repair work today.

The earliest mortar in the fortifications is found inside the tower of el Morro and dates to ca. 1540 (based on the supposition that the interior was not rebuilt or repointed at some later date). This red/beige mortar is uniformly dark red orange in color, has a high fines component, and is quite friable. Clumps of lime are present; these are smaller and fewer than those found in other red/beige mortars.

El Espigón was constructed sometime between 1634 and 1678. A sample of red/beige mortar was extracted from this structure and found to be similar to that used in the tower. However, due to the constant battering of the sea on this structure, and the resulting erosion and replacement of materials (especially mortar), the mortar extracted may not be original to the construction date.

The low retaining wall to the north of Ochoa Bastion by the water probably dates to the late sixteenth or early-seventeenth century. The red/beige mortar is also characterized by a high fines component and extreme friability. There are no clumps of lime in this material.

Red/beige mortars dating to the late-eighteenth-century building campaign are characterized by clumps of lime, white lime marbling, and some clumps of a darker red material. The darker red material was not identified; it could be small clumps of fines. These mortars are not as friable as the earlier mortars discussed above, perhaps due to a higher lime content.

At the very end of the nineteenth century, lime continued to be used by the Spanish in mortars. A red/beige mortar is

used at el Morro in 1897 semi-circular walls on Austria, Ochoa, and Carmen Bastions.

White mortar is frequently used for the brick lining drains and gutters as well as for brick edging on banquettes and tops of embrasures; this mortar was not analyzed for this report. Visually, it appears similar to the white stucco covering the fortifications and therefore, may be of similar constitution. (In some cases, brick-dust mortar seems to have been used for brick lining the gutters, however, this is most likely the remains of the hormigón that once covered the surface and has since eroded off the brick but not the joints. This was not investigated for this report.)

A sample of the mortar from the northeast wall of the magazine under Austria Bastion was investigated; the mortar differs from all other mortars that were extracted from el Morro. The mortar used for the wall is white and extremely friable. The aggregate is comprised of subangular to subrounded, clear to translucent, white quartz grains; perhaps a white sandy clay was used. This mortar is the same as the stucco covering the wall. It is possible that a minimal amount of mortar (the common red/beige mortar) was used for bedding the stone; the stucco that followed filled the recessed joints. The mortar sample could have been extracted from one of these recessed joints. This could also be a rare case where white mortar was used for bedding. Whether white mortar was used in other locations is unknown; casemate walls that are in poor condition (with mortar visible) are constructed with red/beige mortars. Casemate walls with stucco in good condition are generally in areas of high visibility and were not sampled.

White mortar was used for cut stone and was finished with a floated surface and articulated edges (described in greater detail under "Masonry Finishes" in this report).[43] Whether this was used just for pointing or was used for bedding as well is not known. Due to its decorative function, samples were not extracted for laboratory examination.

Stucco

Mortars used for surfacing walls are either plasters or stuccos, with the former generally referring to interior surfaces and the latter to exterior surfaces.[44] Because not all areas of the fortifications can be designated specifically as interior or exterior, the term stucco will be used for all wall surfaces. Spanish documents dating to the construction of the fortifications do not differentiate between interior and exterior stuccoing. In this study, surfaces predating the twentieth century are given greater attention, and exterior surfaces are given greater attention than interior surfaces.

Stucco is applied to masonry structures as a means of protecting them from the erosive effects of weathering. The stucco receives the brunt of weathering and will deteriorate over time; periodic restuccoing assures that this sacrificial surface is kept intact. It is not known how many restuccoing campaigns occurred following the late-eighteenth-century building campaign, or how much surface area was covered with each campaign.

A partial history of stuccos used in the fortifications can be obtained from archival sources and from an examination of extant material. It appears that at different times the fortifications were covered with either red/beige or white stuccos. (The walls could have been left unstuccoed for periods of time as well.)

Both white and red/beige stuccos are found covering walls of the fortifications. The stucco applied during the last resurfacing campaign is white in color and still covers most exterior walls. Stuccos vary in thickness from 1/4 inch to several inches.

A pair of Dutch drawings from ca. 1625 show el Morro and the houses of San Juan to be white in color with red gable roofs.[45] In 1721, another Dutch drawing of both el Morro and San Cristóbal shows the structures to be a dark red orange color (similar to many red/beige mortars).[46]

During the late-eighteenth century, the fortification system was greatly expanded and almost all walls refaced, built on top of, or demolished and built anew, making the identification of stuccos preceding this time almost impossible. The orillón corner excavated at el Morro (illustrated on the 1742 plan) had stucco remaining on the face that was a tan color and classified as red/beige. The north scarp of Mercado Bastion was not refaced in the late-eighteenth century and even though most of the wall was patched in the early-twentieth century, early stucco layers do remain. The surface layer of stucco is white and at least two layers of red/beige stucco are found beneath. These underlayers could either be earlier finish stuccos or scratch coats for the white surface stucco.

In November and December of 1771, all exterior surfaces of San Cristóbal were stuccoed.[47] It is probable that the rest of the fortification system received a similar treatment around this time, or shortly after construction had terminated. A report written by Mestre in 1783 describes the application of stucco. To what extent this covered earlier stucco, or if it was a first time treatment, is not known.

> . . . but due to frequent rains, destroying even the most solid walls, especially those exposed to the winds, it is necessary to cover the scarp and counterscarp with un pie [slightly less than one foot] thick coat of a mixture of clay with a little lime, in a short time it will become solid and durable . . . at no great cost.[48]

No known paintings or drawings document the color of this stucco, but the mention of clay strongly indicates a red/beige mixture. Whether actual clay was used, or if a sandy clay or clayey sand was used, remains unknown. The un pie thickness of the coat is also questionable; the maximum depth of the stucco found on the fortifications is about 3 inches.

In 1808, Mascaro wrote the following:

> The north wall, from the bastion to the castle of San Cristóbal, has been covered with stucco and smoothed with a fine coat [repellado y sacado á plana con [masa] fina], including all of the parapet interior, sides of the embrasures, banquettes and esplanades . . .[49]

This document suggests that stuccoing late-eighteenth-century structures continued into the early years of the nineteenth century. It is not known if this was a red/beige or white mixture, or if this was a first-time application.

Red/beige stuccos (usually one layer but sometimes two) are found beneath the white surface stucco in many locations. These could be the finish stuccos described above; in some places they appear to be scratch coats (discussed later in text). It is possible that earlier finish coats were removed or partially removed (especially if they had deteriorated) when the present finish coat was applied.

Red/beige stuccos were found to be similar in constituents and proportions of constituents to red/beige bedding mortars, indicating that the same mixture was used for both. In fact, it was not always easy to determine whether a material was a mortar or a stucco when viewed in situ or in the laboratory. It is possible that the building of a wall and its stuccoing (the scratch coat) occurred simultaneously, but more likely, excess mortar was spread over the surface of stone blocks as building was underway. It is also possible that stucco partially filled joints that contained a minimum of mortar, giving the appearance of one material (samples were not taken from deep within a joint).

Roughened surfaces are visible on red/beige stuccos where the white surface stucco has worn away or been otherwise removed; this is most apparent on el Caballero. There were two kinds of roughening marks found: those made with a blunt tool

(on still wet stucco) and those made by workers apparently drawing their fingers through the wet stucco. The red/beige stucco of the dome of the sentry box outside the San Juan Gate has cross-hatched scoring. Surfaces were treated in this manner to provide better bond capabilities with the finish stucco. It is possible that an already hardened surface was tooled prior to the application of a new stucco. An early-nineteenth-century report describes tooling and stuccoing: picado y enlucido.[50]

The northeast scarp of Ochoa Bastion is the one exterior surface rendered with a red/beige stucco. Turn-of-the-century photographs of el Morro depict walls as uniformly light in color, with the exception of this scarped wall which appears dark.[51] The surface was floated, indicating its function as a finish coat. The date of application, and why a white stucco was not used, is unknown. This face receives extremely harsh weathering. Perhaps it was restuccoed at some time just prior to the last restuccoing campaign and left in its yet good condition while the rest of the fortifications were restuccoed in white.

An account from 1822 connotes rather poor conditions: de Córdoba described the fortifications in a state of abandonment and severe deterioration.[52] According to Blanco, from 1824 to 1832, the walls of the entire fortification system were "cleaned [and] refaced," suggesting a total restuccoing.[53] Whether all of the walls actually were restuccoed during these nine years has not been determined. However, based on field examination, it is considered that most exterior walls were. (The stucco was given a yellow coating at this time as will be discussed later in the text.) For this report, these nine years will simply be referred to as "the early nineteenth century." Following this major restuccoing, a plan for maintenance was instituted to keep the fortifications in good repair, indicating that restuccoing (as maintenance) continued up until the end of the Spanish tenure. How much work was carried out in these years is not known; stucco patches predating the twentieth century are rare.

In 1842, a colored lithograph was made of the city of San Juan.[54] Both el Morro and San Cristóbal are depicted, as is part of the city wall. El Morro is shown as white and San Cristóbal and the city wall are shown in gray (or shadow). A colored engraving of ca. 1850 also depicts the fortifications light in color.[55] The "Panorama de San Juan de Puerto Rico" of ca. 1860, a colored lithograph, shows el Morro light in color.[56] Manuel Castro's 1861 elevations show the quarters buildings at San Cristóbal as yellow, and the rest of the fortification walls the light color of the paper they were drawn on.

The smoothness and sheen of the stucco's surface are the result of floating.[57] The Real Maestranza de Ingenieros report (ca. 1832) describes the scarped walls of el Morro that were stuccoed and burnished (presumed to be floated): revocado y brunido.[58] Surfaces treated in this way resist water (by allowing for run off), thereby resisting many of the detrimental effects of water. In fact, it is where the surface has lost this outer layer that the deterioration visible today has set in. A description of polishing is given in this same report: embonado, repellado y sacado á plana refers to stuccoing and floating; á plana is a float that is described as being six fingers wide by a palm long.[59]

The finishing of stuccos by floating dates to antiquity. Vitruvius, a Roman architect and theoretician in the first century B.C., discussed "polishing" and attributed the first use of this treatment to the ancient Greeks. He advocated the technique for the prevention of cracking (from shrinkage) and for producing a luster that "reflects from its surface a clear image of the beholder".[60] Roman Malinowski has more recently elaborated on the function of polishing.

> The polishing, being essentially a process which grinds the lime, carbonate or pozzolana of the mortar, creates a dense capillary structure at the surface which increases the impermeability of the material. The carbonation and hydration (that is, the hardening) are also accelerated and the strength and durability improved. It is supposed that the finely polished, hardened surface not only restrains shrinkage and cracking but also inhibits the formation of lime sediments on the walls of cistern and aqueducts due to a better flow of water.[61]

Beach sand is the primary aggregate used in the white stucco found on the fortifications' exterior surfaces. Quartz grains are primarily subrounded in shape and moderately sorted. The sand contains trace amounts of magnetite, rock fragments of unknown composition, pyroxene, and biological calcite. Trace amounts of brick and charcoal fragments are also present.[62]

Stuccos are susceptible to cracking from the shrinkage caused by water evaporation during the drying process. In order to minimize this effect, the least amount of water possible is used to make the stucco mix. A mix composed of rounded aggregate will require far less water for workability than one composed of an angular aggregate. It is not surprising to find beach sand used for stuccos.

Superstructures on el Morro dating to 1897 are rendered with a white stucco. This is similar in appearance and constituents

to that applied earlier in the century, but is not quite as smoothly finished.

A galleted stucco is found on the east scarped wall of the North Bastion of San Cristóbal and on the facing scarped walls of San Carlos, la Trinidad, and Santa Teresa. This is a white stucco with small stones set in to it in a random manner. The date of this work is unclear. It appears in a deteriorated state in 1930's photographs, indicating an earlier application date. However, the uneven nature and hardness of these surfaces is uncharacteristic of early-nineteenth-century spanish work. Perhaps they date to the mid- or late-nineteenth century. Further investigation is needed in order to accurately date the application of this stucco.

Most casemates and interior spaces in both el Morro and San Cristóbal were resurfaced with a cement stucco in the mid-twentieth century. Identifying interior stuccos predating the resurfacing is possible but difficult. It is also possible that some interior stuccos predate the early-nineteenth century. Interior red/beige stuccos are similar to those found on exterior surfaces; interior white stuccos tend to have more finely grained aggregate and are more friable than those used for exterior surfaces. Some interior white stuccos may have been plasters (with a gypsum content); this was not investigated for this report.

The interior of the tower in el Morro is the earliest portion of the fortifications, and stucco found here may also be the earliest interior stucco. The surface layer is white and the layer beneath (applied directly to the brick) is red/beige. The two layers fracture easily at their interface. This weak bond could be the result of a time lapse between the two renderings, indicating two finish stuccos. The red/beige stucco is a homogeneous dark red orange color and lacks the numerous white streaks and clumps of lime which characterize other red/beige mortars.

The white stucco found in the passageway connecting Carmen and Mercado Bastions, the white surface stucco of the tower, and the white stucco of the magazine under Austria Bastion have similar constituents and proportions of constituents. Aggregates are composed primarily of fine grain, fairly even grade, clear and translucent white subangular quartz grains; there are also clumps of fines. The stucco in the passageway has a floated surface.

In one casemate in el Morro, the fourth from the south on the northwest side of the Plaza, stuccos from the early nineteenth (or late-eighteenth century) remain extant. At least three layers are visible in this casemate. The bottom-most layer is a red/beige material (quite light in color)

containing chunks of broken-up stucco. The middle layer is a similar light red/beige material. The surface layer is a white stucco. The base layer, with its bulking agent (the stucco fragments) provided a somewhat level surface over the rubble masonry wall. The middle layer, provided an even more level surface to which the surface stucco was applied. It is possible that other interior walls were treated in a like manner.

Hormigón

Hormigón is a poured cementitious material containing crushed or pulverized brick (polvo de ladrillo) that was used for paving the terrepleins of the fortifications. The tops of some merlons are covered with this material as well.

Hormigón is the modern Spanish term for concrete. However, its use dates to a time well before the development of modern concrete and Portland cement. Eighteenth-century construction documents refer to hormigón as a paving material for terrepleins. Various reports of this period also mention the use of brick dust as an additive in hormigón. Almost all paving (predating cement repairs) is a cementitious poured material, extremely hard, and containing brick dust and gravel size brick (or other fired ceramic material) fragments. In this report, the term hormigón will be used as it was during the eighteenth-century construction of the fortifications: a poured cementitious paving material, containing brick dust or fragments, with lime as the principal binding agent. (In some cases, the term tortada or torta has been used; it seems to refer to the same material.)

There are two forms of hormigón: one is characterized by a smooth surface and finely graded aggregate of sand and brick dust, and the other characterized both by fine and coarse aggregates of sand, brick dust, and brick fragments (visible where the surface has been eroded or chipped). Hormigón de cascote (hormigón of rubble) seems to describe the latter mixture.[63] It is apparent that the coarser material was used as an under layer to create a level substrate which was then covered by the finer surface material. Areas that have not deteriorated are extremely smooth, indicating that the surface was floated.

Brick dust has long been used in mortars, supposedly to give hydraulic properties or increased strength to a mix.[64] In his treatise on architecture, Vitruvius commented on this use: "Further, in using river or sea-sand [in mortar], the addition of a third part composed of burnt brick, pounded up and sifted, will make your mortar of a better composition to use."[65] Whether brick dust actually imparts these properties is

unknown. Hormigón is much harder and more durable than any of the other mortars in the fortifications and it is possible that this property can be attributed to the brick dust constituent.[66]

Mestre's report from January 8, 1785, describes the use of brick dust in paving at San Cristóbal. In order to protect the vaults of the North Casemates from moisture (humedades), the terreplein above was constructed of paving stones covered by a mixture (mezcla) containing brick dust and given a smooth finish (sacado á plana). This material is most likely hormigón. All of the vault floors were covered with [h]ormigón. The material was applied in several layers until the desired level was reached; the top layer was floated.[67] The report of the Real Maestranza de Ingenieros records the use of brick dust. Polvo de ladrillo is listed as a constituent in the tortada of the entrance ramp to San Cristóbal.[68] In 1858, la Perla Ravelin was repaved with hormigón.[69] In this same year, the drawbridge at el Morro was replaced and given a new paving of hormigón de cascote.

Cast Materials

In addition to mortars being used for unit masonry construction, stucco, and hormigón, they are also used in cast materials. Cast stone and cast composite stone are both found in the fortifications. Some walls that appear to be of rubble construction may in fact be cast, considering their high proportion of mortar. All cast materials (predating the twentieth century) are red/beige in color. During World War II, cast concrete was used for constructing new harbor defense structures.

Cast stones are found on the low counterscarp outside of Ochoa Bastion. These have suffered severe deterioration (due to their extreme friability and the absence of a protective coating) and it is difficult to determine their original appearance. They are slightly larger than 1 foot square in area, rounded in shape, and are an even light tan color. Because so much of this wall has been repaired, it is quite possible that these "stones" are a repair material. An installation date is unknown.

Cast composite stone is found throughout the fortifications and was installed by the U.S. Army for patching and repair work in the late 1930s, and by the NPS from the 1960s through the 1980s (fig. 6). These "stones" (or blocks) are 12 inches square by 2 inches thick and were produced as follows: a long trough or box was constructed, measuring 12 x 12 inches by an indeterminate length. Pieces of stone were packed into this box and then filled with mortar. When the mortar had set, the



Figure 6. Cast composite stone of merlon on north wall of Santa Barbara Battery. Photo by J. Jacob, 1989.

formwork was removed and the mass sawn into slabs (circular saw marks are visible on some of the slabs). The principal binding ingredient of the mortar appears to be lime, although there may be a small percentage of cement mixed in. Cast composite stones are set with cement or cement-lime mortars. All blocks are mounted into the walls in a square position except on a small retaining wall by San Agustín Bastion where they are mounted on the diagonal.

Differentiating between late 1930s cast composite stone and 1960s cast composite stone is not easy, although the earlier work is generally more weathered. Variations occur in these blocks; perhaps a detailed study of the variations and the locations in which they are found would provide information on actual or relative dates of installation. The majority are composed primarily of stone in fairly large chunks with three to five chunks per block. (The fact that so many of these stones have one cut edge suggests that pieces were obtained from the fabrication of the polygonal stone slabs that were also being used for patching in the late 1930s.) Some blocks, and these appear to be more recent, have smaller stones and a proportionally higher content of binder. In la Perla Bastion, blocks are characterized by a small stone in each corner and one in the middle (resembling the "five" side of a die).

The low wall off of the east corner of Ochoa Bastion lacks a stucco coating and exhibits a conglomerate of mortars and rubble stone. It is possible that some type of form was constructed and these mortars (distinguished by color and texture) were poured in one after the other, along with the rubble fill. Perhaps this was a location where surplus mortar was deposited at the end of each day.

At the southeast end of the low counterscarp outside of Ochoa Bastion is another example of what may be poured construction. Two distinct layers of red/beige mortars are visible here. These are similar in color, texture, and constituents, with the top being just slightly darker than the bottom. No rubble stone or brick was added to this mix. This configuration indicates two pours. Because of the relatively low lime content in red/beige mortars (and the relatively high fines content), it does not seem likely that the curing of the lime provided the bonding capabilities and strength needed to support such a wall: the large mass would prevent any lime not on or close to the surface from curing. The wall is not very high, and perhaps high strength was not as necessary as mass. Further investigation is needed to fully understand the nature of these materials and their strength capabilities.

During World War II, a variety of structures were built on, and adjacent to, el Morro and San Cristóbal. All of these were built of reinforced concrete.

MASONRY FINISHES

Following the restuccoing of the fortifications during the early-nineteenth century a finish was applied to exterior surfaces, much of which remains today. The finish is yellow ocher in color and coated scarped and curtain walls (both interior and exterior), merlons, banquettes, and some walls facing open interior spaces. Quarters buildings, guardhouses, walls facing the Plazas of San Cristóbal and el Morro, and some interiors may have received new (but different) finishes at this time as well.

Whether the yellow ocher-colored finish was applied during the early-nineteenth century or at some later date is unknown. In some places, the finish covers perfectly smooth stucco, indicating application soon after stuccoing. In other places, the finish covers small defects (or small losses) in the stucco, indicating application at some time much later than stuccoing. (The finish has become streaky over time; it is possible that the material covering small surface blemishes is the finish that has run down wall faces.) This finish did not appear to have been reapplied after the first application. None of the documents examined for this report recorded the application of masonry finishes.

Finishes thought to predate the early-nineteenth century and those postdating this time were only briefly examined. Figurative paintings and drawings will be discussed later, as will finishes of the quarters buildings at San Cristóbal.

Extant exterior finish is now characteristically streaky with colors ranging from pale yellow to orange to dark yellow ocher. At San Cristóbal, a small portion of the wall along the inside of a merlon adjacent to a World War II watch tower on the North Bastion has been blocked off from pedestrian access and is protected from harsh weathering. This area displays an example of what is considered to be the original appearance of the finish: an evenly covered surface which is a deep golden yellow ocher in color with a sheen and a translucent quality. (It is possible that the original finish varied somewhat in color and weathering has simply added to these variations.) For this report, the color will be described simply as "yellow."

Exterior finishes were examined <u>in situ</u> and representative samples extracted from the fortifications for laboratory examination. An attempt was made to identify the pigments and binders used. Samples of the finish were subject to analysis, but with limited results. The finishes are believed to have had an organic binder; analysis failed to determine the material.[70] The pigments of the colors remain to be determined.

Brush strokes in the finish are barely discernable on fortification walls, indicating a coating of fairly low viscosity. The one exception is found at el Abanico where brush strokes are distinctly visible on the north wall of the north ramp; it is not known if this finish dates to the early-nineteenth century or is later.[71]

In some areas of the fortifications, decorative finish work executed primarily in yellow and red remains. The red tint was usually achieved by a thin layer of brick-dust stucco, but in some places, a brick red colored paint was used. It is possible that brick dust (or a pigment of like color) was applied directly to the still-wet stucco.

Decorative work imitates ashlar and is found primarily on merlons and salient angles. The use of faux ashlar patterns on walls has origins that predate the Spanish empire. Vitruvius documents the ancient Greek use of a yellow ocher for finishing interior chambers.

> Consequently the ancients who introduced polished finishings began by representing different kinds of marble slabs in different positions, and then cornices and blocks of yellow ocher arranged in various ways.[72]

Faux ashlar surfaces (executed in yellow) are found on the ramp to the Main Gate of San Cristóbal, the South Gate of San Cristóbal, the walls of la Trinidad, and salient angles and the two gates at el Abanico.[73] Faux ashlar surfaces executed in red embellish merlons and salient angles of Santa Elena Bastion, San Carlos, el Abanico, the arcade of the Officers' Quarters, the stair tower at San Cristóbal, and banquettes on Santa Barbara Battery. Faux ashlar surfaces executed in yellow will be described first, followed by descriptions of those executed in red, and finally those which fit neither category.

There is a continuity in the execution of faux ashlar work. Faux blocks are depicted as the same size and in the same configuration as the blocks actually used in the construction beneath, generally 11 to 14 inches in height by 26 to 32 inches in length.[74] They are finished in either yellow or red and are sometimes given further distinction with a rough surface texture. Joints of faux ashlar surfaces are generally 1/2 to 7/8 inches wide and are either left white (unfinished mortar or stucco) or finished with yellow or black. They are articulated on either side by a thin line scribed into the stucco and usually pencilled black.

The exterior convex wall of the ramp (the late-eighteenth-century portion) leading to the Main Gate of San Cristóbal has a coursed ashlar pattern depicted with yellow blocks and white joints. (In some cases faux joints are yellow; perhaps the

result of the yellow from the blocks streaking down the wall face.) A scribed line pencilled black outlines each faux block (fig. 7). Above the segmental arches of the ramp, faux voussoirs are depicted in a like manner (fig. 8).

On the exterior of San Carlos, traces of faux quoins remain on the east end of the south scarped wall. These are yellow in color with yellow faux joints articulated on either side by scribed lines pencilled black. Each joint is further articulated with a bisecting line at its outer corners in a mitred fashion.

All four levels of la Trinidad have a similar finish treatment with the top level of the battery exhibiting the most intact condition. The east scarped wall is entirely finished with a coursed ashlar pattern; on the north scarped wall, faux quoins embellish the east end. The exterior ends of merlons have faux quoins facing their embrasures; they are rough in texture while the faux joints are smooth with scribed lines pencilled black on either side. As on San Carlos, diagonal black lines bisect the outside corners of the faux joints. Banquettes are finished with faux quoins on their vertical surfaces; the horizontal surfaces are too deteriorated to determine an original appearance (fig. 9.) The three south walls have a coursed ashlar pattern covering both faces, similar to the exterior surfaces of the structure. The ramp of the lower level has a similar pattern on its south side.

Faux quoins are located on the north and south salient angles of el Abanico (fig. 10). These are yellow in color and have a rough surface texture. Faux joints are painted black.

El Abanico, San Carlos, and Santa Elena Bastion share a similar faux ashlar treatment. In these structures, faux quoins were executed with a thin brick-dust stucco. These were then finished with the yellow coating found on the rest of the fortification walls.

At el Abanico, much of the original red finish was covered over with a cementitious paint in the early 1960s.[75] However, due to the incomplete covering and partial deterioration of the latter, it is not difficult to conjecture the original appearance. Running along the top of the walls (with the exception of the north end of the west face) is a band of brick-dust stucco, roughly 6 inches in width, articulated on the bottom with a scribed line pencilled black (fig. 10). Faux quoins on the northeast merlons on both exterior and interior edges are also faced with a thin layer of brick-dust stucco and articulated in a similar manner to the band.



Figure 7. Detail of faux ashlar finish on exterior of convex wall of ramp leading to the Main Gate of San Cristóbal. Photo by J. Jacob, 1989.





Figure 8. South face of ramp wall leading to the Main Gate of San Cristóbal. Photos by J. Berkowitz, 1987.



Figure 9. Banquette on top level of La Trinidad. Photo by J. Jacob, 1969.



Figure 10. South salient angle of el Abanico. Photo by J. Jacob, 1949.

At Santa Elena Bastion, red faux quoins are found on the interior corners of the merlons. The faux quoins are finished with an extremely thin layer of red (it is not known if this is a paint or a thin stucco) and given a rough surface treatment. The faux joints are smooth, 1 inch wide, painted black and scribed on either side.

Faux quoins on San Carlos (the interior corners of the northeast merlons of the upper terreplein) are executed with a thin layer of brick-dust stucco (fig. 11). A band of brick-dust stucco, about 6 inches in width, connects the tops of the faux quoins (covering the brick edging beneath). A black pencilled line articulates the very outer edge of the faux quoins and band but does not articulate the edges of individual blocks.

Over the door and windows of the casemates of San Carlos are faux voussoirs and faux quoins, barely visible due to deterioration. They appear to have been painted a very light red or pink that may be either unique to the fortifications, or the result of deterioration. Whether this paint was applied to stucco or to the actual blocks could not be determined. Here, the faux blocks are rough in texture and the faux joints are smooth and white.

At Santa Barbara Battery, traces of brick-dust stucco remain on the top edge of the banquettes facing the bay. The brick in this location are canted on the top corner and covered with white stucco. It appears that indentations were made in the stucco on top of each brick and then filled with the brick-dust stucco to the same plane of the adjacent white stucco. This would have given a toothed appearance to the banquettes (fig. 3).

In almost all locations throughout the fortifications, at the junction of paving and wall, the surface application of hormigón was applied to the face of the wall in a thin coat to a height of about 12 to 18 inches. The top edge is usually straight. The yellow coating covering the walls (including this base treatment) was also applied to the terreplein, as evidenced in areas adjacent to walls were foot traffic has been minimal.

The piers of the Officers' Quarters arcade and the door surrounds of the stair tower at San Cristóbal share a similar decorative surface treatment. In each location, cut stones are used in the construction. Joints are pointed with a white mortar brought out flush with the stone face. They are trowled to a smooth surface, and cut or otherwise shaped to a band 3/4 inch in width. The two edges are articulated with a scribed line pencilled black. Traces of red paint are found adjacent to mortar joints and appear to have been applied directly to



Figure 11. Embrasure on northeast side of upper terreplein of San Carlos. Photo by J. Jacob, 1989.



Figure 12. Detail of painted finish on pier of Officers' Quarters arcade, San Cristóbal. Photo by J. Jacob, 1989.

the stone (fig. 12). However, this is extremely difficult to determine due to deteriorated conditions. It is possible that a very thin layer of stucco (possibly the same material as the pointing mortar) covered the stones and was painted red and has since eroded away, leaving only the small amounts adjacent to joints. (This pattern of stucco deterioration is not uncommon in the fortifications.) It is also possible that mortar from the joint was troweled over the stone face, to a greater or lesser extent, and the red paint applied to the entire surface and only that on the mortar substrate has survived. At the Officers' Quarters, the red varies in tone; whether this is the result of fading or of two different paints is unknown at this time. The finish of the Officers' Quarters begins at the base of the piers and runs over the intradose of the connecting arches. The faces of the arches appear to have been stuccoed and painted white.

Two cistern heads of cut stone are located on el Caballero. It is difficult to determine if they were ever stuccoed. The joints are pointed with a white mortar which was brought out flush with the face of the blocks and trowled to a smooth surface. The 3/8 inch band was then tooled with a device similar to a comb drawn along the length of the joint. There appear to be traces of red paint on the blocks but they are too small and faint to determine the extent of a painted finish.

The finish of the post (perhaps a gatepost) at the west end of the south line of retreat at el Abanico has deteriorated to such an extent that its identification is nearly impossible. However, the horizontal mortar joints are still in good condition. The joints are somewhat raised with one scribed line pencilled black running through the middle. Unlike other similar joints, they are not finished on either side but are characterized by uneven edges.

On both the South Gate and the Northeast Gate at el Abanico, joints are 1/2 inch in width, pointed with a white mortar, trowled to a smooth surface, and articulated on either side with a scribed line pencilled black. It does not appear that these posts were ever stuccoed.

A decorative finish is found on the stone vaults of two passageways in el Morro: that at the base of the triangular stair under Austria Bastion and that leading to the magazine under Austria Bastion. They are not unlike the faux ashlar finishes described above. Evidence of remaining stucco indicates that the entire vault in the passageway to the magazine was finished with a white stucco and that the actual mortar joints of the blocks were articulated on either side with scribed lines pencilled black. In the passageway at the base of the triangular stair, mortar joints are articulated

with a raised band of pointing mortar, about 1 inch in width. No sign of pencilling or applied color is visible.

On the interior side of the dome of the stair tower at San Cristóbal are the remains of a decorative finish scheme. A geometric design is outlined in scribed lines pencilled black. A hypothetical view of the dome and its finish as it appeared in the nineteenth century is illustrated in a HABS drawing (fig. 13).

An 1842 lithograph depicts the back facade of the Officers' Quarters as bright yellow in color (the rest of the fortification walls are white or light gray).[76] The 1861 Manuel Castro sections and elevations of San Cristóbal depict the facade color of the Officers' Quarters, the Troops' Quarters, the North Casemates, and the signal house on el Caballero as bright yellow. The window and door surrounds, pilasters and trim are white and the base of the Troops' Quarters is light green. The adjacent portions of San Cristóbal are not colored but left the same color as the paper of the drawing. The fact that both of these illustrations show a similar color scheme indicates that the artists' renderings are accurate representations of a brighter paint finish on quarters buildings. Due to the cement stucco applied to all walls in this century, extracting samples for color identification was practically impossible. However, samples were obtained from under the cement on the exterior of the North Casemates. Two layers (the first and the fifth) are bright yellow;[77] it is possible that this second yellow was that illustrated by Castro.

It is conceivable that the guardhouses at el Abanico and el Morro were also of a different color than the fortification walls. Due to their cement stucco covering, finish samples were not extracted from the structures.

Like the structures surrounding the Plaza of San Cristóbal, those at el Morro were resurfaced in the mid-twentieth century with a cement stucco. The walls surrounding the Plaza are now painted a bright yellow ocher with white trim and green base. Photographs of the Plaza prior to this work (early to mid-twentieth century) show both a monochromatic scheme (that is quite light) and a two-tone scheme (that is also light, without much differentiation in the two tones). Determining other color schemes will be impossible without destroying the present stuccoed surface.

The lighthouse at el Morro was probably painted when it was built (1908), or soon thereafter. Photographs predating the mid-1960s show the lighthouse exterior painted with both monochromatic and polychromatic schemes, all of which were of a light palette. Paint samples show many paint layers, with

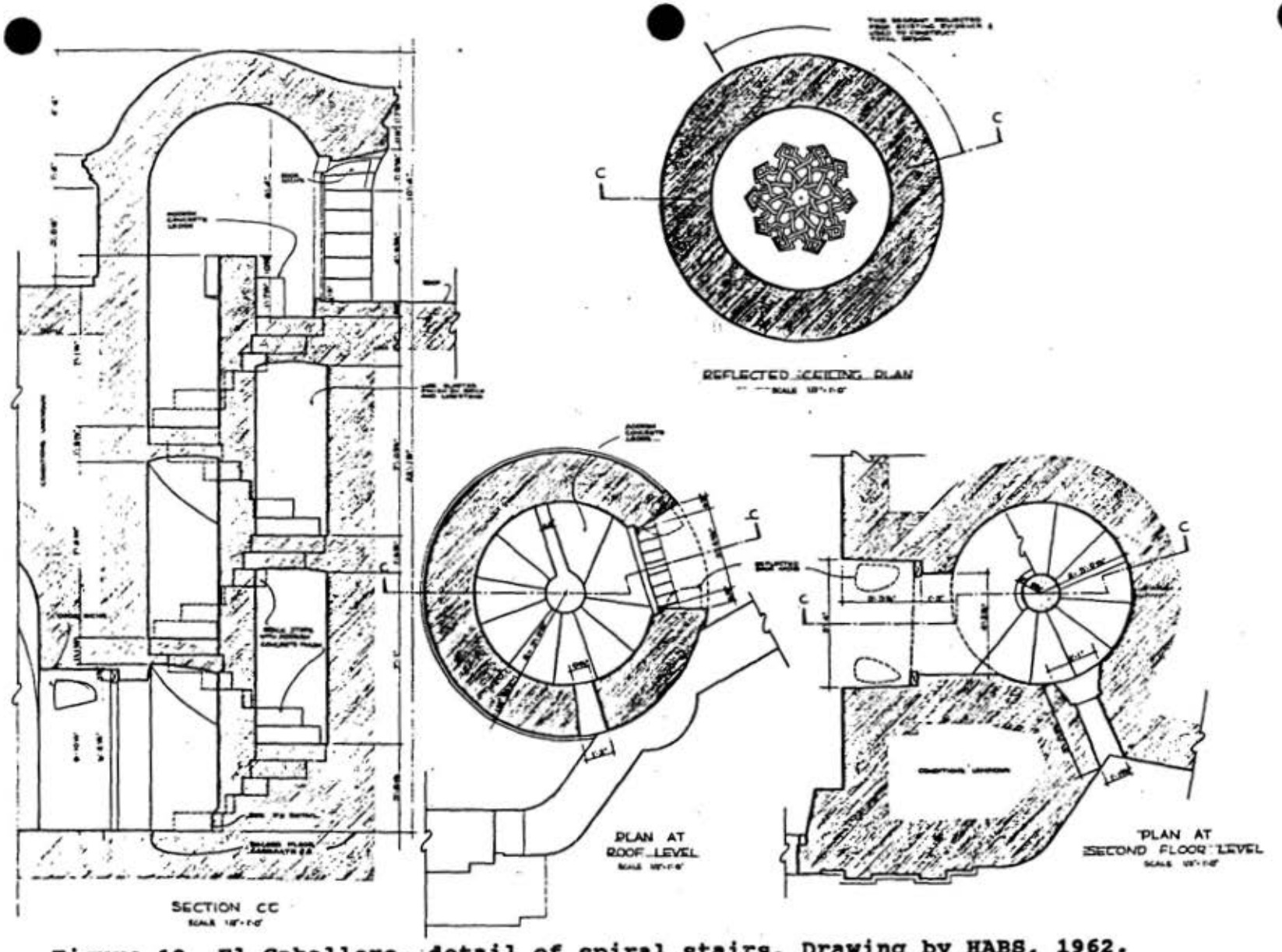


Figure 13. El Caballero, detail of spiral stairs. Drawing by HABS, 1962.

earlier layers in various shades of light gray and white and later layers in creams and light yellows.[78]

The two mortar-bomb reliefs over the entrances of Tunnels 1 and 2 at San Cristóbal are painted: the mortar itself is black and the flames emitting from the top are red. The original color(s) were not investigated for this report.

Determining original interior finishes and finish histories for the fortifications is extremely difficult. Many interior spaces (casemates, passageways) have either been refaced with a cement stucco in the last half century or have suffered greatly from deterioration. Interior finishes were only briefly examined for this report.

In the magazine under Austria Bastion, a yellow paint is found on the wall surfaces. These walls actually have four layers of paints with the top being yellow (similar in color to Castro's elevations of the quarters structures) and the bottom three white.

A dark red paint, perhaps the original finish, is found in several locations as a dado. It is found on the wall of the platform on the northeast side of the stair connecting the Plaza de Armas and Santa Barbara Battery of el Morro, the east exterior wall of the Officers' Quarters, and some areas of the North Casemates walls which face the Plaza. It is not known how this finish functioned decoratively with the yellow finish of the quarters buildings, or if the two colors date to different finish campaigns.

In the spring and summer of 1955, the interior of the chapel of el Morro was investigated to determine its original appearance. Sometime afterwards, it was "partially restored" and all original material covered over. The layers of paint and decorative schemes that were found on the walls, altar, and holy water basin are listed in the completion report.[79] The chapel is now painted white.

The casemate situated on the northwest side of el Morro's Plaza, the fourth from the south, was not restuccoed in this century and in areas of surface paint degradation, a polychromatic scheme is evident. Whether this scheme was contemporary with the polychromy found in the chapel is not known. The small bits of remaining paint indicate that horizontal stripes of red and blue were located about 44 inches up from the floor; this paint does not appear to be the original finish. The embrasure of this casemate has many layers of different colored paints. These include creams, dark gray, coral, dark yellow ocher, dark red and dark green.

Photographs of the Plaza of el Morro dating to the 1940s and 1950s show a paint scheme consisting of a dark dado (Gjessing notes the color as dark green[80]) about 30 inches in height, and light upper walls. In some locations, a decorative meander band is situated just above the dado.

GRAFFITI AND ILLUSTRATIONS

Throughout the years, names, drawings, and geometric designs have been applied to, and scratched into, the walls of the fortifications. They are especially apparent in areas more out-of-the-way than others. It is beyond the scope of this project to fully describe and illustrate these marks, but some description is justified.

Graffiti is usually scribed into the stucco (wet or dry) with a sharp tool. Examples thought to predate the twentieth century were also applied with either a red or black paint (or other material). Modern graffiti is applied with paints, markers, and pens.

Sailing ships are a common image on the walls of the fortifications. Those documented by HABS are carefully executed in black and found in the tower at el Morro and the dungeon at San Cristóbal (fig. 14). Black ships are also found in Tunnel 6 and on a merlon (facing the embrasure) on Santo Domingo Bastion. Other black line drawings are found in el Morro. In addition to the drawing of the ship in the tower is the remains of a drawing of a pediment. A drawing of a serpent is on the wall in the circular stair.

Drawings of ships are barely discernable along the merlons (both facing the terrepleins and their embrasures) of Santa Barbara Battery, Austria Bastion, and Santa Elena Bastion. These are executed in red. In a few locations figures other than ships are depicted, but these could not be identified.

Geometric images that were scribed into the still wet stucco are found in several locations. On one of the north merlons at Santa Elena Bastion are two concentric circles with symbols of Mercury placed between the two circles. A pattern made with series of interlocking circles (perhaps made with a compass) is located on one of the merlons at el Abanico, as is a small series of cross hatched lines. At el Morro, a heart circumscribed in a circle has been drawn on the floor of the small chamber adjacent to the passageway to the magazine under Austria Bastion (fig. 15). Barely discernable on the south scarp of San Carlos Bastion is a rectangle delineated in the stucco with scribed and pencilled lines. This measures 16 x

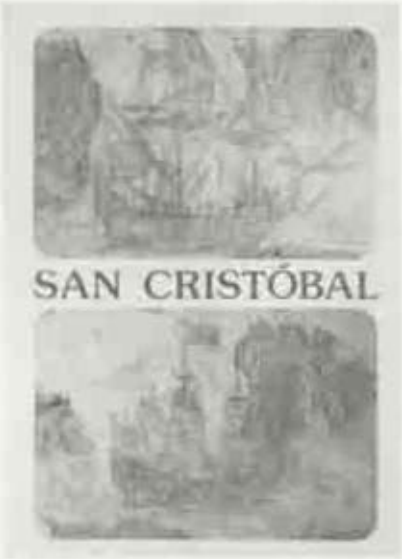


Figure 14. Drawings of ships found in the "dungeon" at San Cristóbal, date unknown. (Postcard, San Juan MHS.)



Figure 15. Floor of small chamber adjacent to the passageway to the magazine under Austria Bastion, el Morro. (HABS photo, 1942.)

19 inches, with a 1-1/2 inch border inside and diagonal lines bisecting each corner.

The interior walls of el Abanico are covered with graffiti, mostly scribed into the stucco. Names, dates, and ships are the primary features.

Within each cistern at San Cristóbal is a grisaille image. Saint Christopher, the Crucifixion, and what appears to be a woman (perhaps the Virgin Mary) are found in cisterns 1-3, high on the wall above the watermark.

WOOD

Wood had many important uses during the development of the fortifications: structure; defense; scaffolding and centering; doors, gates, and shutters; and burning for the production of lime. Various species of wood were most likely used, each serving its own specific function. Some wooden elements are considered to remain from the late-eighteenth-century building campaign, most however, date to the twentieth century. A survey of wooden elements was not made for this report but rather, general information on wooden elements used during the Spanish tenure was gathered, and is here disseminated.

The first use of wood in the fortifications would have been as a part of the early temporary works. Information on this use is found in documents associated with early building campaigns, period military treatises, and other material pertaining to general fortification history. Only those uses described, or alluded to, in the San Juan literature will be discussed here.

In 1583, Menéndez de Valdés included "wood and fagots" in a list of "the necessary building materials" available in Puerto Rico.[81] Torres-Reyes referenced this list, providing a literal translation resulting in a somewhat inaccurate description. In English, a "fagot" is a bundle of sticks or branches bound together and generally used for fuel. Fagot can be correctly translated from the Spanish term fagina. However, fagina has a more specific meaning than its English counterpart. In a Castilian dictionary dating to 1732, fagina is specified as a military term; it is defined as a small shaft of thin branches or brush, mixed with earth, and used to make approaches or to block moats and other parts. It also means kindling.[82] The 1984 dictionary from the Real Academia Española gives a definition of fagina that is also associated with fortifications: a sheaf of thin branches tightly held and used by military engineers for many purposes, particularly for

resurfacing; resurfacing may indicate their use in association with earthen embankments.[83]

In E. Chambers Cyclopedia of Arts and Sciences (London, 1752), an illustration of fascines is given.[84] Two bundles of sticks are depicted: one with both ends cut off evenly, one with one end cut off evenly and the other left uncut with its tapered ends protruding (fig. 16). George Ripley and Charles A. Dana also mention fascines in The American Cyclopaedia (1874): "The interior slope [of a ditch in temporary works] is revetted by sods, or some material hastily gathered for the purpose, as logs, boards, fascines, gabions, &c."[85] Although the exact configurations of fagina described in the Spanish definitions are unclear, the illustration provided by Chambers appears to be a close match. It may be that fagina were used for facing earthworks, both to prevent (or retard) erosion from weathering and enemy access.

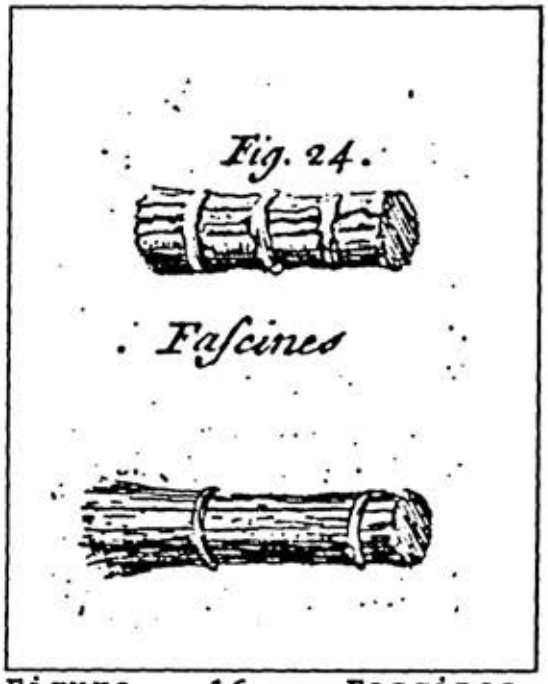


Figure 16. Fascines. Illustrated in E. Chambers, Cyclopedia of Arts and Sciences, 1752.

Torres-Reyes made several references to fagina y tierre in his history of the fortifications. By 1590, "the landward side of el Morro was protected by a large earth and faggot [sic] trench, seven feet deep, and running from sea to sea."[86] In 1770-1771, ". . . temporary works . . . were being constructed on the north coast between San Cristóbal and el Morro. These works, raised with earth and fagot, were designed to prevent a sudden English attack in that area." In the same years, ". . . supplies of fagots and timbers were gathered for the construction of a temporary advanced fort and two other works beyond the glacis."[87]

When Menéndez listed both "wood and fagots" in 1583, he obviously considered the two items distinct from one another implying that they may have differed in their functions. It may be that "wood" was used for everything that was not a fascine or a fagina. It is not known if wood for burning was "wood" or fagina.

Torres-Reyes documented other uses of wood. In 1730, "the sunken section [of the cistern] had a wooden floor at the top which had partially collapsed . . . "[88] In 1770-1771, palisades served alongside harrow gates, banquettes, gates, "and all the details which were necessary for a perfect state of defense."[89] (Harrow gates will be discussed later in the text.)

During the late-eighteenth century, wooden bridges were installed; their exact locations are not known, nor are any extant today. In 1771, O'Daly documented one such bridge at Santiago Bastion: ". . . placing a drawbridge and a fixed [bridge] of wood for the crossing of the moat . . ."[90]

Also during the late-eighteenth century, wooden doors, gates, and shutters were installed in casemates, gates, and quarters buildings. Torres-Reyes wrote: "Most of the work performed from June 1776 to the first three months of 1778, had to do with . . . complet[ing] other numerous details like doors, windows . . ."[91] The Manuel Castro drawings clearly depict doors and shutters on the Officers' Quarters, Troops' Quarters, and North Casemates. These drawings provide information on the configuration and finish color of these elements as they appeared at that time. It is presumed that these are the same elements that were installed in the previous century. Some of these elements remain extant today both at el Morro and San Cristóbal.[92]

Wooden doors, shutters, and their associated frames were identified by visual inspection as late-eighteenth-century; they appear to be well worn and markedly different from reproduction elements fabricated in the last twenty years. Whether they actually date to this early period or are replacements installed in the nineteenth century is not known. However, native hardwoods are remarkably durable and it is reasonable to assume that those considered to date to the late-eighteenth century probably do.[93] It is also unknown if doors or shutters were ever moved from one location to another over the course of years or if they have retained their original positions. Most doors believed to date to the late-eighteenth century have been patched, once again suggesting significant age. Many casemates (in the San Cristóbal outworks and lower levels of el Morro) are completely absent of doors.

In the early 1960s, HABS documented extant doors, gates and shutters in the fortifications (figs. 17-22 and 28); some of these may date to the late-eighteenth century, others to the early-twentieth century. It is presumed that an attempt was made to replicate these accurately (from what was either being replaced or what was extant), and that the HABS illustrations can be considered to portray doors, gates and shutters as they appeared in the late-eighteenth century.

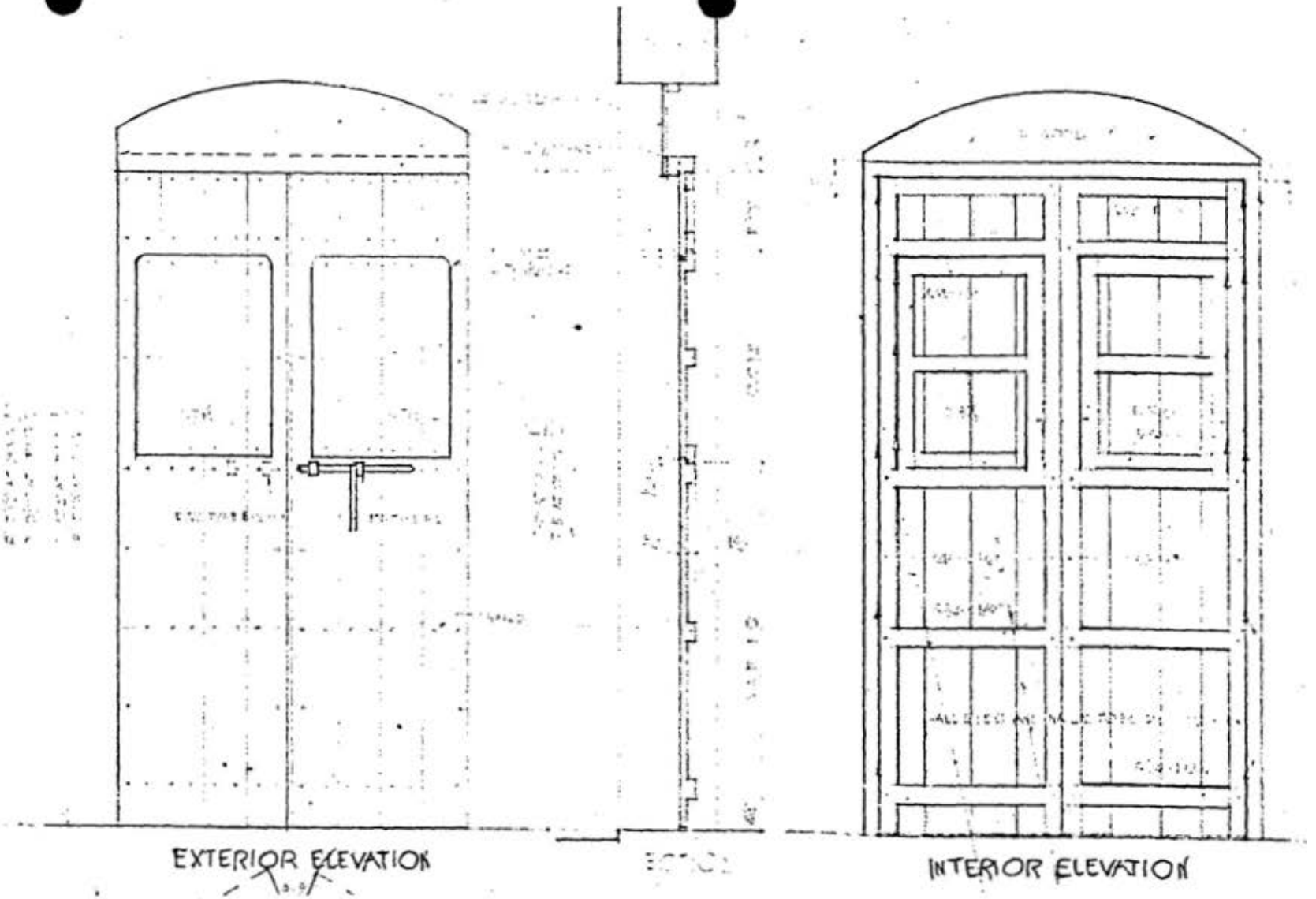


Figure 17a. Door type "A", San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS: SJ/3062, 1962.)

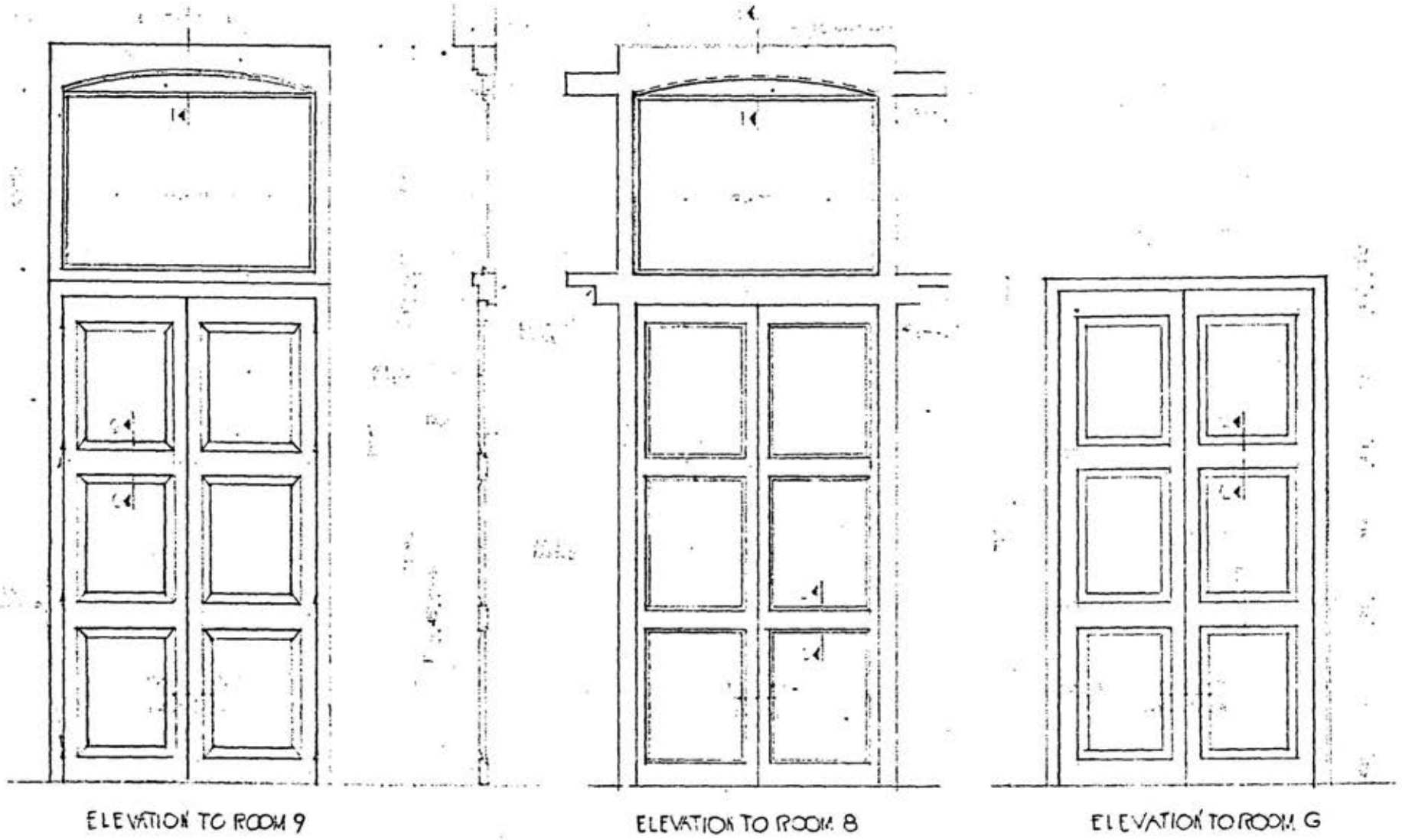


Figure 17b. Door type "D", San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drqawing no. NHS:SJ/3062, 1962.)

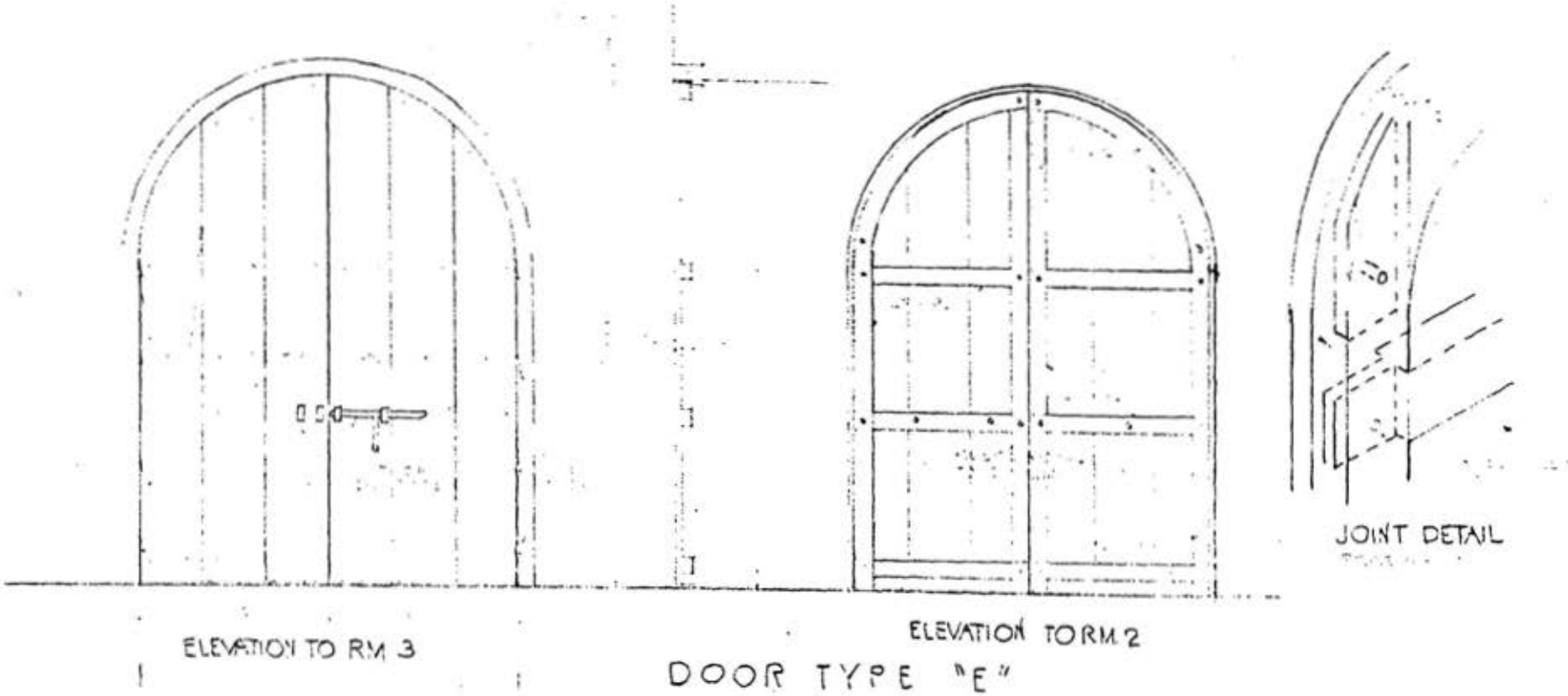


Figure 17c. Door type "E", San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062, 1962.)

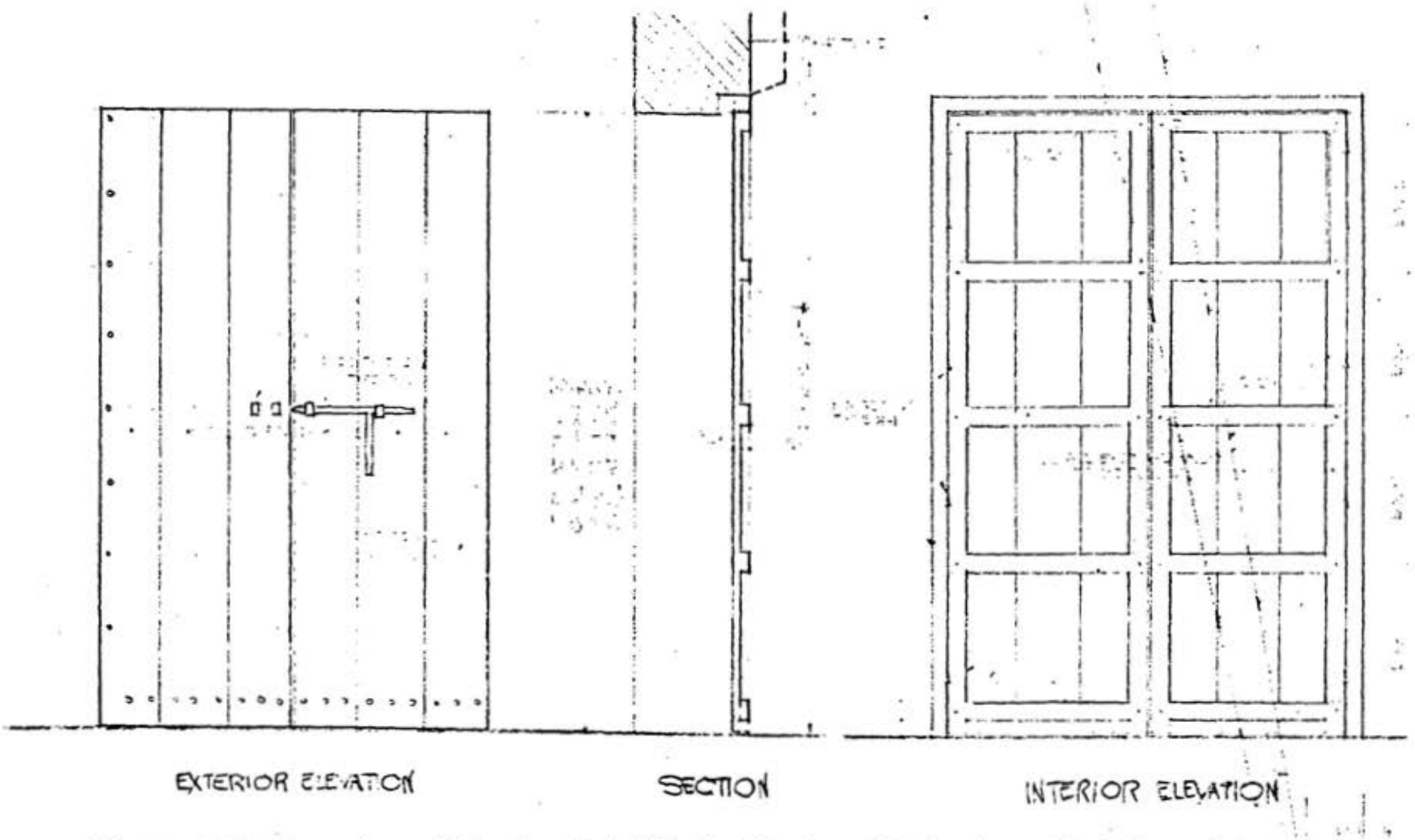


Figure 17d. Door type "F", San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062, 1962.)

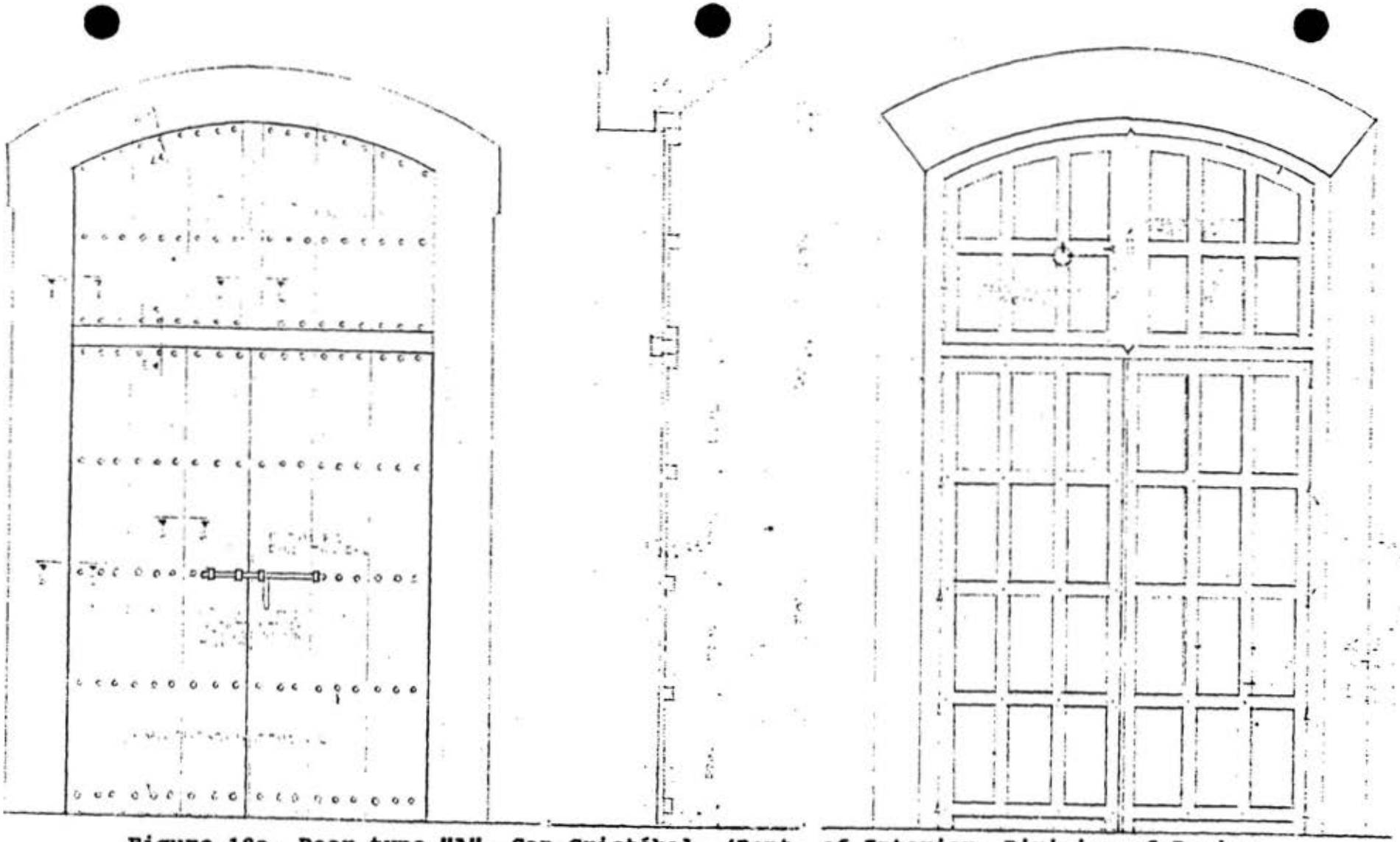


Figure 18a. Door type "A", San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062, 1962.)

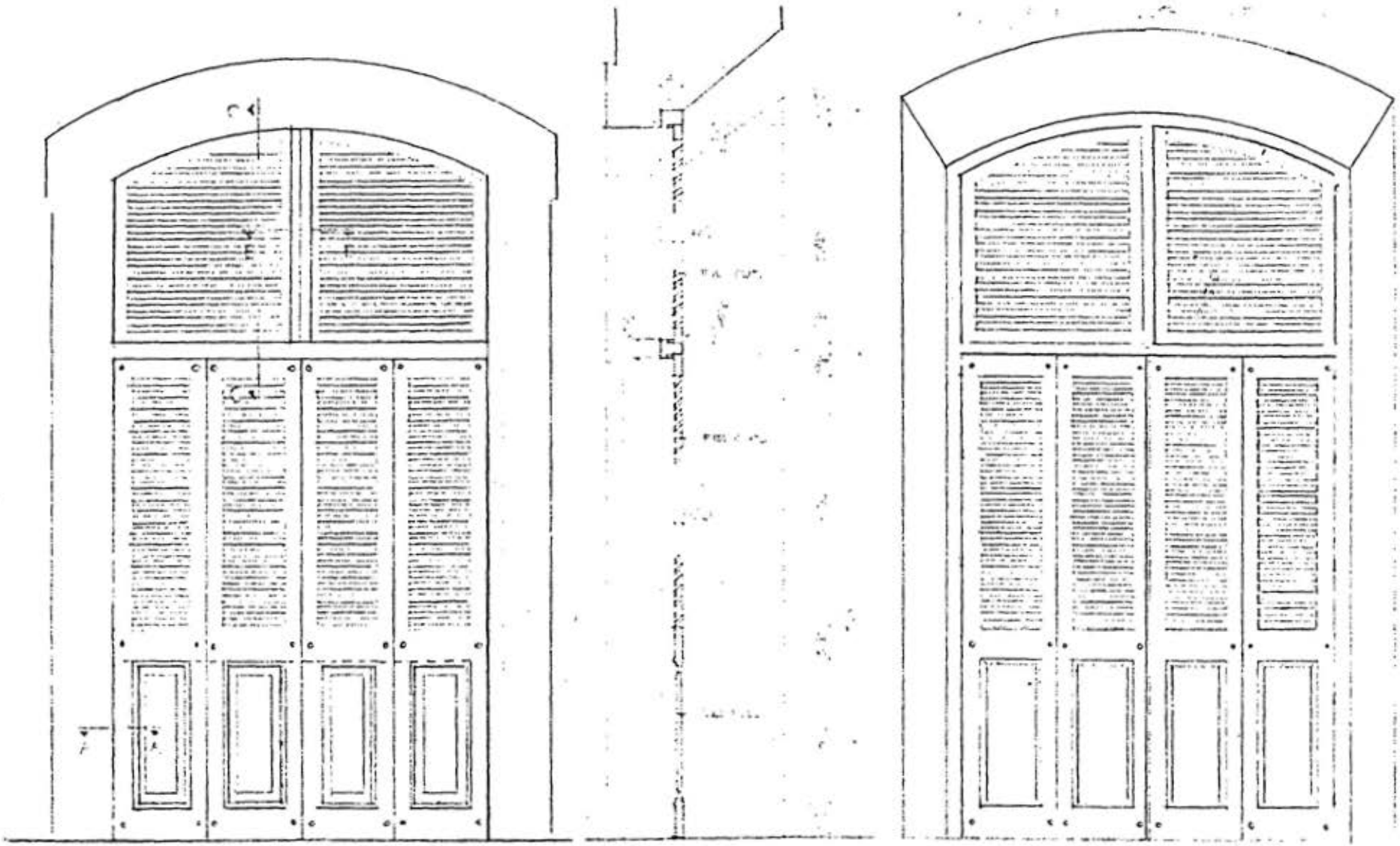


Figure 18b. Door type "B", San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062, 1962.)

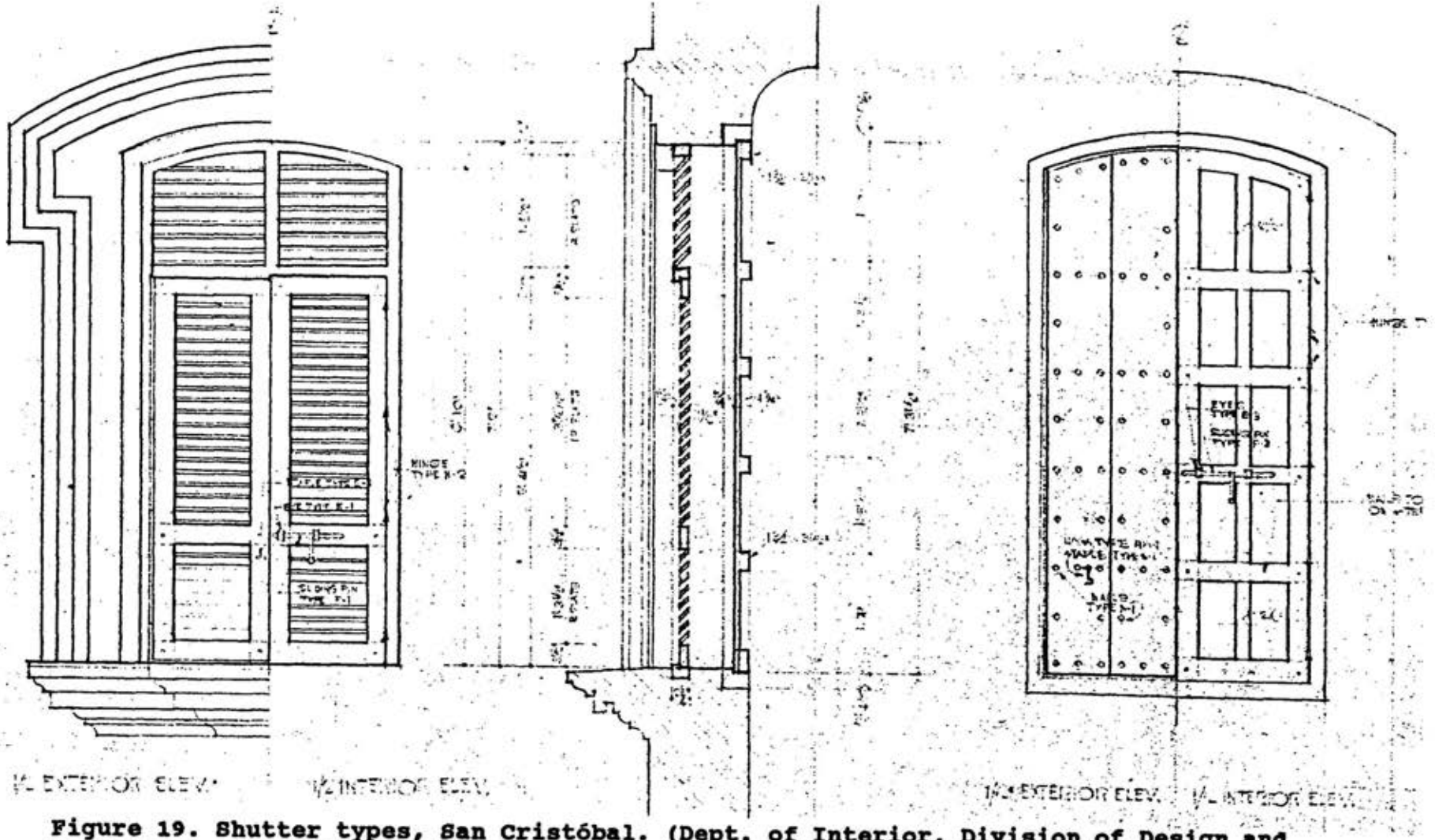
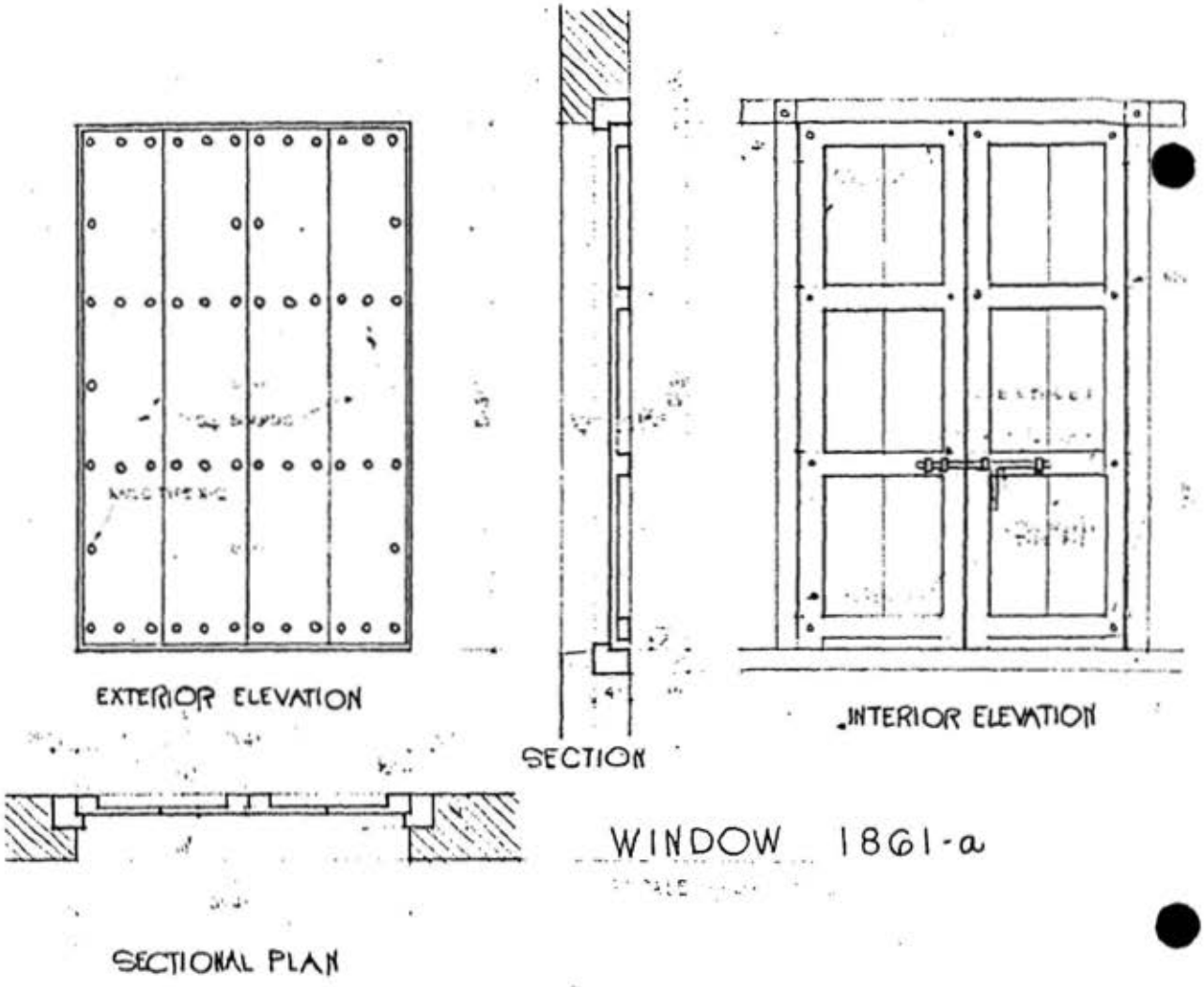


Figure 19. Shutter types, San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062, 1962.)



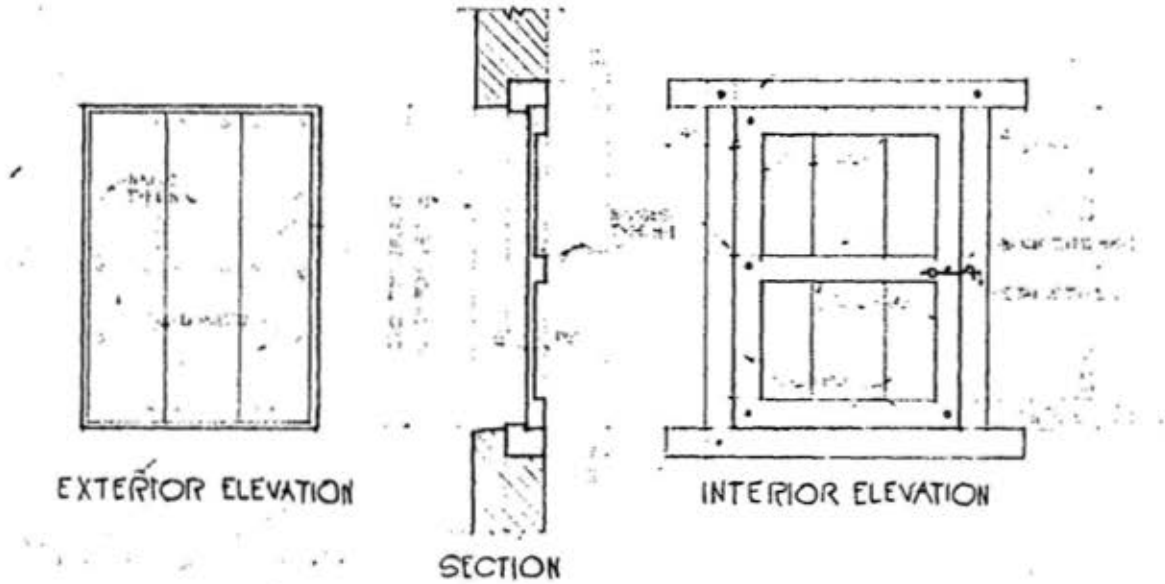


Figure 20a. Shutter types, San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062, 1962.)

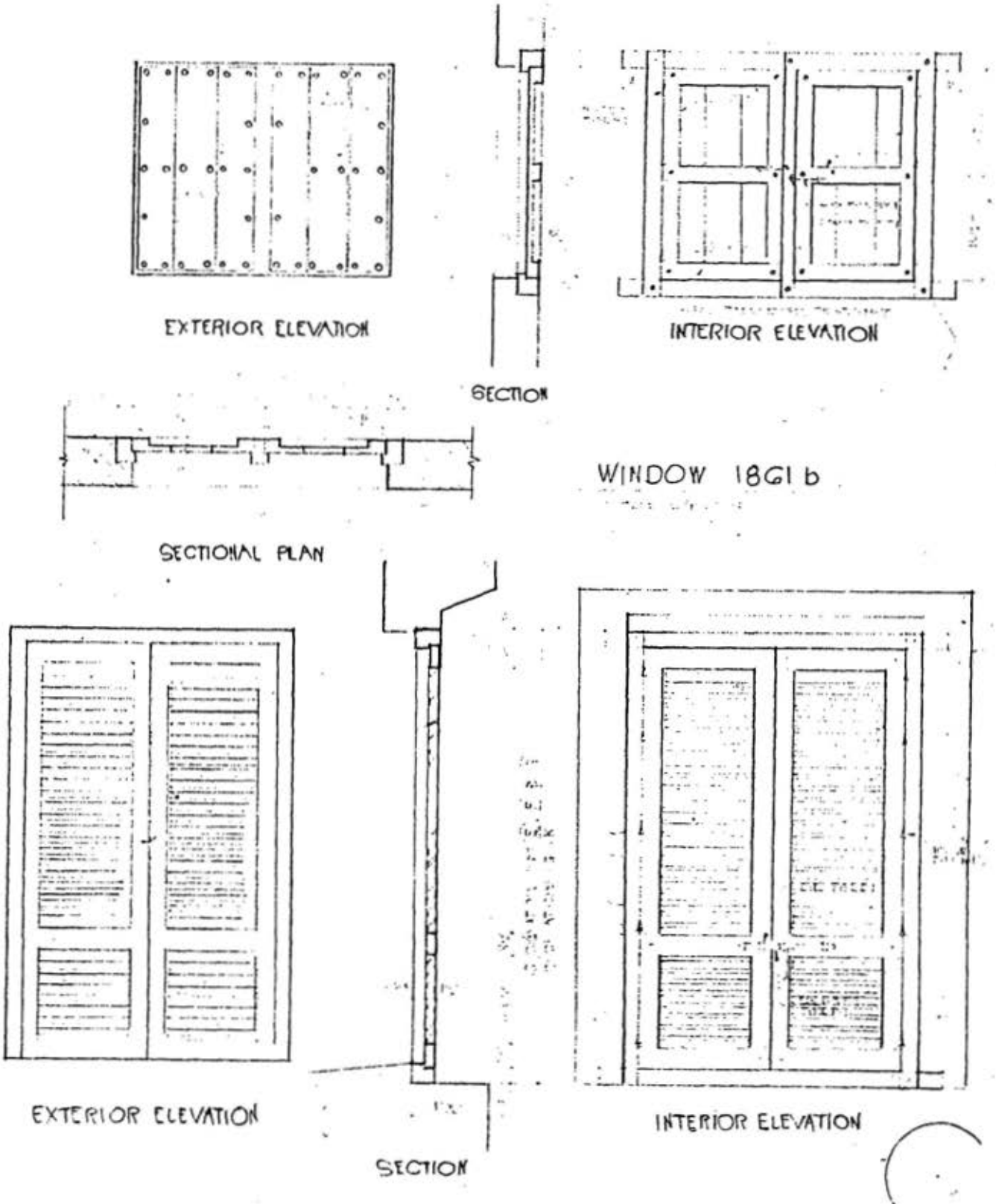


Figure 20b. Shutter types, San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062, 1962.)

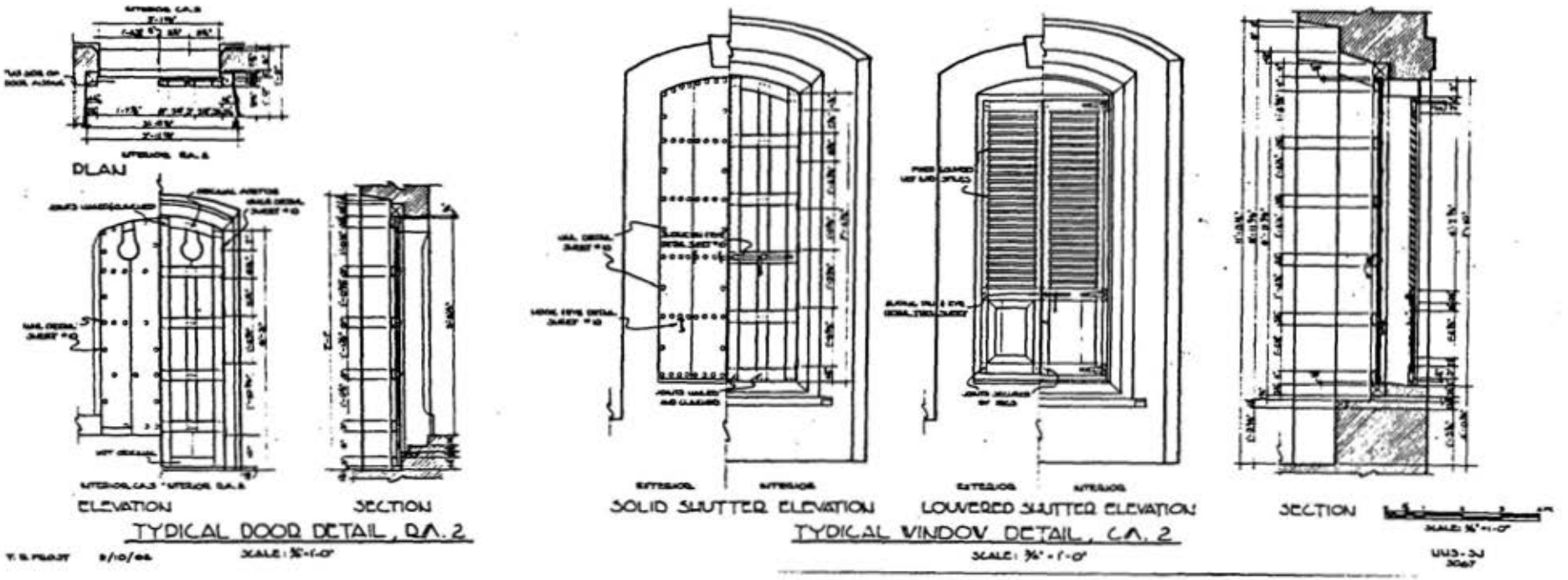


Figure 21. Door and shutter types, San Cristóbal. (Drawing by HABS, 1962.)

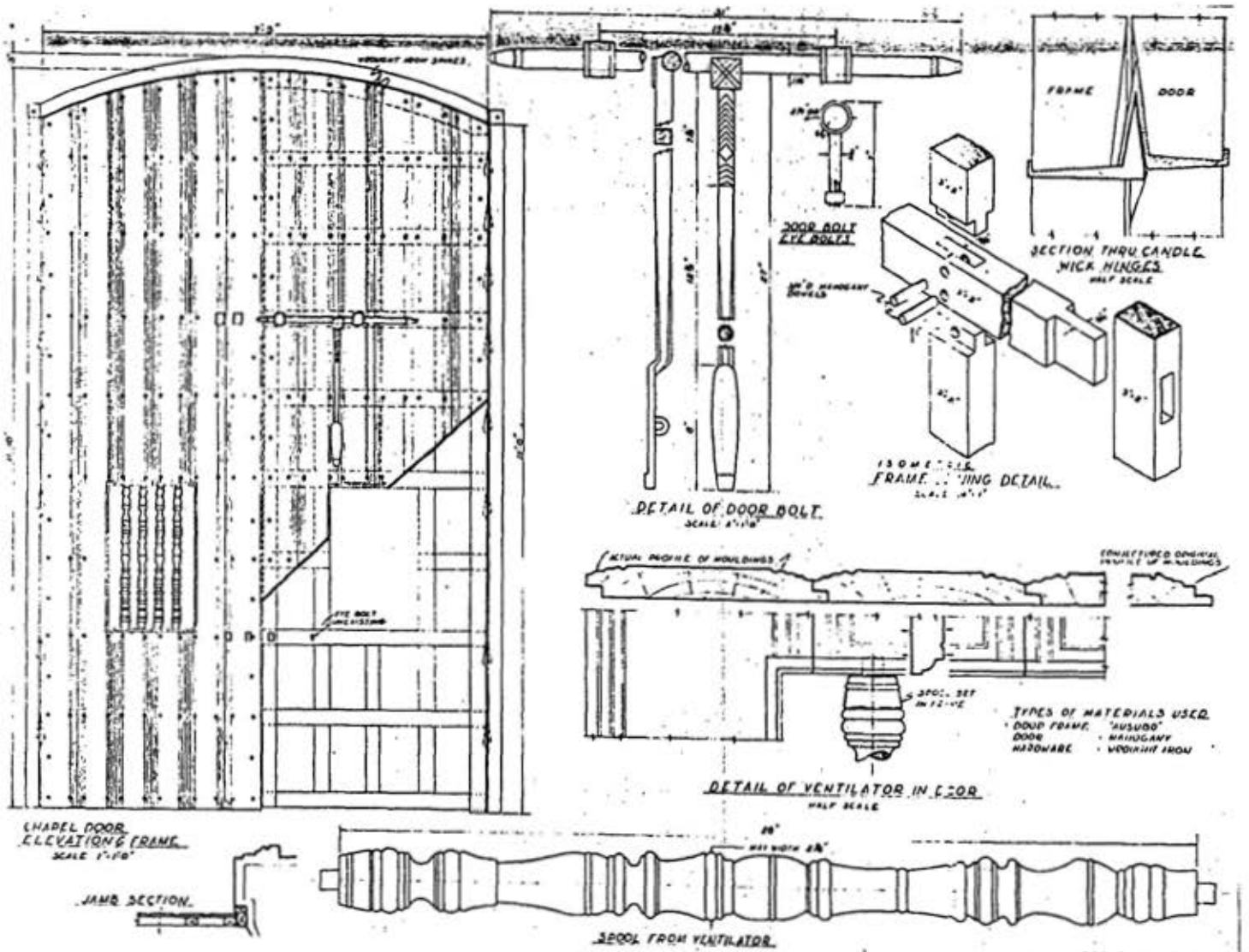


Figure 22. Chapel door and details in el Morro. (Drawing by HABS, 1955.)

Doors are typically of vertical planks braced on the back (interior side) by both vertical and horizontal members. Doors to casemates are double, hinged on either side with both sides opening to the exterior. Some doors have a small opening in the top third; this opening has a hinged cover opening to the interior with a grille on the exterior side.

Window shutters are of two varieties. One is similar to the doors just described with vertical planks braced on the back; the others are outfitted with fixed-louvers. A ca. 1905 photograph of the Troops' Quarters depicts louvered shutters.[94] These are similar to those illustrated by Castro in 1861, but have a solid panel in the lower section.

No gates predating the twentieth century remain, although some wood fragments give evidence of their former locations. The wood lintel of the south gate of San Cristóbal may be original. Tunnel 3 has a piece of wood embedded in the masonry jamb of the doorway (east-facing) to which a hinge for a gate may have been attached. The 1963 HABS drawings of la Princesa depict wooden fragments at the midpoint of the reveals of the gates, indicating the existence of a wood frame at one time. At the northeast gate of el Abanico, wooden brackets are set into the reveal of the cornice of each gate post.

The main gates of el Morro and San Cristóbal, and those at el Morro's chapel, the Troops' Quarters, and the San Juan Gate are constructed of vertical boards braced on the back by horizontal and vertical members. Wickets (a small hinged door in the lower part of a larger door) were placed in these gates to enable easy pedestrian access (fig. 23).

The harrow gates referred to in 1770-1771 are described by Torres-Reyes as "made of timbers whose dimensions were commonly 6 by 4 inches, and 6 inches distant from each other, well fastened to three or four crossed bars, and secured with iron."[95] A harrow gate is illustrated in a late-eighteenth-century document (fig. 23) and appears just outside of the Main Gate of San Cristóbal in Castro's drawing. This type of gate is no longer extant in the fortifications.

Castro's elevation of the North Casemates shows screens in the tops of the arcade arches. His elevation of the Troops' Quarters shows a montante (fan or transom) over one of the tunnel entrances. Both features are no longer extant.

During the 1970s, all doors, shutters, and frames of San Cristóbal and el Morro were stripped of their finishes and treated with a mixture of kerosene and linseed oil,[96] making the identification of historic finishes on these elements practically impossible. However, the stripping was not completely thorough and there are several places where paint

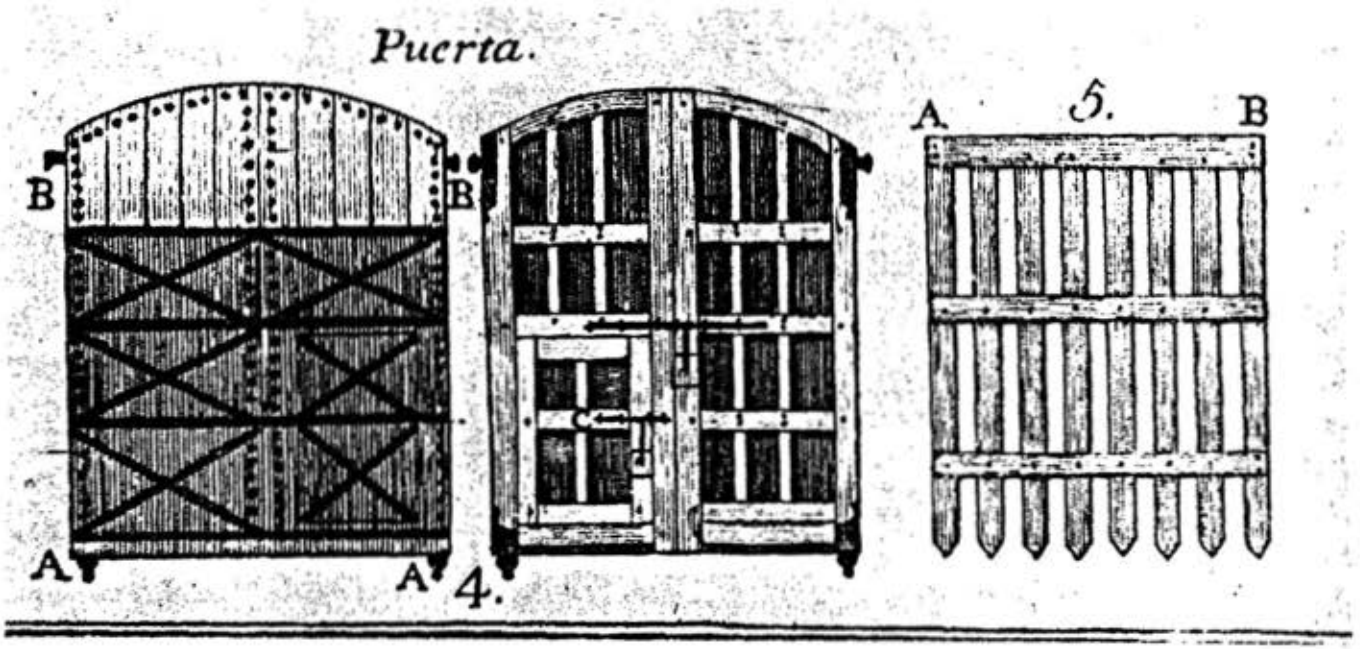


Figure 23. A harrow gate is illustrated on the right. The gates currently found at the fortifications are similar to that illustrated in the center. (From Richard Torres-Reyes "San Cristóbal Gates," 1964.)

still remains. Paint samples extracted from these areas provide a partial history of finishes. Samples from the inside of a casemate door and frame at el Morro (second casemate to the north of the main gate on the Plaza) were examined. Many paint layers are present, about twice as many on the frame as on the door, with dark browns and greens predominating. In 1974, finishes from a shutter (supposedly dating to the late-eighteenth century) from the Troops' Quarters were examined by the National Park Service's Harper's Ferry museum laboratory; twenty-two layers were identified.[97] In 1987, samples from another shutter of the Troops' Quarters were examined and over thirty layers of finishes were identified.[98]

Castro depicted doors and shutters as green in color; this same green is found in several layers of the paint samples. What appear to be gates in the arches in front of the cisterns (southwest facade) are brown in color.

In 1808, Ignacio Mascaro recorded the use of a mixture of liquid pitch, tallow, and red ocher to treat the palisades and gates of el Abanico.[99] It is possible that the red ocher served the dual purpose of providing color and acting as a fungicide or insecticide. None of these elements remain.

Ceilings and roofs that are not of masonry construction are supported by wooden beams and purlins. All of these roofs are flat. At the el Abanico guardhouse, beams measure 4 x 8 inches and are spaced closely together (2 feet on center) with 1/2 inch corner beads. Purlins (1 x 3 inches) rest on top of the beams and run in the opposite direction, supporting the tiles of the roof or the floor above. Prior to the replacement of the roof of the el Abanico guardhouse, traces of white wash were found on the purlins.[100] Flat roofs are found on a small structure on Carmen Bastion, and on the guardhouses at el Abanico and el Morro. The date of construction of the structure on Carmen Bastion is unknown; the roof appears original to the structure. The beams in the guardhouse at el Abanico are all replacements; it is unknown if those at el Morro are original or not. The former wooden beams in the North Casemates have been replaced with cast concrete.

The balustrade of the main stairway in the Troops' Quarters is presumed to be original to the building's construction in 1771. The newel posts and balusters are turned. There are two types of balusters: one on the stair and one on the balcony; the balcony and stair handrail have different profiles as well (fig. 24). The balustrade is now painted a dark green.

Along the outer scarped walls of el Abanico are a series of holes in a horizontal line just below the embrasures. These holes are positioned 12 inches apart on center. Some holes

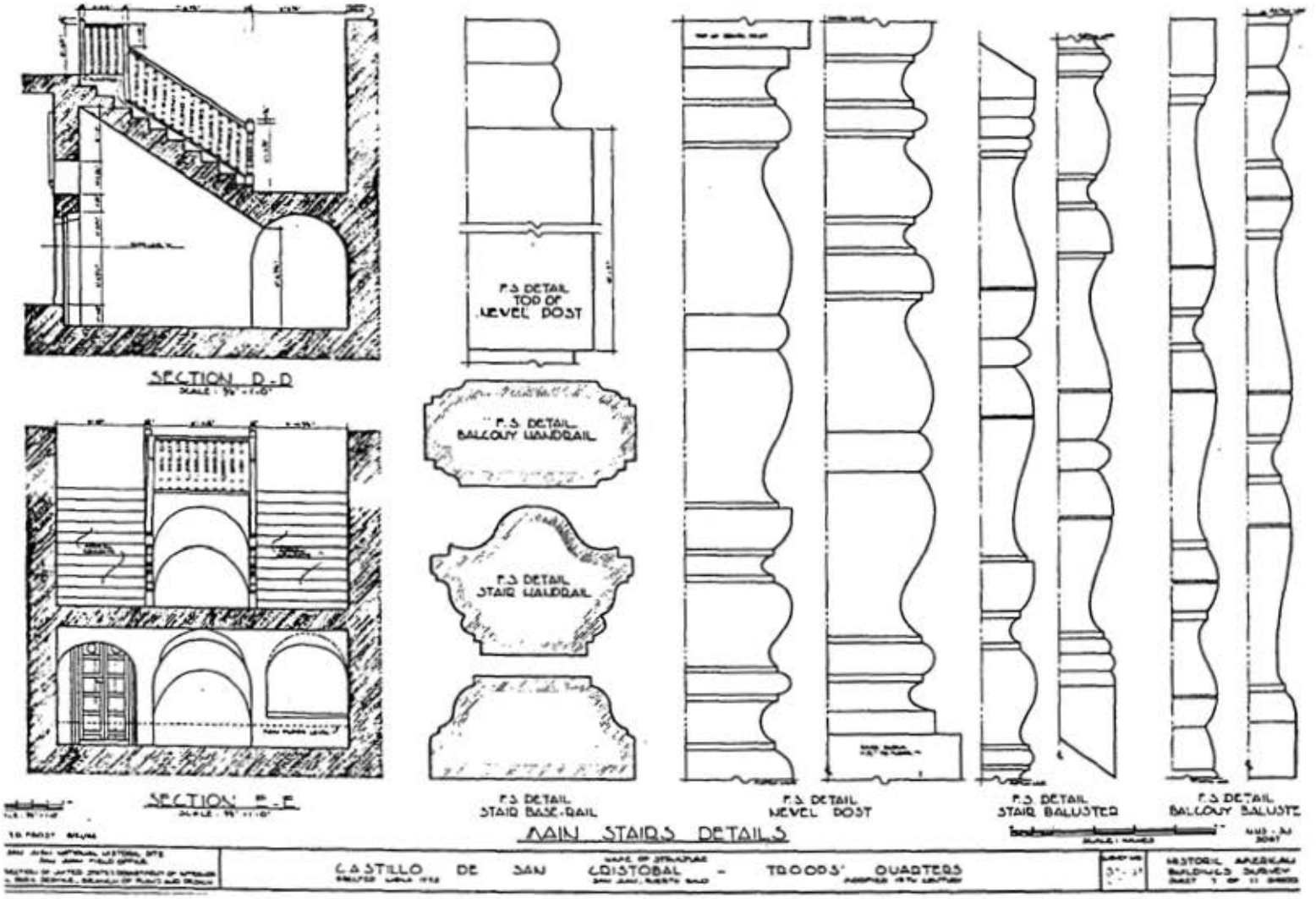


Figure 24. Stair railing details from the Troops' Quarters, San Cristóbal. (Drawing by HABS, 1962.)

appear to be empty, some are filled with cement, and some contain fragments of wood. They mark the position of a row of fraise that projected outward from the wall with sharpened ends to deter enemy access.[101] At la Princesa, a series of 4 inch patches located near the top of the wall indicate the former location of fraise.

There are wooden elements of unknown function in one of the casemates in el Morro. (This casemate is located on the west side of the Plaza, fourth from the south.) At set intervals along the side walls are cross marks cut into the stucco, about 1 foot high and 8 inches wide, with the butt end of a wooden pole (about 2 inches in diameter) exposed in the very center. Similar configurations may be in other casemates, but because they have all been covered over with a cement stucco, their locations are not known.

In 1908, the lighthouse at el Morro was partially rebuilt, and at this time, or shortly thereafter, window shutters and doors were installed. Finish samples were not extracted from these materials.

During the restoration of the chapel in el Morro in 1955, charcoal (burned wood) was discovered to have been used as chinking material in the masonry. Charcoal was not found as chinking in any other location.[102]

Wood remains in holes adjacent to gun emplacements at el Morro. Some of these fragments may be contemporary with the emplacement, others are more recent. The exact purpose of these pieces was not researched for this report.

During the extensive repair campaigns in the twentieth century, many wooden elements were installed in the fortifications. These include: cistern heads; stair and sill nosing; handrails; stairs; bridges; gates, doors, shutters, and their enframements; and the balustrades of the chapels. Materials exposed to weathering have been stained or painted a dark brown. Interior materials are varnished.

METALS

Metal elements dating to several periods are found throughout the fortifications. However, they date primarily to the twentieth century. For this report, metal elements will be discussed by type, with emphasis given to those predating 1898.

Little documentation exists concerning the manufacture of the fortifications' metal work or its place of origin. It is

not known if metal work was fabricated on site (and if so, where the raw materials came from) or if it was brought from Spain. In 1783, Mestre included one "master blacksmith" in his list of craftsmen and builders.[103] This would seem to be an indication that architectural hardware was being fabricated on site, however, it is possible that the blacksmith's primary responsibility was the care and repair of stone cutting tools or artillery.

It is difficult to ascertain which metal elements date to the late-eighteenth-century building campaign. The rapid deterioration of iron work makes dating difficult as all corroded material appears to be "old." Architectural metal work dating to the late-eighteenth-century building campaign is primarily associated with doors and window shutters. Hardware is believed to be original if located on original doors and shutters showing no signs of previous fixtures (i.e. nail holes or ghosts). Original hardware consists of hand wrought rose-headed nails and hinges. The original finish of these elements is not known; modern replacements are painted black.

Door and shutter hinges are composed of a conical pintle and socket arrangement, commonly called gozne de capuchino (capuchin hinge).[104] (See figures 25-27.) Capuchino hinges are not evenly spaced along the edge of the door and frame but rather become increasingly closer together towards the top. This assembly provides the increased strength needed at the top where the stress is greatest. On some doors, shutters, and frames the conical ghosts of such hinges are visible.

Many metal elements are twentieth-century replacements, both reproduction and new design. It is not known how closely the designs for the replacement elements followed the originals. HABS drawings from the 1950s and 1960s illustrate hardware that was to be reproduced: all fasteners, sliding bolt latches, and small grilles (figs. 21, 22 and 26). Many elements that were originally iron were refabricated in bronze to prevent rapid corrosion. There are two basic sizes of grilles. Small grilles cover the small openings in doors and large grilles function as gates to tunnels or casemates. They all appear to date to this century. Numerous iron fasteners are situated on tops of merlons, parapets, and on walls. The dates of their installation are not known, nor were their functions researched for this report.

In the last half century of Spanish tenure, new gun emplacements were installed. Some of these are characterized by iron tracks. Those on Ochoa Bastion were installed between 1854 and 1858.



Figure 19. Cuauchino hinge from shutter on Troops' Quarters, San Cristóbal. Photo by J. Jacob, 1989.

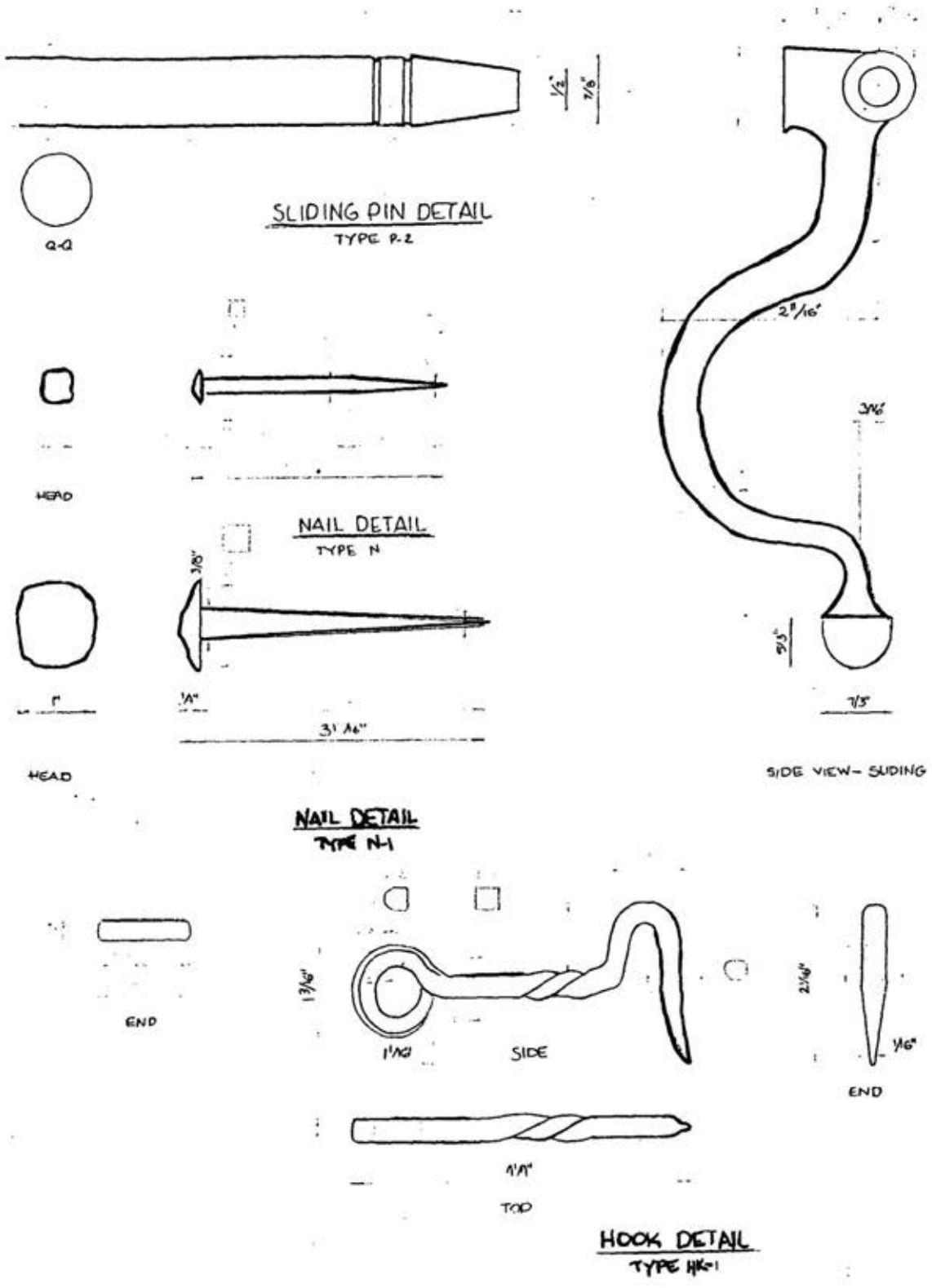


Figure 26a. Hardware details from the Troops' Quarters, San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062.)

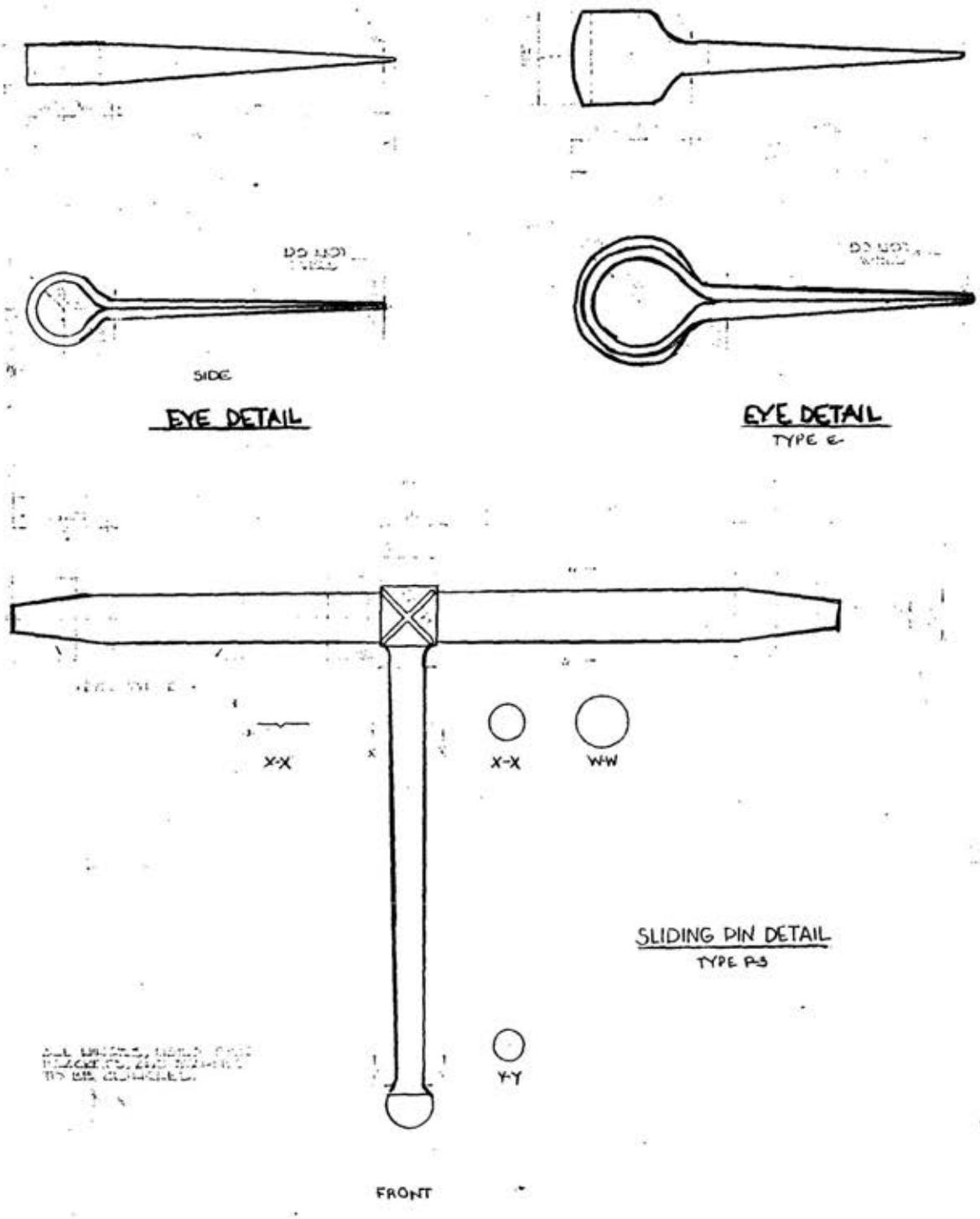


Figure 26b. Hardware details from the Troops' Quarters, San Cristóbal. (Dept. of Interior, Division of Design and Construction. Drawing no. NHS:SJ/3062, 1962.)

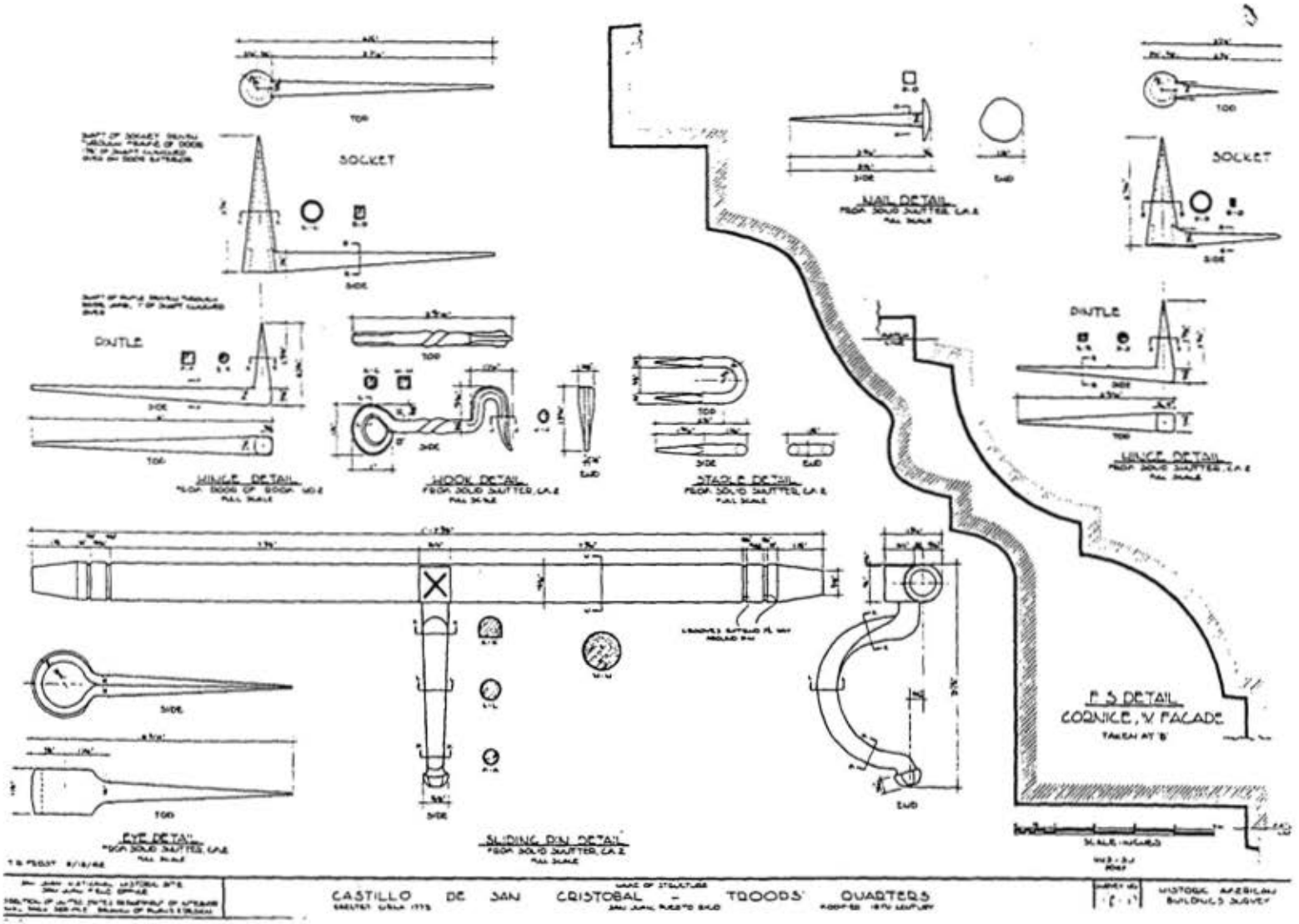


Figure 27. Hardware details from San Cristóbal. (Drawing by HABS, 1962.)

The housing for the light in the lighthouse on el Morro is of cast iron and bronze. Metal work used in conjunction with the light and the lighthouse dates to the fabrication of the light itself (ca. 1875) and to the construction of the lighthouse (1876 and 1908).

Cannon and cannon balls are displayed in the fortifications for decorative purposes and to aid in the interpretation of military history. Cannon are mounted in blocks of concrete; cannon balls are set in small pyramids mounted in concrete. Cannon are situated by the San Juan Gate and a single cannonball is mounted on top of each gate post at the bottom of the ramp to the Main Gate of San Cristóbal (fig. 28 and 1980s HABS drawings). The age, origin and dates of installation of these was not researched for this report. In 1898, a projectile fired at el Morro entered at the tower level and remains imbedded in the wall, protruding into the tower. It is possible that there are other projectiles (dating to 1898 and to earlier bombardments) imbedded in walls that have since been covered over.

Reinforced concrete was used for the World War II harbor defense structures. The types of rebars used was not investigated for this report. The associated gun mounts and tracks are of iron or steel. Heavy steel doors were installed in some casemates and tunnels during this time as well.

Modern metal elements also consist of handrails, guardrails, flag poles, wall plaques, and chain link fences. Metal elements associated with cistern heads and ventilation shafts also date to this century.

GLASS

In 1846, the first lighthouse was constructed on el Morro.[105] It is probable that this lens assembly was the first use of glass in the fortifications. The lighthouse now located on Ochoa Bastion consists of a 1900 base and a 1908 superstructure.

> The illuminating apparatus was a 3rd order, lenticular, 1875 French Sautter, Lemonnier & Cie lens installed in 1908. The central drum measured 1 m. and had 8 flashing panels, each made up of 6 ring elements and one bull's eye. . . . The rotating machinery was protected by a cylindrical cast-iron and glass case.[106]

Casemates in el Morro and San Cristóbal that have been made into offices or exhibition space have had glass installed in

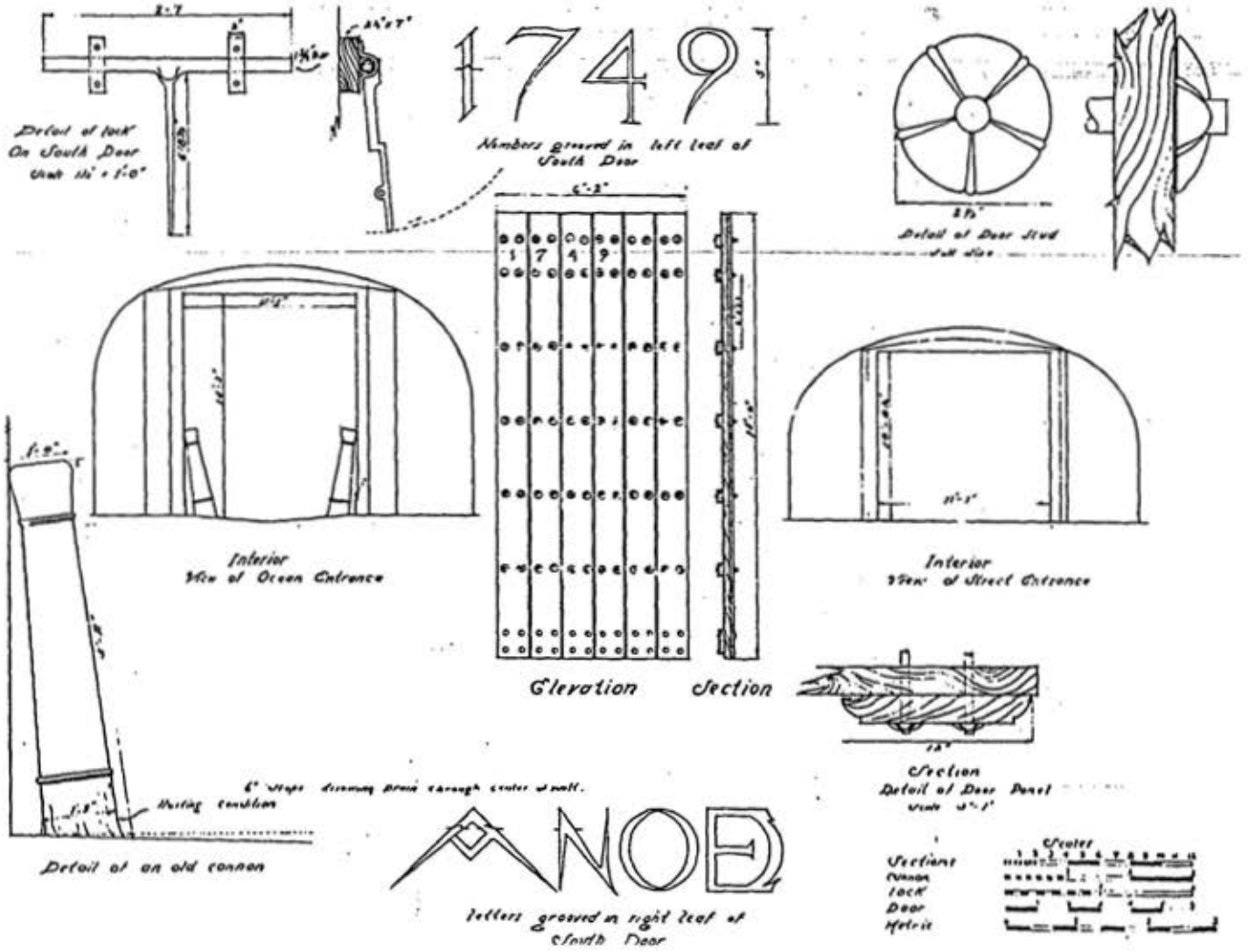


Figure 28. Old cannon and hardware details of Old San Juan Door. (Drawing by HABS, ca. 1960.)

their window openings. The dates of installation were not researched for this report.

BITUMEN

Bitumen is "a brownish black, native mixture of hydrocarbons with oxygen, sulphur, and nitrogen, and often occurs . . . in regions of natural oil deposits."[107] Its use in the San Juan fortifications was documented in several reports dating to the late-eighteenth century. During the construction of el Príncipe Revellín in 1772 (now demolished), bitumen was applied to the extrados of the vaults, followed by a layer of mortar. Earth was packed on top of the vaults to bring the mass up to the level of what would be the terreplein above, which was surfaced with hormigón. The bitumen and mortar was "necessary for the protection of an arched construction against humidity and filtration of water from the terreplein."[108] Two years later, the interior walls of these vaults (which were used as cisterns) were "prepared with a fine coat of mortar and bitumen to have them ready to receive water at the end of the year."[109] Bitumen was found under the surface stucco in the cisterns of San Cristóbal.[110]

NOTES

1. Sillería and cantería both translate to "ashlar." Late eighteenth-century construction documents use the term sillería; this term is no longer used today. Mampostería translates to "rubble stone."

2. Three geological reports were used:

Pedro A. Gelabert, Construction-Material Resources of the San Juan Quadrangle, Puerto Rico, Geological Investigations Bulletin No. 6, Prepared in cooperation with U.S. Department of Commerce Bureau of Public Roads (Commonwealth of Puerto Rico: Department of Public Works Bureau of Materials and Soils Testing and Research, Soils and Geology Division, 1964).

Robert B. Guillou and Jewell J. Glass, A Reconnaissance Study of the Beach Sands of Puerto Rico, Geological Survey Bulletin 1042-I, Prepared in cooperation with the Economic Development Administration of the Commonwealth of Puerto Rico (Washington: United States Government Printing Office, 1957).

Clifford A. Kaye, Geology of the San Juan Metropolitan Area Puerto Rico, Geological Survey Professional Paper 317-A, Prepared in cooperation with Puerto Rico Water Resources Authority, Puerto Rico Economic Development Administration, Puerto Rico Aqueduct and Sewer Authority, and Puerto Rico Department of the Interior (Washington: United States Government Printing Office, 1959).

3. Gelabert, pp. 29-30. (Caseharden: to form a hard outer surface.)

4. Diego Menéndez de Valdés, document dated May 23, 1583 (AGI-SD 155-13), cited by Ricardo Torres-Reyes, "Construction History of San Cristóbal: 1643-1800," (NPS, 1968), San Juan NHS archives, pp. 3-4.

5. Alexander O'Reilly, document dated June 24, 1765 (AGI-SD 2501-19), trans. Richard Crisson, HPC.

6. Juan Francisco Mestre, document dated September 13, 1783, National Archives, Records of the Spanish Governors of Puerto Rico, Record Group 186, microfilm copy in San Juan NHS archives, trans. Richard Crisson, HPC.

7. Documents dated 1771 and 1772 (AGI-SD 2510-41 and 2506A-7), cited by Torres-Reyes, "Construction History," pp. 75-76 and 79.

8. Mestre, September 13, 1783.

9. The rubble section was exposed when the Water Battery was constructed in the late eighteenth century.

10. "Preservation of Historical Fortifications, San Juan, P.R.," Stamped: Office Chief of Engineers, 613(PR-San Juan)98/1, Feb. 18, 1939, typewritten document in the San Juan NHS archives.

11. See Note 28.

12. Menéndez, May 23, 1583.

13. Thomas O'Daly, document dated February 27, 1771 (AGI-SD 2510), trans. Edward Hunter Ross, 1948-1949, typewritten document in the San Juan NHS archives.

14. Thomas O'Daly, document dated April 21, 1769 (AGI-SD 2502-27), cited by Torres-Reyes, "Construction History," pp. 38-39.

15. Crosby, "Notes on the Defenses of San Juan, Puerto Rico;" and Goethals to Wilson, January 20, 1899, NA, RG77, General Correspondence 1894-1924, Docs. 27360/104 and 27360/169, cited by Edwin C. Bearss, "Historic Structure Report, Historical Data Section: San Juan Fortifications 1898-1958," unpublished document (NPS, 1984), p. 28.

16. U.S. Army Corps of Engineers, Office of the District Engineer, "Ft. Brooke, San Juan, P.R., San Agustín Bastion Foundation Exploration and Sections," Drawing no. 88-03-01, Sheet 4, February 1952, in the San Juan NHS archives.

17. Thomas O'Daly, document dated April 30, 1772 (AGI-SD 2506A-7), cited by Torres-Reyes, "Construction History" p. 80.

18. Mestre, September 13, 1783.

19. Bearss, "Historic Structure Report," pp. 30-39.

20. O'Reilly, June 24, 1765.

21. Ibid.

22. (AGI-SD 2502), referenced by Juan Blanco, "A Study of the Morphological Structure of the Systems of Fortifications of San Juan de Puerto Rico with a Special Emphasis on the Development of the 'Frente de Tierra de San Cristóbal'" (1988), manuscript in the collection of the NPS, Southeast Regional Office, pp. 732-733.

23. See archaeological report in Volume III, Appendices.

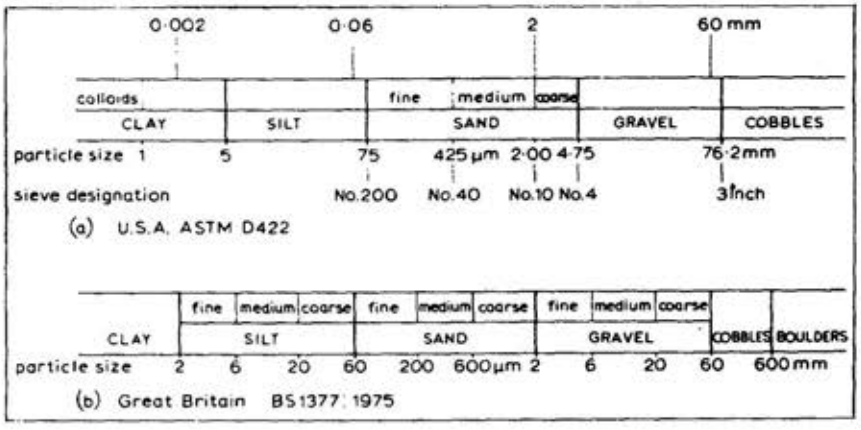
24. Report of the Real Maestranza de Ingenieros (ca. 1832), in the Archivo Alvaro Bazán, Exp. 14966, Museo Naval--Cuartel General de la Armada: Legajo P.R., cited by Blanco, pp. 747-748.

25. At el Cañuelo, brick are used for paving on the terreplein.

26. F. Ross Holland, America's Lighthouses (Brattleboro, Vermont: Stephen Day Press, 1972).

27. Galleting: small pebbles or chips of stone (or brick) set into mortar for decoration.

28. ASTM D 2487, "Standard Test Method for Classification of Soils for Engineering Purposes," and D 2488, "Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)," define fines to be those particles of soil too small to be seen individually, or those passing a No. 200 sieve. ASTM D 2487 classifies these as clay and silt; their organo-mineral constituent was not determined for this study. The following chart is derived from D 2487 and is reproduced in: Jean Marie Teutonico, A Laboratory Manual for Architectural Conservators (Rome: ICCROM, 1988), p. 73.



29. Analysis of San Cristóbal mortars was carried out at both HPC and CPR. Analysis of el Morro mortars was carried out at HPC. Both the procedure and the expression of data are similar for the two Centers, although there are some variations. The procedure (and the variations) is outlined below.

A sample of mortar is pulverized, dried, and twenty grams mixed with a dilute solution of hydrochloric acid; the material digested by the acid is called the "acid-soluble material." At CPR, the carbon dioxide effervesces into the air. At HPC, the carbon dioxide is collected in an Erlenmeyer flask filled with water; the quantity of carbon dioxide collected is measured by the amount of water displaced. At both HPC and CPR, the fines are separated from the sand by levigation and filtration. The sand and fines are allowed to dry and then weighed; the color of the fines is matched to the "Munsell System of Color Notation" using the soil color charts. At CPR, percentages by weight of sand, fines, and acid-soluble material are calculated. At HPC, weight and volume

data are fed into a computer program (developed by E.B. Cliver, HPC) which calculates percentages by weight of sand, fines, and acid-soluble material, and estimates parts per volume of sand and binder (lime, clay, cement).

Because sands of the San Juan area have a high biological calcite content, the acid soluble portion of the mortars contains both binder and aggregate. This is not taken into account in the volumetric estimate of mortar constituents.

Samples containing Portland cement were identified based on their characteristic light gray color, hardness, location, and period of application. Component parts of cement-lime mortars are difficult to determine in this type of analysis.

30. This differentiation between beach and pit sands is quite general, and therefore, not altogether accurate. It is possible that some beaches were inland in former times and that inland sources of sand could have been former beaches. In this case, because two distinct sands are present in mortars (those with predominantly subangular grains and those with predominantly subrounded grains), the general beach and pit distinctions will be used.

31. Gregory J. Cavallo, Corona, N.Y., report dated November 2, 1989, and Allan S. Gilbert, Bronx, N.Y., report dated March 9, 1987. Copies of both reports are in Volume III Appendix C and D.

32. Gelabert, p. 31.

33. The biological calcite constituent of sand originates as shell or coral and is characterized primarily by cylindrically-shaped pieces.

34. Gelabert, p. 37.

35. Whether the clay size fines are mineralogically clays was not determined for this study. It is possible that clays are located in San Juan, it is also possible that certain types of soil have clay-like properties but are not mineralogically clays. The term "clay" will be used in this report, even though it might not be accurate.

36. Gelabert, p. 54.

37. Ibid., p. 55.

38. Menéndez, May 23, 1583.

39. O'Reilly, June 24, 1765.

40. Blanco, p. 733. Based on Thomas O'Daly "Pregón de Pública Subasta," document dated March 27, 1772 (AGI-SD 2500).

41. Suárez Coronel, document dated January 1594 (AGI-SD 155-16), cited by Ricardo Torres-Reyes, "Structural Development of El Morro: 1539-1600," San Juan NHS archives ca. 1965., pp. 27-28.

42. The "Munsell System of Color Notation" identifies color in terms of three attributes: hue, value and chroma. Color standards are opaque pigmented films on cast-coated paper, mounted on charts of forty hues.

43. Floating is achieved by drawing a float (a large flat wood or metal trowel-like tool) over a smooth and semi-dry stucco, bringing the laitence to the surface. The resulting density of the laitence at the surface provides a protective outer layer as well as a sheen.

44. Analysis was not carried out to determine whether interior stuccos contained gypsum. The term "parging" is used as a synonym for "stuccoing" in some chapters in the San Cristóbal section of this report.

45. Illustrations located in the Vatican Library, Pal. Lat. 2105 79 and 2105 80, Vatican City, published by Aníbal Sepúlveda Rivera, San Juan: Historia ilustrada de su desarrollo urbano, 1508-1898 (San Juan: Centro de Investigaciones Carimar, 1989), p. 79.

46. Drawing located in Casa Blanca, San Juan.

47. Document dated December 31, 1771 (AGI-SD 2510), cited by Blanco, pp. 574-575.

48. Mestre, September 13, 1783.

49. Ignacio Mascaro, "Plaza de San Juan Bautista de Puerto Rico, Ano de 1808," December 31, 1808, Records of the Spanish Governors of Puerto Rico, The National Archives, Washington, D.C., Record group 186, Plaza de San Juan de Puerto Rico 1808-11, trans. Richard Crisson, HPC.

50. Real Maestranza de Ingenieros, ca. 1832, cited by Blanco, p. 747.

51. Photographs in the collection of the San Juan NHS.

52. Pedro Tomás de Córdoba, Memorias de la Isla de Puerto Rico, Vol. IV (1839), cited by Blanco, p. 744.

53. Blanco., p. 744-745.

54. Illustration located the New York Public Library, New York, New York, published by Sepúlveda, front and back inside covers of book.

55. Location of illustration unknown, published by Sepúlveda, p. 1.

56. Illustration located in the New York Public Library, Stokes Collection, H-30, New York, New York, published by Sepúlveda, p. 246.

57. See note 43.

58. Real Maestranza de Ingenieros, ca. 1832.

59. de Córdoba, pp. 416, 419, cited by Blanco, pp. 745-46.

60. Vitruvius, The Ten Books on Architecture, Book VII, Chapter III, trans. Morris Hicky Morgan (Cambridge, Mass.: Harvard University Press, 1914; reprint ed., New York: Dover Publications, Inc., 1960), pp. 206-208.

61. H. Fahlbush and R. Malinowski, Untersuchungen des Dichtungsmortels von 5 geschichtlichen Rohrleitungen im agaisch anatolischen Raum (Braunschweig: Leichtweiss-Institut fur Wasserbau, 1981), cited by Roman Malinowski, "Ancient Mortars and Concretes: Aspects of their Durability," History of Technology, Seventh Annual Volume, ed. A. Rupert Hall and Norman Smith (London: Mansell Publishing Limited, 1982), p. 90.

62. Cavallo, November 2, 1989.

63. Rafael Clavijo, "Ysla de Pto. Rico," Comandancia Exenta de Yngs., Parte de la Revista Pasada en el año e 1858, located in the Servicio Historico Militar-España, Madrid, Spain, cited by Blanco, p. 756.

64. Giorgio Torraca, Porous Building Materials; Materials Science for Architectural Conservation, 2nd ed. (Rome: ICCROM, 1982), pp. 71-72.

65. Vitruvius, The Ten Books on Architecture, Book II, Chapter V, p. 45.

66. Investigation of a thin section of hormigón with polarized light did not reveal the long thin crystalline structures characteristic of cements which provide the strength associated with such material. Their absence in the sample of hormigón indicates that the strength desired was not achieved with the addition of brick dust. Nevertheless, hormigón is a material far more durable than the white or red/beige mortars. Further

investigation with polarized light and other microscopy techniques may explain this phenomenon.

67. Juan Francisco Mestre, document dated January 8, 1785 (AGI-SD 2510-50), trans. Richard Crisson, HPC.

68. Real Maestranza de Ingenieros, ca. 1832.

69. Clavijo, cited by Blanco, p. 755-756.

70. A report from Dr. Norbert Baer is forthcoming.

71. El Abanico received maintenance work in the early 1960s at which time certain walls were painted. This finish could date to this time, although it appears to be similar to that applied in the nineteenth century. The 1960s work is documented in two documents located in the San Juan NHS archives: "Completion Report of Construction Project," "Rehabilitation of El Abanico Fort," July 1962, and a Memorandum to the Acting Chief of EODC from Charles Peterson, Supervising Architect of Historic Structures, January 28, 1960.

72. Vitruvius, Book VII, Chapter V, p. 210.

73. Faux ashlar surfaces are also found at el Cañuelo.

74. The heights of cut stone blocks are less than those blocks used in wall construction.

75. See Note 71.

76. See Note 54.

77. The middle layers were comprised of whites, an orange pink, and a red. For further information, refer to Volume II, Chapter 2 discussing the North Casemates.

78. A paint study of the lighthouse (both exterior and interior) was carried out by Barbara Yocum, HPC. The report is in the files of HPC. Interior finishes were not examined for this report.

79. Frederik C. Gjessing, "Report on the Investigation and Restoration of the Chapel, San Felipe del Morro" (NPS, San Juan National Historic Site, March 1956), document in the San Juan NHS archives. His description of painted finishes is as follows:

> Eight layers lime washes of various colors were noted above the original plaster . . . Three of these revealed decorated dados and dado stripes running on both sides of the chapel from the altar to the door and one layer showed traces of mural decorations of an architectural

> nature . . . [A layer of plaster covered these paints] and was in turn covered by two layers of oil paint. [p. 7]
>
> On top of the original plaster of the altar were nine layers of lime washes covered by tow layers of oil paint. All lime washes revealed decoration in different colors . . . The lowest layer in addition to the lime wash showed lining of some of the mouldings of a dark varnish type paint with metal particles which may have been gilt. [p. 7]
>
> The holy water basin . . . had the same number of lime washes and in general did not differ from the altar. [p. 9]

Paint schedules, color samples, and photographs are included in the original report; the material examined for this report was in photocopy form which was not useful for actual color history.

80. Ibid., p. 2.

81. Menéndez de Valdés, document dated October 24, 1583 (AGI-SD 155-13), cited by Torres-Reyes, "Construction History," pp. 3-4.

82. Real Académia Española, Diccionario de la Lengua Castellana, en que se Explica el Verdadero Sentido de las Voces, su Naturaleza y Calidad, con las phrases o Modos de Hablar, los Proverbios o Refranes, y Otras Cosas Convenientes al uso de la Lengua. (1732; reprint edition, Madrid: Editorial Gredos, 1963), p. 708. Trans., Richard Crisson, HPC.

83. Real Academia Española, Diccionario de la lengua Española, (Madrid, 1984), p. 627. Trans., Richard Crisson, HPC.

84. E. Chambers, Cyclopedia of Arts and Sciences, (London: 1752).

85. George Ripley and Charles A. Dana, eds., The American Cyclopaedia: A Popular Dictionary of General Knowledge, Vol. VII (New York: D. Appleton and Company, 1874), p. 335.

86. Adolfo de Hostes, Ciudad Murada: Ensayo acerca del proceso de la civilizacion en la ciudad española de San Juan Bautista de Puerto Rico, 1521-1898 (Havana: Editorial Lex, 1948, pl. 170, and Luis M. Díaz Soler, Historia de la Escalivitud Negra en Puerto Rico (1493-1890, Editions of the University of Puerto Rico (Madrid: Imprenta Viuda de Galo Saez, 1952), p. 61.

Both cited by Ricardo T. Reyes, "The Harbor Defenses of San Juan in the Sixteenth Century" (NPS, 1955, revised 1956), San Juan NHS archives, p. 79.

87. Thomas O'Daly, document dated March 15, 1771 (AGI-SD 2503), cited by Torres-Reyes, "Construction History," pp. 70 and 73.

88. [Félix Prósperi, Antonio de Arredondo, and Juan Francisco Fernández de Valdelomar], document dated November 10, 1731 (AGI-SD 2499), cited by Torres-Reyes, "Construction History," pp. 11-12.

89. O'Daly, March 15, 1771, pp. 71-73.

90. O'Daly, February 27, 1771.

91. Thomas O'Daly, documents dated January 30 and June 5, 1775 (AGI-SD 2510-47), October 1, 1776 (AGI-SD 2501-46), and October 7, 1777 (AGI-SD 2510-48), cited by Torres-Reyes, "Construction History," p. 94.

92. The original elements are as follows: the door on the second casemate to the north of the main gate on the Plaza de Armas at el Morro and the following at the Troops' Quarters: the main door, the northernmost shutter on the first floor, and the five southernmost shutters on the second floor.

93. Doors, shutters, and their associated enframements are supposedly made of ausubo, but no reliable documentation was found to substantiate this. Samples were not identified by a tropical wood specialist.

94. A copy of the photograph is in the photo archives of San Juan NHS. The original is in the National Archives. This view was dated ca. 1905 in an 1962 HSR on the Officers' Quarters. It was taken sometime after the flagpole was removed from the Troops' Quarters and sometime before August 1912.

95. Ricardo Torres-Reyes, "San Cristóbal Gates," Historic Structures Report (1964), p. 3.

96. "Maintenance Rehab. of Physical Programs: San Cristóbal Museum Restoration," file no. D24, San Juan NHS archives.

97. Memorandum dated May 8, 1974, to the Superintendent SAJU from "Architect," San Juan NHS archives.

98. Paint samples are located in the HPC, Boston, MA.

99. Ignacio Mascaro, documents dated June 30, 1808 and December 31, 1808 (National Archives), cited by Torres-Reyes, "El Abanico Fort," Historic Structure Report, April 1965, p. 12.

100. Ricardo Torres-Reyes and F. Blair Reeves, "Historic American Buildings Survey, Guard House, Fuerte El Abanico, Castillo de San Cristóbal," 1963.

101. HABS uses the term "outriggers" which is incorrect.

102. Gjessing, "Restoration of the Chapel," p. 6.

103. Mestre, document dated September 13, 1783.

104. It is possible that the name was derived from the Franciscan Order of monks who wore long pointed cowls or hoods, called capuchins; this origin has never been substantiated.

105. Benjamin Nistal-Moret, "The Lighthouse System at Puerto Rico, 1846-1979," National Register of Historic Places Inventory--Nomination Form, 1979, p. 2/47.

106. Ibid., pp. 12/47-13/47.

107. Rutherford J. Gettens and George L. Stout. Painting Materials A Short Encyclopedia (D. Van Nostrand Company, Inc., 1942; reprint ed., New York: Dover Publications, Inc. 1966), p. 94.

108. O'Daly, document dated April 30, 1772, cited by Torres-Reyes, "Construction History," p. 78.

109. Thomas O'Daly, document dated June 30, 1774 (AGI-SD 2510-45), cited by Torres-Reyes, "Construction History," p. 90.

110. Personal communication with Joan Berkowitz, HPC.

IV. CULTURAL LANDSCAPE REPORT:

EL CASTILLO DE SAN FELIPE DEL MORRO

San Juan National Historical Site
San Juan, Puerto Rico

By

Richard C. Crisson
Robert Holzheimer
Marjorie Smith

EL CASTILLO DE SAN FELIPE DEL MORRO

CULTURAL LANDSCAPE REPORT

San Juan National Historical Site
San Juan, Puerto Rico

Superintendent, SAJU	MAY 20 1991 Date recommended
ACTING Regional Director, SERO	5-23-91 Date approved
State Historic Preservation Officer, PR	MAY 17 1991 Date concurred

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INTRODUCTION

The PRSHPO is coordinating the "Inner City Rehabilitation Plan for the San Juan, Puerto Rico Historic Zone." The plan includes the preparation of a CLR for the area facing toward land in front of el Castillo de San Felipe del Morro.[1] This area was open during most of its history, being the original glacis, or the sloped land in front of a fortification that is kept clear of all obstacles so that it could be swept by the fire of the defender. Although some plans call it el Campo del Morro, or "the Esplanade of el Morro,"[2] early twentieth-century documents referred to it as "the parade ground." For this report, it will be called the "Esplanade." The Esplanade is the same area known as Parcel A, discussed further in the scope of the study area.

Purpose of the Report

A Cultural Landscape, according to the NPS Cultural Resources Management Guidelines and Technical Supplement (usually referred to as NPS 28) is defined as follows:

> A geographic area, including both cultural and natural resources, including the wildlife or domestic animals therein, that has been influenced by or reflects human activity or was the background for an event or person significant in human history.

The CLR for SAJU is intended to identify, evaluate, and determine the appropriate recommendations for the development and management of the Esplanade based on an analysis of the historical evolution, significance, and integrity of the landscape. The study also identifies primary views that have been important throughout the history of the site and that merit preservation, as discussed in detail in the Documentary Data and Analysis section. The CLR identifies areas that can accomodate appropriate recreational activities and identifies locations where vegetation may be planted that will not disrupt the identified views of historic importance.

This report includes general recommendations for landscape treatment based on an analysis of the historic evolution of the Esplanade. The conceptual recommendations include improvements that will accommodate public recreation and interpretation, will maintain the integrity of the landscape, and will allow for contemporary design solutions in selected areas of the Esplanade.

Identification and Scope of the Study Area

San Juan National Historic Site (SAJU) is located in San Juan, the capital of Puerto Rico. The Commonwealth of Puerto Rico is a self-governing island in the Caribbean, in permanent union with the United States of America. SAJU comprises the principal fortifications associated with the city, commonly known as Old San Juan. All the fortifications are on the small island, or Islet, of San Juan except for the detached unit on Cabras Island, known as el Cañuelo. The 615-acre Islet of San Juan is connected by bridges and causeways to the metropolitan area of San Juan. Old San Juan's historic district is today an extremely dense urban center, consisting predominantly of mixed commercial and high-density residential areas with little open space.

The focus of the CLR is to study the area referred to as the Esplanade of el Morro, as indicated on fig. 1. The rocky promontory containing the Esplanade lies at the extreme northwest point of the islet of San Juan. It began as a fortified site ca. 1540, when it was referred to by the Spanish as el Morro, meaning the bluff or headland. The geographic advantages of this site may have been apparent even earlier to the native Indian population.[3] The fortified site soon became known as el Castillo de San Felipe del Morro.

The "Esplanade" has been expanded for this report to include all or part of three parcels that are administered by the NPS and the Commonwealth. Parcel A is administered by the NPS, while Parcel B and C are managed by the Commonwealth. A distinction has been made throughout this report in discussing more fully those features within Parcel A, and differentiating them from features outside of the Esplanade in Parcel B and Parcel C. The study area is defined on the northwest by the scarped walls and dry moat of el Morro, on the west by a steep embankment and the defensive walls of Batería de San Fernando; followed by the curving parapet walls of Bastión de Santa Elena; and ending on the south and west by the angular parapet walls of Bastión de San Agustín--a portion of which are today called Casa Rosa and the Casa Rosa scarped wall. The entrance channel to the harbor is directly below the west-facing city walls. Parcel B terminates at the extreme south by the Casa Rosa Gate, near the historic San Juan Gate. The east boundary of the Esplanade is defined west to east by three large masonry structures: el Manicomio, or the Insane Asylum--now the School of Plastic Arts; followed by el Asilo de Beneficencia, or the Welfare Asylum; and el Cuartel de Ballajá, or Ballajá Barracks. These structures are included in Parcel C, administered by the Commonwealth, and are outside of the study area. For this study, the portion of road north of the Ballajá Barracks will be called Norzagaray Street.

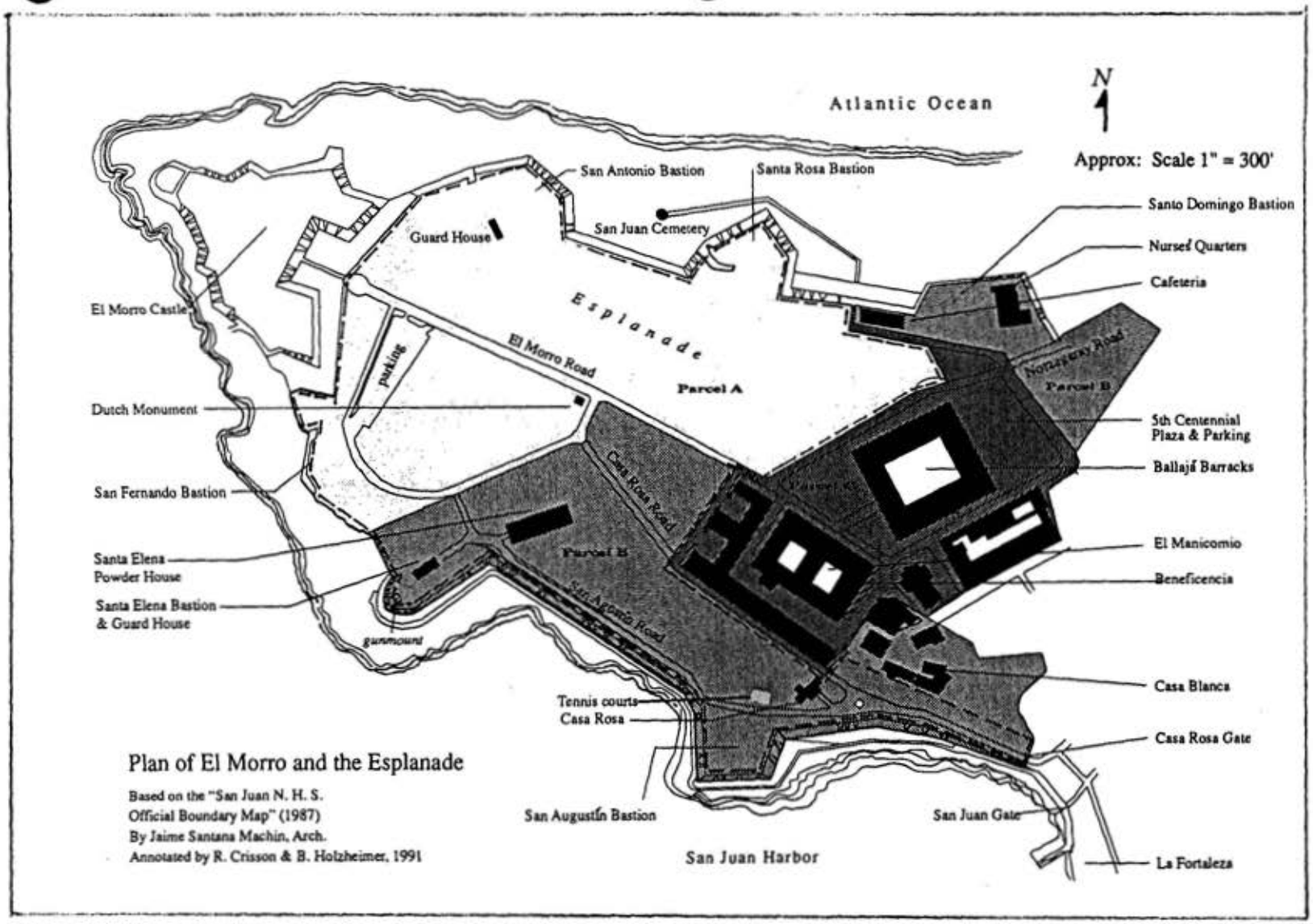


Figure 1. Study area. This site plan indicates the study area for this report and Parcels A, B, and C. The study area is shown within the dashed line and the Parcels are differentiated by varying textures.

The eastern edge of the Esplanade is defined by various elements that are on Parcel B and C: the Fifth Centennial Plaza and Parking Garage (both presently under construction); Bastión de Santo Domingo, containing the Neurological Institute, but often referred to by its former name, the "Nurses' Quarters"; and terminating with another large masonry structure, known by its former name, the "Cafeteria," located between the Road to the Cemetery and the north city wall.[4] The Esplanade is enclosed on the north by the defensive north city wall, defined east to west by the two bastions of Santa Rosa and San Antonio. San Juan Cemetery is directly below this wall, and extends northward to the edge of the shore. The limits of the CLR study area and the parcel locations are shown on fig. 1.

Historical Overview

El Morro and its Esplanade are integral components of the cultural, historical, and architectural ensemble of the San Juan fortifications. The Esplanade and el Morro are often discussed as a whole, because they are components of a military site performing as one defensive unit. The 1982 World Heritage Site nomination described the fortifications as a characteristic example of:

> important architectural and engineering developments... eminently associated with events of exceptional historical importance and significance. Essentially complete and well-preserved they represent the continuum of more than four centuries of architectural, engineering, military, and political history... [They] retain the general appearance of advanced eighteenth-century defense technology, as applied to the topography of a difficult and strategically significant site.[5]

As early as the sixteenth century, Spain recognized that San Juan Harbor was a "safe" shelter from both tropical storms and enemy attacks. The port was utilized as a secure base of naval operations from which shipping entering the Caribbean could be controlled. Consequently, Spain slowly developed the city as a heavily fortified position that by royal decree in 1765 was made a "Defense of the First Order."[6] Spanish occupation lasted until 1898; as a result of the Spanish-American War, Puerto Rico came under the jurisdiction of the United States. Thus, the primary significance of the site is ca. 1540-1898.

According to Volume III of the San Juan HSR, the evolution of el Morro can be divided into five major periods: 1540-1600, 1600-1765, 1765-90, 1790-1898, and 1898-1961. In theory, one would assume that the evolution of the Esplanade paralleled the evolution of el Morro, but in reality, it was significantly different. El Morro evolved through a series of construction

phases, while the Esplanade remained undeveloped through the period between 1540-1898. Today, SAJU and its 75 acres comprise most of the surviving Spanish Colonial fortifications in San Juan. El Morro with its 7 acres and the Esplanade with its 23 acres, remain as the primary attraction within the Park. According to the GMP, in the context of history and prehistory, SAJU represents an example of the subtheme "Spanish Exploration and Settlement." Although in 1984 there were 11 other NPS sites depicting Spanish activity in the United States, only SAJU represented Spanish activity in the Caribbean.

The Esplanade evolved over time, but its function as an open glacis and as a parade or training ground remained unchanged into this century. Although Spanish occupation ended in 1898, the form and character of the Esplanade remained largely unchanged until ca. 1930. While the defensive military significance of the site decreased in the twentieth century, more structured recreational uses began to appear. The height of recreational use within the Esplanade occurred after 1930, when all recreational facilities were in place, e.g., a swimming pool, tennis courts, golf greens, and a baseball diamond. However, limited ceremonial activities may have been conducted later, as evidenced by a ca. 1939-photograph.[7] Aerial photographs, figs. 9-13, document this change. The military era of el Morro ended in 1958 when the last U.S. Army troops left the fort. It was not until 1961, however, that the land contained within the former Fort Brooke Military Reservation was conveyed to the U.S. Department of the Interior.

Methodology

The standards, definitions, and methodologies for research include the execution, organization, and final presentation of the CLR as they are defined in NPS 28. In order to evaluate the site integrity and provide appropriate recommendations, the following methodology was applied.

Research

The first step involved the collection and review of all available and pertinent information regarding the evolution of the Esplanade. The investigation included both documentary research in archives and field survey work. The information generated was organized into historic periods considered important to site use and development. An important part of this effort was to document existing conditions. This investigation considered all relevant NPS documents, the List of Classified Structures, the National Register of Historic Places nomination, and various other public and private

photographs, plans, illustrations, publications, and plant lists. The CLR, supported also by documentary research included in the HSR of el Morro, establishes historic views (vistas) to and from the land side of el Morro across the Esplanade. Research was done to identify principal historic and contemporary views to and from el Morro as they may relate to the Esplanade. Contemporary views are discussed in the Existing Conditions section. Footnotes have been used throughout the HSR and CLR to describe source material and relevant information, and are keyed to the bibliography in Volume I of this Historic Structures report.

Analysis

The second step involved comparing existing conditions with landscape data from the various periods of historic significance to determine what remained from these periods. This step provided the criteria for the development of specific landscape recommendations. Based on the historical research, individual landscape features that collectively defined the overall character of the site were identified. For this study, the individual features were grouped into seven basic components: circulation, structures, land form, vegetation, small-scale features, utilities, and views.

Recommendation

The third step involved the development of a recommended plan that retains the Esplanade's integrity, is consistent with its significance and programmed use, and provides general guidelines for managing the resource.

ADMINISTRATIVE DATA

Statement of Significance

A previous research study stated that "the defenses of San Juan, Puerto Rico, most of which are included in the National Historic Site, are, both individually and collectively, of First Order of Significance."[8] Although el Morro and the defensive city walls are included in the List of Classified Structures, the Esplanade, not being a structure, is not listed separately. El Morro is used for on-site interpretation of the construction and military history of the San Juan fortifications. The same study further stated:

> These fortifications and the old city of San Juan constitute an unsurpassed historical and architectural ensemble that visually documents the exploration, conquest, and defense of Puerto Rico by daring Spanish conquistadores and their successors from the time of Christopher Columbus through the Spanish-American War. Nowhere else in the western hemisphere are there such extensive fortifications possessing such a high degree of integrity.[9]

The significance of the San Juan Fortifications was further distinguished when they were officially accepted to the World Heritage List by the United Nations Educational, Scientific, and Cultural Organization (UNESCO). The World Heritage List identifies cultural and natural properties considered to be of outstanding universal value and worth safeguarding for future generations. La Fortaleza and SAJU qualified for this distinction as outstanding examples of structures that illustrate a significant stage in history, and because of their direct and tangible association with ideas or beliefs of outstanding universal significance. Volumes I, II, and III of the San Juan HSR elaborate further on the significance of the other portions of the San Juan fortifications, including el Morro, San Cristóbal, and the city walls. An evaluation of the above-mentioned statements of significance was not included in the scope of work for this CLR.

There is no specific mention of the Esplanade in the National Register of Historic Places nomination for el Morro, dated 1973. This is not surprising, since landscape resources were generally not recognized until more recently. Nevertheless, the Esplanade is an integral part of the defensive fortifications--the glacis of el Morro.

General Management Plan Synopsis

The following has been excerpted from the General Management Plan and Environmental Assessment for SAJU. Usually referred to as the GMP, this document was approved in September 1985. The following material pertains predominantly to the history and proposed management and treatment of el Morro and the Esplanade. The GMP proposed the following:

> To preserve the historic structures and grounds...to prohibit any arbitrary alteration, restoration, or removal of historic fabric that make up the historic structures and grounds; and to remove all vehicles from the Esplanade and prohibit new parking development within the historic site.[10]

Planning Perspective

Because SAJU is located within the congested urban center of Old San Juan, open space is considered to be of critical importance. Recreational activities were recommended to remain as long as they were compatible with the primary purpose of cultural resource preservation. The future of SAJU is inextricably tied with the future of the city that is contained within the defensive city walls--a relationship defined by the GMP as the "good neighbor policy." The GMP summarized the goal of the overall theme presentation at SAJU: to help visitors understand the nearly 500 years of history represented by the fortifications of San Juan.[11]

Management Zoning

All of the 75 acres within the authorized boundary of SAJU were to be managed as a historic zone. The purpose of management zoning was to indicate where park operations, management functions, visitor uses, and developments were appropriate. Zones were identified based on the authorizing legislation, NPS policies, the nature of the site's resources, the desired visitor experience, and established uses. Subzones provided more specific guidance for management, development, and visitor use. The preservation and adaptive use subzone at SAJU (52 acres) included all of the defensive city walls under the jurisdiction of the NPS, all of San Cristóbal, el Cañuelo, and el Morro (but not the Esplanade). This subzone was designed to preserve, protect, and interpret historic and/or archeological resources and their settings. The unstructured recreation subzone (nearly 23 acres) included the Esplanade. This subzone was designed to preserve historic structures and settings and to allow casual outdoor recreation activities.

Among the acceptable activities allowed on the Esplanade were kite-flying, picnicking, and unstructured softball games.[12]

Preservation Philosophy

The fortifications of San Juan were viewed in the GMP as a historic district that evolved over time. It began with the earliest construction at la Fortaleza (ca. 1533), followed by el Morro (ca. 1540), and extending to 1961 when most of the site was transferred to the jurisdiction of the Department of the Interior. Nevertheless, the GMP emphasized that the significant historic period was the period of Spanish occupation, ca. 1540-1898.

Visitor Support Facilities

The GMP recommended that the existing 40-space parking lot be reduced in size and/or redesigned to provide a "park-and-ride" staging and drop-off area with limited parking. El Morro Road was recommended to be divided into two lanes, with one for pedestrians and the other for limited vehicular use. Curbs and culverts were recommended in order to control erosion and water runoff. The site adjacent to the entrance at Norzagaray Street and north of Ballajá Barracks was recommended to be redesigned.[13]

Plant Life

The Esplanade was described in the GMP as a highly significant part of the historic scene, and one whose expanse was kept clear of vegetation so that an approaching enemy could be easily detected. The GMP described the Esplanade as follows:

> ...the open character of the land is just as much a part of the defense concept as are the walls of el Morro themselves. The Esplanade will be managed as an open space. Nothing will be planted that would intrude on the views of el Morro, and the lawn will be maintained.[14]

Cultural Resources Preservation

Finally, the GMP recommended that a long-term preservation management philosophy be instituted to prevent the arbitrary removal, alteration, or destruction of the historic fabric of this internationally significant historic site.

Administrative History and Summary of Agreements

SAJU was established in 1949 by the Secretary of the Interior, but the site remained under the control of the U.S. Army as part of the Fort Brooke Military Reservation. Although U.S. troops left el Morro in 1958, it was not until 1961 that a major portion of the fortifications were transferred to the Department of the Interior. The remaining portions were declared surplus in 1966, and were transferred by title in 1967 from the Department of the Interior to the Commonwealth. A new cooperative agreement dated 1976 superseded all previous agreements and defined the various areas of jurisdiction and responsibility. Under the 1976 agreement, the Commonwealth retained title to Parcels A, B, and C. Parcel A (the Esplanade) remained within the official boundary of SAJU to be managed and administered by the NPS. Parcels B and C, outside the boundary of SAJU, were to be managed and administered by the Commonwealth "in a manner that will support the purpose for which the historic site was established."[15]

Recommendations for Records Preservation

Records dating from 1519-1991 have been examined and copied whenever possible. During the course of research for both the HSR and the CLR, archives in Spain, Puerto Rico, and the United States and hundreds of sources were consulted by many researchers. All sources and archives have been listed in the the main bibliography, Volume I.

The great length of the historical period and the large number of historic archives in numerous countries makes it likely that additional information exists. As additional relevant information becomes available in the future, it should be reproduced and included in the SAJU Archives. These archives are the obvious choice as the final repository for the material gathered during the research phase. It is presently staffed by a professional librarian/historian, is in the process of being computerized, and is administered by the NPS. Thus, records will be preserved and researchers will have access to the collection.

DOCUMENTARY DATA AND ANALYSIS

The Documentary Data and Analysis section includes a narrative landscape history based on available information including photographs, maps, sketches, books, and other written and/or graphic materials. The study team developed this section of the report by tracing the evolution of the landscape over time from ca. 1540, when the construction of el Morro began, to the present.

The team identified character-defining site elements as follows: circulation, structures, land form, vegetation, small-scale features, utilities, and views. Pertinent site elements served as broad categories under which the documentary data was analyzed and recorded during the research phase of the study.

Although the Task Directive for the CLR directed the study team to focus on the Spanish occupation, the entire history of the site was reviewed. The study team determined that two distinctly different types of landscape character existed at times that generally corresponded to the two periods of Spanish and U.S. occupation. (These two periods have been classified as Period I, ca. 1540-1898, and Period II, ca. 1898-1961.)

The team confirmed that an open and largely undeveloped landscape character existed for the duration of Period I. During this period, vegetation and structures on the Esplanade were kept to a minimum. This was typical of a glacis to ensure clear sightlines for defensive purposes. Circulation and land form remained relatively constant. Comparing the historic appearance of the glacis with the appearance of the Esplanade today confirms that they are similar.

U.S. occupation commenced late in 1898, as a result of the Spanish-American War, and the landscape character of the Esplanade began changing almost immediately. Thus, the defensive character of the Esplanade began to change concurrently with the American occupation. Between 1898 and ca. 1930, at least three Officers' Quarters were built near the fort. Groups of palm trees were planted near the buildings, and a number of small-scale features such as fences, golf greens, and a baseball diamond were installed. From ca. 1930-61, the U.S. Army developed the Esplanade much more intensively. Four additional roads, approximately 20 major buildings, and a number of associated outbuildings were constructed, and numerous trees were planted along the roads. The intensive development activity after ca. 1930 created a congested landscape distinctly different from the open Esplanade of the Spanish occupation.

In summary, the change from Spanish to American occupation led to a change in the military function of the Esplanade, from an open glacis designed for defensive purposes and used for drills, to a residential and recreational support facility. The appearance of the Esplanade that had existed for some 350 years was replaced by one that lasted approximately 60 years.

The following landscape narrative presents a synopsis of the documentary data, organized by the two periods of military occupation and by the pertinent landscape elements identified during the research phase of the study. The last part of this section describes the site as it exists today.

Period I: Spanish Occupation, ca. 1540-1898

This section of the report describes landscape conditions during Period I. Figures 2 and 3 illustrate the various landscape elements during this period. These elements include: circulation, structures, land form, vegetation, small-scale features, utilities, and views. Figure 4 further illustrates the character of the Esplanade during Period I.

Circulation

Access to and circulation within the Esplanade have remained almost unchanged since the site was first developed ca. 1540. A 1625 Dutch map indicates that there were three basic access routes to el Morro at that time.[16] The southernmost route ascended from the harbor, through the San Juan Gate, up to the "spine" of high ground that divides the Esplanade into northern and southern halves, and thence to el Morro. Another route proceeded from the center of the city and followed the "spine" along its entire length, joining the southern route at about the middle of the Esplanade. The third route extended from the northern edge of the city and ran into the other two routes after they had united.

Maps from 1776 (fig. 2) and 1792[17] show not only the three older routes but also a network of paths on the Esplanade. Both maps suggest that the southern route was the major means of accessing el Morro from 1540 to 1860. It would have been used to transport supplies and artillery from the harbor to the fort. This old route is approximated by the present-day Casa Rosa Road and the portion of el Morro Road leading from Casa Rosa Road to the fort.

A map from 1861 (fig. 3) suggests that the route from the center of the city became the more prominent means of accessing el Morro at about this time.[18] The section of the road known as Norzagaray and at the eastern end of the Esplanade was

constructed, and several important buildings--the Ballajá Barracks and el Manicomio (the Insane Asylum) and el Asilo de Beneficencia (the Welfare Asylum)--were constructed at the eastern boundary. Up until the end of Spanish occupation in 1898 the road was called el Camino del Castillo del Morro, or the Road of the Castle of el Morro. Since ca. 1900 it has been commonly called el Morro Road. The earliest photograph found for this report (fig. 4) shows this road ca. 1890. The road was about 25 feet wide, and had a slight crown, a gravel surface, and drainage ditches on either side.

El Camino del Castillo del Morro was realigned at the very end of the Spanish-occupation period. The need arose to construct a hospital, which became known as the Yellow Fever Hospital. An 1897 plan prepared by José Laguna for such a hospital complex showed two proposed locations for the hospital: one that required a slight realignment of el Morro Road and one that did not.[19] The plan of 1899 indicates that the Spanish built the hospital on the first site and did realign the road.[20] This alignment remains today.

The original purpose of the old northern route is unclear. It resembled a road on the 1625 map, and did in fact connect the city with el Morro. However, its out-of-the-way location suggests that it was not a major route to the fort. It later gained in importance. After San Cristóbal was built, the northern route was extended to form a link between it and el Morro. In the late eighteenth century it provided access to defensive bastions built along the north shore. After the north bastions became obsolete due to improvements in artillery during the nineteenth century, the segment of the path connecting to the main route to the fort disappeared (see fig. 3).

Similar paths serving the west bastions are not on the 1625 map, but they do appear on those from 1776-92. The 1861 map suggests that these were coalescing into a road that would later become today's San Agustín Road.

The 1861 map indicates that other present-day streets were developing at that time, as well. The map shows the newly constructed Ballajá Barracks at the east end of el Camino del Castillo del Morro (el Morro Road), and a street along its north side that corresponds to the present-day extension of Norzagaray Street. This street seems to have been created to address a problem caused by the construction of the barracks and the Welfare Asylum (ca. 1841) farther west. The barracks' location would have constricted the flow of traffic along el Morro Road to the city. Therefore, the new street was built to skirt the congested area. The entrance gate may have been built at the east end of the extension of Norzagary Street at this time.[21]



Figure 2. 1776 Map, San Juan, Juan de Villalonga, under the direction of Thomas O'Daly, Museo Naval, XXII-A-9, Madrid. Reproduced in Anibal Sepúlveda Rivera, San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898.

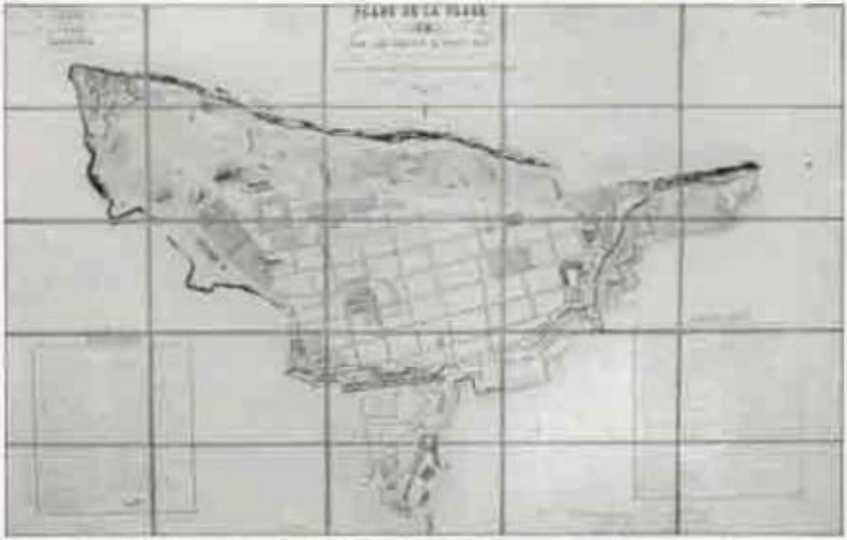


Figure 3. 1841 Map, Plano de la Plaza de San Juan Bautista de Puerto Rico. Rafael Clavijo y Plá, 1841, S.G.E. Cart. X (CAT. 46). Reproduced in Aníbal Sepúlveda Rivera, San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898.

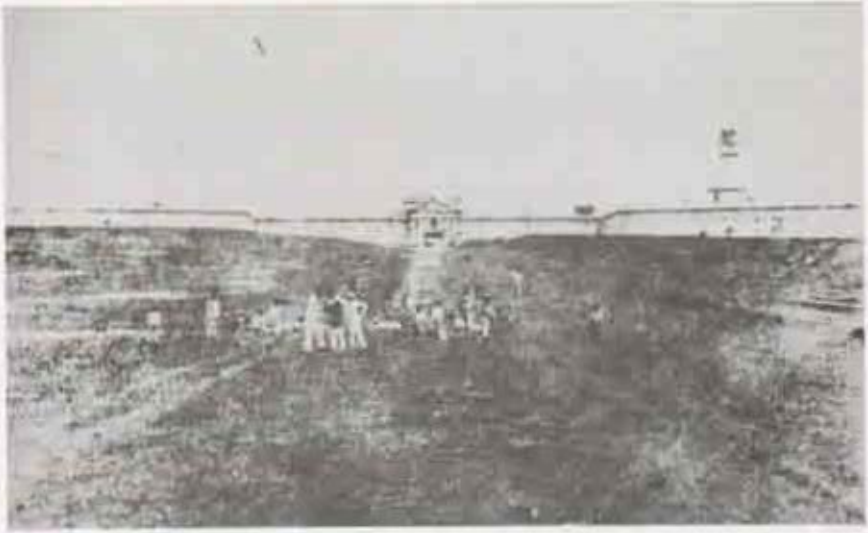


Figure 4. The Esplanade: ca. 1890. This view of the fort from el Morro Road illustrates the open character of the Esplanade, its landform and the road treatment. SHPO Archives, San Juan, PR.

The 1861 map also shows the newly constructed el Manicomio (Insane Asylum). It is logical that a street would have been built along the asylum's northwest wall, in the location of present-day Manicomio Road. However, such a street does not appear on this map. It does seem to appear on a map from 1899, after the construction of the Yellow Fever Hospital.[22]

Structures

During the period 1540-1898, a number of buildings were built on the Esplanade. Most of the major structures survive, including the guardhouses of Santa Elena, San Antonio, and San Agustín (this guardhouse is now called Casa Rosa); and el Polvorín de Santa Elena, or the Santa Elena Powder Magazine, usually referred to as the Powder Magazine.

The earliest structure in the area of the Esplanade, other than el Morro, appears to have been a small chapel located northeast of the present-day el Morro Road. It appeared as a round symbol on an early Dutch map, where it was identified as the "Little White Chapel."[23] The structure was also known as la Capilla del Calvario, or the Chapel of Calvary. An account of 1511 described the construction of the chapel as follows:

> The first act executed by the Spanish upon coming ashore was to give thanks to God and celebrate a mass given by Father Santo Domingo de Guzmán, who [ordered to be] constructed a decent altar in the intermediate site of the field of el Morro to preserve [the memory of] such a religious and Christian act; a small chapel with the name of Calvary [was constructed] there.[24]

This structure was later shown on 1678, 1750, and 1766 maps.[25] The chapel was demolished between 1774-82; more recent documents reported that its rubble was used for the construction of the hospital known as la Concepción (the Immaculate Conception).[26]

Among the number of small structures that appeared on or near the Esplanade, and were subsequently removed, was one located ca. 1765 at the extreme southeast quadrant of the Esplanade--near the present Norzagaray Street.[27] The O'Daly map of 1772 indicated a military barracks and a stable on the area that later became the site of the Welfare Asylum.[28] These building were no longer shown by 1783.[29] The Santa Elena Powder Magazine was built ca. 1787, immediately east of the Santa Elena Bastion and below the crest of the Esplanade.[30] By 1861, both the Santa Elena and the San Agustín Guardhouse (today called the Casa Rosa) were in existence.[31] In 1887, a small cluster of structures of unknown use were located near the present site of the tennis courts.[32] These same structures

appear on a map of 1897.[33] The San Antonio Guardhouse, near the battery of the same name and immediately east of the moat of el Morro, appeared first on the same 1897 drawing.

Toward the end of the century the need arose to construct a Yellow Fever Hospital. The same 1897 plan showed two proposed locations for the hospital: one that required a slight realignment of the main road and one that did not.[34] A map of 1899 indicates that the Spanish built the hospital on the first site and did in fact realign the road.[35]

Land Form

The Esplanade is located on the east end of the Islet of San Juan. The eastern end of this open plain, at the San Juan Gate, is near sea level. However, the Esplanade slopes upward toward the west, reaching an elevation of about 35 feet above mean sea level at the fort of el Morro. In addition, the plain is divided into northern and southern halves by a "spine" of high ground that runs east-west the entire length of the Esplanade.

The importance of the topography of the site was recognized by Field Marshal Alexander O'Reilly ca. 1765.[36] In a partial description of the Esplanade, he noted that the fort sat at a higher elevation than the Santo Domingo Convent, located at the eastern end of the Esplanade near the Santo Domingo Bastion.

O'Reilly went on to state that the terrain at the center of the Esplanade was uneven, but would not be too difficult to improve for defensive purposes. He observed that the composition of the Esplanade was 3-4 feet of sand over hard clay. He noted the existence of a hill called la Altura del Calvario (the Calvary Hill) in the vicinity of the present-day Ballajá Barracks. (The location of this hill was shown on several early sketch maps.) O'Reilly also noted the presence of a ravine, which began just east of the hill and opened toward the Atlantic Ocean. He described the ravine as being 660 feet long, 120-180 feet wide, and 10-18 feet deep. He proposed to lower Calvary Hill in order to improve the defensive capabilities of el Morro, and stated that the ravine's proximity to the hill was advantageous.[37] The advantages appear to have been two-fold: the earth taken from the hill could be dumped into the ravine, and the ravine itself would be made level ground.

It would appear that this work took place. There is no hill today, and all that is left of the ravine is a depression. However, the dates of the work are unclear. The northern, seaward end of the ravine was probably filled in by 1792 when construction of the city wall was finished in this area.[38]

This work was most likely part of the improvements noted by Thomas O'Daly in 1775. He stated that 448 workers were then busy at the fortification of el Morro and San Cristóbal, including masons working the various quarries in or near San Juan. Among these was a quarry at "el Calvario," on the Esplanade of el Morro.[39]

One would assume that it was Calvary Hill that was being "quarried," or taken down for filling the ravine. However, nineteenth-century references use the term "quarry" to refer to both the hill and the ravine. For example, a site plan of 1857 labeled this area as the "Ravine of Ballajá Quarry."[40] It is thus difficult to determine when Calvary Hill disappeared completely; nineteenth-century references to the "quarry" may mean the ravine, which has persisted in modified form to the present day.

A map of 1861 indicates that the southern end of the ravine may have been filled in by this date.[41] The same map suggests that the ravine was partially filled in by that date to form the extension of Norzagaray Street.[42] However, this has not been documented in other references. An 1896 observation refered to "an ancient quarry, now depleted, known as Calvary, filled with trash by the inhabitants...."[43] Additional fill for the ravine could have been obtained from the rubble caused by the naval bombardment in 1898. Photographs from that year show piles of debris north of the Ballajá Barracks.[44]

Between 1873 and 1887, then, the present configuration of the Esplanade was established. The condition of the relatively smooth-surfaced Esplanade was shown in a ca.-1890 photograph (fig. 4). The 1898 bombardment left numerous holes in the Esplanade, however. "The dark hillside was dotted with the geyser-like earth clouds of exploding shells, most of them rising around el Morro and the barracks."[45] In 1899, work was approved to regrade and fill in the holes on the Esplanade.[46]

Vegetation

The open character of the Esplanade remained relatively unchanged throughout Period I. Planting was limited to grasses and/or groundcover and was maintained as an open field for military defensive purposes.

Puerto Rico and the Islet of San Juan fall into a subtropical latitude. The Esplanade area was most likely cleared of vegetation when el Morro was first begun ca. 1540. Rodrigo de Figueroa in 1519 described the site of San Juan as being wooded.[47] However, maps did not indicate vegetation on the Esplanade throughout most of the first period. In 1598,

an account by Reverend Layfield appeared to indicate that the rest of the Puerto Rico was wooded. Reverend Layfield stated:

> ...within and surrounding the town, there are large numbers of coconut palms, in addition to the large fruit, these provide a poetic and wonderful aspect to the scenery.... The hills are crowded with fruit trees; lemons, limes and oranges are ordinarily found where no man has sown them.[48]

The lack of vegetation on the Esplanade was also confirmed by a Dutch map of 1625 showing the Esplanade barren of trees, while other areas of the islet were heavily vegetated.[49] The lack of vegetation was also apparent in the previously cited sketch map by A. Vingboons of the same year.[50] The sketch map of el Morro and San Cristóbal by Luis Venegas Ossorio in 1678 did not show trees on the Esplanade, but did indicate vegetation in other outlying areas of the city.[51] By 1797, French naturalist Andrée Pierre Ledrú reported that vegetation was limited on the entire islet. He explained that "it was necessary to travel three miles from the city to find habitat in which to gather specimens."[52] An 1821 sketch of the Esplanade by another French naturalist, Auguste Plée, illustrated one single palm tree growing near the moat and sallyport of el Morro.[53] Figure 4 shows the Esplanade still barren of trees ca. 1890.[54]

Small-Scale Features

One small-scale feature exists today that dates back to the 1540-1898 period--the Dutch Monument. The monument commemorates the Dutch siege of 1625, and first appeared clearly on a map of 1861.[55] Other small-scale features throughout this first period are described below.

The Dutch maps of ca. 1625 indicated features that were labeled "our positions."[56] The specific nature of these structures is unclear, since they could have been temporary trenches or stockade fences constructed as part of the siege of el Morro by the Dutch troops.

Another small-scale feature whose specific extent is unclear was a counter-mining gallery (tunnel) constructed during the late eighteenth century. The entrance to this gallery is extant today in the outer wall of the moat (the counter scarp), near the eastern corner of the moat. This gallery is similar to ones found at San Cristóbal. However, the distance to which it extended eastward into the glacis is unknown. An underground counter-mining gallery system was supposedly part of the military defenses of the fort. Nothing like this is

documented in any historic plan. However, Angel Rivero Mendez in 1922 stated that prior to 1898:

> The entire glacis of el Morro was permanently countermined with principal branchlines, that allowed for a person to walk upright, and other lateral [lines] that ended in mining blast holes, and allowed travel on the knees.... A large part of the subterranean [tunnels] were blocked two years before the [1898] War, during the installation of the Ordoñez rifles. It was very dangerous to travel along these tunnels, not only due to the excessive humidity, but to the thousands of guabas, horrible-looking spiders, which inhabited the tunnels.[57]

A large sewer or dry well was cited in the Archeological Assessment of 1989 as having existed at the east end of the Esplanade, near Norzagaray Street. However, this feature was not documented by other historic sources. The same Archeological Assessment stated that a burial site dating to an 1823 smallpox epidemic was located in the area of the present-day Manicomio Road and the Welfare Asylum.[58] No other documentary sources have confirmed the existence of the cemetery.

Utilities

No sources of water existed on the Esplanade or within the Islet, according to an 1598 account by the Reverend Layfield, who said:

> On this Islet there are no rivers or springs.... The houses have cisterns, sometimes two, but there is always water since it frequently rains.[59]

A "large well" was shown on the 1625 Dutch sketch maps in the vicinity of today's San Antonio Bastion, a north-facing bastion just east of el Morro.[60] This may have been a cistern, since no wells were noted in any other documentary source.

Two below-grade drain pipes in the west bastion walls, near Santa Elena and San Agustín Bastions, provided limited site drainage. Other drains located in the north bastion wall, near the bastions of San Antonio, Santa Rosa, and Santo Domingo, also provided similar site drainage. Most of these drains remain but their condition is unknown. They were probably constructed during the completion of the defensive city walls in 1765-92.[61]

Views

The primary historic view from the fort was an almost 360-degree field of vision. This broad view was possible because of the site's strategic location, topography, limited development, lack of trees, and the scale of the fort. Remarkably, similar views exist today and are illustrated in the Existing Conditions section.

The views across the Esplanade were largely unobstructed throughout Period I, as illustrated in fig. 4. The San Antonio Bastion, Casa Rosa, the Insane Asylum, Ballajá Barracks, and Santo Domingo Bastion were all clearly visible from el Morro. During the early part of Period I (ca. 1540-1780), views from the fort also would have included Calvary Hill, the adjacent ravine, and the road to the San Juan Gate. Juan de Villalonga's plan of 1776 (fig. 2), documented in plan the features discussed above. The open views were maintained during the quarrying of the hill and the filling of the ravine, and they persisted up to the end of Period I.

Period II: U.S. Occupation, ca. 1898-1961

This section of the report describes the landscape conditions during Period II. It includes illustrations that indicate the locations of the character-defining elements (figs. 5-7): circulation, structures, land form, vegetation, small-scale features, utilities, and views. Figures 8-10 further illustrate the character of the Esplanade during Period II.

Circulation

El Morro Road continued to be the main route into the fort after American occupation of the site began. The American bombardment during the Spanish-American War caused much damage to the Esplanade, including the road. In 1899, it was reported that the section of el Morro Road from the Dutch Monument to the fort was in especially poor condition.[62] A project was devised to realign the ditches flanking el Morro Road and to use dirt and gravel taken from them to build up a crown on the road, in order to improve drainage. Photographs taken ca. 1905 show that this work was done.[63] Figure 5 also shows the turnaround that was built near the sallyport of el Morro and the diagonal path that led north from the intersection of el Morro and Manicomio Roads to the Esplanade. These features remain today.



Figure 8. The Esplanade: ca. 1905. This view of el Morro from the east shows three Officers' Quarters, masonry wall of the Yellow Fever Hospital, and the Dutch Monument. The open character of the Esplanade, areas denuded of grass due to intensive use, projectiles along road, early utilities and road treatment are illustrated. Captain Ralph E. Gambell Collection, SAJU Archives, San Juan, PR.



Figure 6. South view of Esplanade, 1931. Aerial view showing areas denuded of grass, soldiers marching in drill formations, the baseball diamond, 9-hole golf course, three Officers' Quarters and Yellow Fever Hospital. Vegetation is very limited with a few trees clustered near the Quarters and Casa Rosa. SAJU Archives, San Juan, PR.

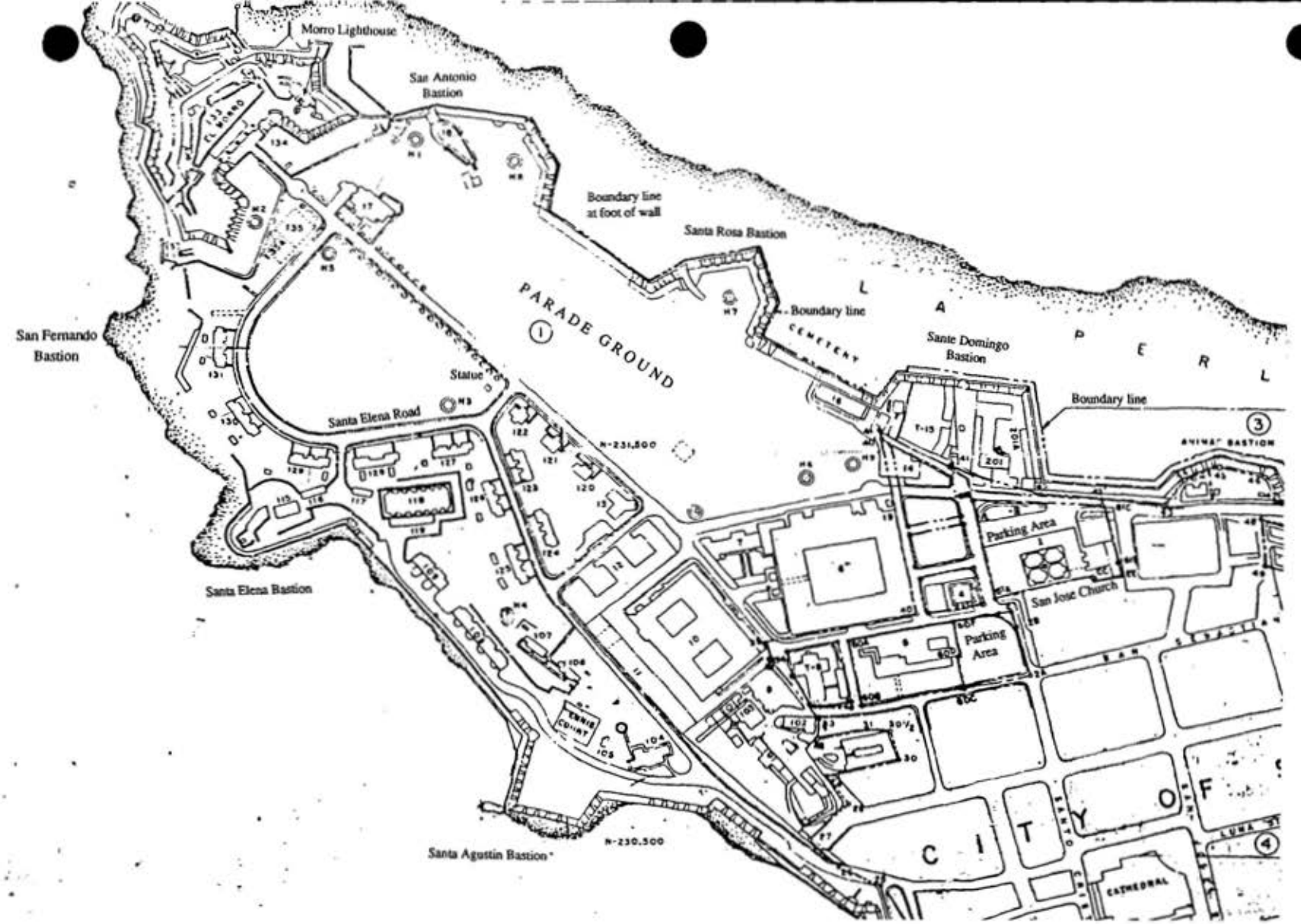


Figure 7. Map of ca. 1960, el Morro and surroundings. Based on 1886 survey showing U.S. Army development, ca. 1930-1961. Sheet 1 of 1, SAJU 0550. SAJU Archives.



Figure 8. East view of Esplanade, 1911. Aerial view showing the open character of the site, the condition of the Esplanade, city in background, and the three Officers' Quarters and the Yellow Fever Hospital in the foreground. Projectiles and utility poles are seen along the paved el Morro road. HAER Archives, San Juan, PR.



Figure 9. East view ca. 1937. Aerial view from el Morro towards the city shows mature trees lining the roads, in Parcel B, and along the north city wall. The Officers' Mess and military housing south of el Morro Road can be seen. The Esplanade appears well maintained. SAJU Archives, San Juan, PR.



Figure 10. East view, ca. 1867. Aerial view of el Morro showing sally port, Officers' Mess, San Antonio guardhouse, swimming pool and golf greens. Mature palm trees are clustered near the pool and the Officers' Mess. The Esplanade appears well maintained. HAJU Archives, San Juan, PR.

Between 1910-11, the entire length of el Morro Road--a distance of 1,110 feet--was paved with asphalt. This was the first time any portion of the road had been paved. The adjacent walkway was constructed with a three-inch concrete base and was top-dressed with a 1-inch layer of concrete. A gutter extended for the same distance. The concrete walk was 5 feet wide and 1,649 feet long. A concrete curb was installed for the entire length. On the south side of the walk, a curb extended for an additional 690 feet.[64]

In 1930-31, several major changes were made to the circulation pattern on the Esplanade. El Morro Road remained as the main access route to the fort. However, two new paved roads were constructed on the southwest side of el Morro Road. One of these followed the track of the old southern route from the harbor. It was called the Casa Rosa Road. The other road, the Santa Elena Road, was an entirely new road that formed a loop southwest off el Morro Road.[65] The roadwork included 2,020 feet of bituminous macadam road, 3,971 lineal feet of a combination curb and gutter, and 16,000 square feet of concrete walks.[66] The work probably included the reconstruction of Manicomio Road, as well. Both the Santa Elena, Manicomio, and the Casa Rosa Roads retain their original, ca. 1930-31 configuration today.

A 1934 U.S. Army map indicates that the old paths serving the south bastions had by that time developed into a single road called the Bay Road. It extended from Casa Rosa Road north to the Santa Elena Powder Magazine.[67] Between 1938-39, 800 feet of this road was resurfaced with macadam and asphalt road to create a thoroughfare 20 feet wide. This work included some terracing and backfilling in the area between the San Agustín and Santa Elena Bastions.[68] (See "Land Form," below.) Today this road is known as the San Agustín Road, but it still retains its 1939-40 configuration.

No parking lots were indicated on maps during most of Period II. The 40-car, asphalt-paved visitor parking area was developed after Period II.

Structures

The U.S. Army inherited from the Spanish a number of buildings both on and around the Esplanade. Military buildings included the Santa Elena Powder Magazine, the Yellow Fever Hospital, the Insane Asylum, Ballajá Barracks, and three guardhouses. Residential structures lined the eastern edge of the Esplanade north of the Ballajá Barracks. In addition to the Spanish buildings, the U.S. Army constructed approximately 20 more buildings and a swimming pool during Period II.

In 1901 three Officers' Quarters were built near the entrance to el Morro: two on the south side of el Morro Road and one on the north side of the road.[69] The one on the north side appears to have been the home of the fort's Commanding Officer. A one-story wood frame building probably built by the U. S. Army appears in a 1913 photograph in front of and approximately centered on the north side of the Ballajá Barracks.[70] The same photograph shows the nineteenth-century residential structures in that same area. Figure 6 confirms the existence in 1923 of the various guardhouses, the Yellow Fever Hospital, the Ballajá Barracks and adjacent residential buildings, the Powder Magazine, and the Officers' Quarters of 1901.

Substantial construction development was conducted by the U.S. Army on and around the Esplanade between 1923 and 1934. The majority of new development took place in 1930-31 on the southwest side of el Morro Road, where military housing was built along Casa Rosa and Santa Elena Roads. Redevelopment occurred at the east end of and northeast of el Morro Road. The Yellow Fever Hospital was removed and replaced with three Officers' Quarters and a Post Headquarters. The nineteenth-century residential structures north of the Ballajá Barracks were demolished to make room for the construction of the Nurse's Quarters before 1934 and the Cafeteria and Post Exchange (PX) after 1934. (The Nurses' Quarters is called the "Bachelor Officers Quarters" on the 1934 map; today it houses the Neurological Institute). The two 1901 Quarters buildings on the south side of el Morro Road near the fort were razed. The third 1901 structure near the fort--the Commanding Officer's quarters, on the north side of the road--was rebuilt or replaced by a three-story Officers' Open Mess (see figs. 9-10). A swimming pool was built north of the Open Mess, and the nearby San Antonio Guardhouse was rehabilitated as a pool house with a patio. (See "Small-Scale Features," below.)

The post-1930 structures significantly obstructed the views between el Morro and the Esplanade. All but two of them were later removed; the swimming pool was filled in by 1971.[71] The two surviving structures were the Cafeteria and the Nurse's Quarters. They still exist today, being in Parcel B in the vicinity of the Santo Domingo Bastion.

Land Form

Land-form changes during Period II included regrading associated with the U.S. Army construction development. Among this work was the terracing of the original shoreline slope just west of the Bay Road (later San Agustín Road) between the San Agustín and Santa Elena bastions, in what is now Parcel B.

The backfilling work was required by the reconstruction of the west city wall in that area.[72]

Figure 6, taken in 1923, shows a depression southwest of el Morro Road, encircled by the present-day Santa Elena Road. The depression appears to be about 300 feet in diameter, with a circular path around its edge and intersecting perpendicular paths or lines. The function of this area is unknown.

Vegetation

A ca.-1905 photograph shows a single immature palm tree growing near the Commanding Officer's Quarters.[73] Several 1923 photographs show a few mature palm trees adjacent to the three Officers' Quarters located near the fort (see figs. 6 and 8). Clearly, the Esplanade remained barren of trees during the early years of Period II.

Early twentieth-century photographs show coarse grasses growing on areas other than those that received heavy use, such as the parade ground area southeast of el Morro and north of el Morro Road. From the fences and domestic animals shown in ca.-1905 photographs, it may be assumed that the Esplanade's grasses and groundcover were maintained by grazing animals.[74] Other documentary sources did not provide information regarding the types of grasses/groundcover that existed on the Esplanade, nor of the landscape management practices followed during this period.

Trees planted around 1930 appear to be 6-8 feet tall in 1934. Australian pines (Casuarina equisetifolia) and palm trees (Cocos nucífera) lined el Morro Road, the Casa Rosa Road, and the Santa Elena Road.[75] Groups of palm trees were also planted near the swimming pool, along the north city walls, and along the west edge of the Esplanade near San Fernando Bastion (fig. 10). These trees were as effective as buildings in diminishing the visibility across the Esplanade and the views to and from el Morro.

A comparison of 1923 and 1957 aerial photographs reveals that by 1957 the Esplanade was not being used as a parade ground (see fig. 6, 8-10). In the 1923 photograph, the Esplanade had areas subjected to intensive use and thus almost bare of grass. The installation of the nine-hole golf course necessitated the planting of new types of grasses, such as the one commonly known as "Bermuda" grass. This fine-blade grass has a tendency to spread easily and is today prevalent throughout the Esplanade. The aerial views of 1957 show that the Esplanade had improved in appearance and appeared as a well-maintained lawn.

The paving of the Bay Road (San Agustín Road) in 1939 included terracing and sodding near the Casa Rosa (San Agustín Guardhouse). After Period II, a garden was also planted near this area, in Parcel B. No plans are available to indicate the specific details of the garden design or its installation. The garden and the sodded area were damaged as a result of Hurricane Hugo in 1989, but evidence remains of the garden and the recreation elements.

Small-Scale Features

The small-scale features remaining from Period II are the garden remnants in the area of the Casa Rosa, discussed above. The Dutch Monument from Period I also survived, but was modified by the addition of a square masonry base.

Military documents from 1900 state that "there was suitable open space between el Morro and the Ballajá Barracks for a drill ground."[76] Another reference to "military training facilities" constructed on the Esplanade was cited in the Archeological Assessment.[77] Limited information exists regarding military features located on the north side of the Esplanade between the Santa Rosa and the Santo Domingo Bastions. Archeological remains of military features may exist in this area, according to the same archeological report.

Wood post fences topped by a single flat board criss-crossed the Esplanade ca. 1905 (fig. 5). The fences appear to have been painted white; they were used to define areas immediately adjacent to living quarters, and to form paddocks for the grazing animals. In addition, a solid masonry wall almost 7 feet high enclosed the Yellow Fever Hospital, with gates on the west and north sides. A low metal fence surrounded the Dutch Monument. Figure 6 indicates that the paddock fencing and the fence around the monument were removed by 1923. The absence of a paddock fence probably indicates that domesticated animals were no longer kept on the Esplanade.

A masonry wall of unknown date connected the San Antonio Guardhouse and the bastion. The wall was nearly 8 feet high; it was constructed in stepped sections and had a centrally located entry gate. The earliest photograph that shows the wall dates to ca. 1913.[78]

Figures 6 and 8 show that by 1923, a baseball diamond and dugouts and a nine-hole golf course had been installed at the eastern end of the Esplanade.

By 1930-31, a swimming pool was built adjacent to the San Antonio Bastion, utilizing a ramp that led to the "old powder house." A new wall was built to the north and east to enclose

the pool area. The pool was elevated and steps led from the pool house to the pool.[79] The pool was filled in by 1971, and the guardhouse was converted to public restrooms.[80]

Figure 5 indicates that by ca. 1905 the north side of el Morro Road was lined with eighteenth- and nineteenth-century artillery projectiles, mainly mortar bombs, painted white. Figures 6 and 8 show them in 1923. They had no obvious functional use and were apparently installed for ornamental purposes. They were removed after Period II, ca. 1982.

A U. S. Army plan of 1938-39 indicated the destruction of the "San Cristóbal Tunnel".[81] The entrance to the tunnel was located in the counter-scarped east wall of the moat. The purpose and construction date of this tunnel was previously described in the Introduction/Summary section, under Small-Scale Features. The entrance to the tunnel remains, but the condition of the rest of the tunnel has not been verified.

Utilities

Plumbing and sewer systems were first installed during the spring of 1899.[82] The area north of el Morro Road was regraded, and obstructions in the sewer line were removed to alleviate the drainage problem.[83] A square feature is shown with dotted lines in the same area, on the ca.-1960 plan (fig. 7). This may have been associated with site drainage. However, field investigation has not verified its function, present condition, or even its existence. The ca.-1960 plan also shows the existence of a cistern in the area south of el Morro Road, near the sallyport. The construction date of the cistern is unknown. The ca.-1960 plan is the first to show it, but cisterns at el Morro generally date to Period I. The cistern survives today, but its condition was not verified.

During the summer of 1901, electrical wires and light fixtures attached directly to wooden utility poles were installed by San Juan Light and Transit Company to provide service to the three Officers' Quarters, including the Commanding Officer's Quarters, and to service the fort. The installation also included three arc lights for el Morro Road.[84] Other ca.-1905 photographs in the Gambell Collection indicate that electrical power extended from the Commanding Officer's Quarters to the northeast side of the Esplanade.

Additional landscaping work at el Morro was undertaken between 1930-31, including the removal of masonry walls and the paving of roads.[85] At the same time a new water system was laid within the grounds of el Morro, including 6,754 feet of iron pipe and vitreous clay sewer, five manholes, and four "Kennedy" fire hydrants. A new electrical system was also

laid, with a primary cable buried two feet deep. The underground cable made a complete loop of the area. Twenty-four street lights were installed on the southwestern side of el Morro road, and the standards were equipped with 1,000-lumen lamps. The system had two "subway-type transformer manholes."[86]

Gas service was provided to the Esplanade prior to 1939.[87] The utility lines are shown in current plans and may still remain.[88]

Views

During Period II, the views previously associated with the Esplanade became obstructed as buildings were constructed, and as trees were planted and matured. The northern half of the Esplanade remained relatively open and was visible from the fort. From el Morro, one could see across the northern half of the Esplanade toward the Ballajá Barracks and toward Santo Domingo Bastion. However, the views of el Morro Road, el Manicomio Road, Casa Rosa Road, and to the Santa Elena and San Agustín Bastions were largely obstructed by the two-story concrete buildings constructed by the U.S. Army and by the mature trees lining these roads. In summary, by 1957, views between the south half of the Esplanade and the fort were substantially obscured (see fig. 9).

Existing Conditions

This section includes a narrative that describes the locations of landscape elements. These elements include circulation, structures, land form, vegetation, small-scale site features, utilities, and views. Figures 11-13 and 15-17 illustrate the present character and primary views associated with the Esplanade. Figure 14 indicates the locations of the three primary views and should be referenced for all elements discussed below.

Circulation

Site circulation within the Esplanade today includes six roads: el Morro, Santa Elena, Casa Rosa, San Agustín, Manicomio, and the extension of Norzagaray. The main visitor-access route to the fort is el Morro Road, which is paved and has concrete sidewalks along its southern edge. The other five are paved secondary-access routes. The small dead-end path leading diagonally north from el Morro Road is paved for approximately 100 feet but remains unnamed. Although the path survives from Period I, it was paved during the twentieth century.



Figure 11. West view, 1996. Aerial view towards el Morro showing paved road system, corner parking lot, parallel parking, and the Dutch Monument. TRRRPO, San Juan, PR.



Figure 12. East view, 1989. Aerial view from el Morro toward the city showing the paved road system, 40-car parking lot, parallel parking, the Dutch Monument, tennis courts, the chain-link fence, and the play area in Parcel 8, PRHTPO, San Juan, PR.



Figure 11. North view of Parcel B, 1989. Aerial view of Parcel B shows the Casa Rosa, the tennis courts, and the play area, the San Agustin Road and Bastion. The condition of Parcel B trees was indicative of damage caused by Hurricane Hugo, September 1989. PRHPO, San Juan, PR.

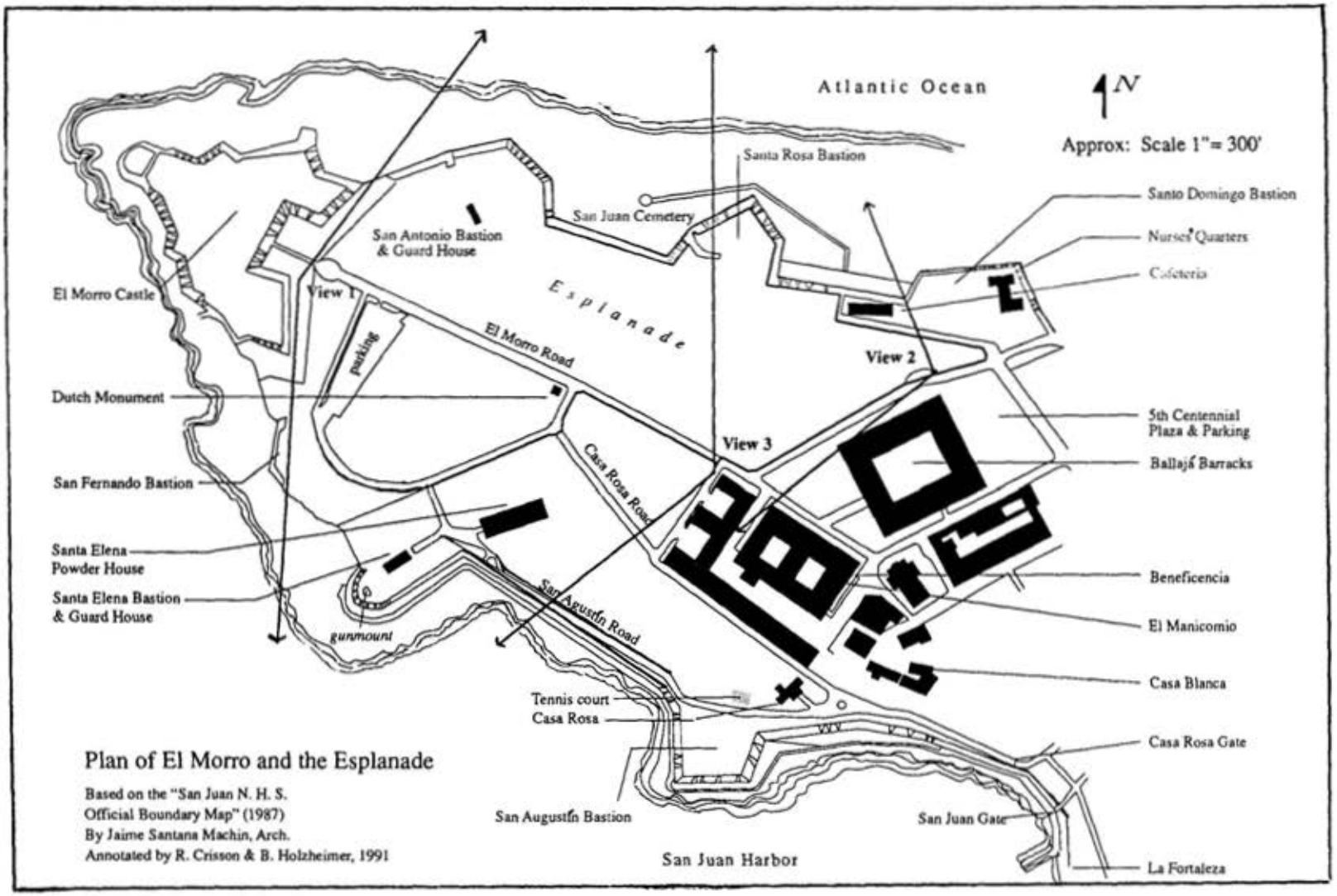


Figure 14. Existing Conditions. Site plan indicates locations of existing buildings, roads, vegetation, and primary views. The primary views (Views 1, 2, and 3) are keyed to composite photographs depicted in Figures 15, 16, and 17.



Figure 15. Composite photograph, East View, 1991 (View 1). Vista from el Morro showing parking lot, parallel parking along the roads, trees in Parcel B, and the general open character of the site. Photography by Richard C. Crisson.



Figure 18. Composite photograph, West View, 1991 (View 2). Vista from Ballajá Barracks shows el Morro, Dutch Monument, parallel parking along roads and sloped area in front of Ballajá Barracks. View is limited to the south by el Manicomio (School of Plastic Arts). Photography by Richard C. Crisson.



Figure 17. Composite photograph, West View, 1991 (View 3). Vista from intersection of Manicomio and el Morro Roads shows el Morro, Dutch Monument, parking, and Powder Magazine area. Photography by Richard C. Crisson.

A 40-car, triangular-shaped, paved parking lot is located near the fort off el Morro and Santa Elena Roads. Some visitors and park staff use this parking area. Some visitors also parallel-park along the existing roads. Parking also occurs on the unpaved area surrounding the Santa Elena Guardhouse. This temporary parking has denuded areas of lawn, and may be causing soil erosion and long-term damage to the Santa Elena Bastion and its guardhouse.

Structures

The structures located on the Esplanade today are the Santa Elena Powder Magazine, the San Antonio Guardhouse, the Santa Elena Guardhouse, and the Casa Rosa (formerly the Guardhouse of San Agustín). The former Cafeteria and Nurses' Quarters, located on the east end of the Esplanade, remain as well. The two Parcel B structures are administered by the Commonwealth. Parcel C, also administered by the Commonwealth, contains the structures that line the southeastern edge of the Esplanade: the Ballajá Barracks, the Welfare Hospital, and the Insane Asylum.

Land Form

The Esplanade features two significant topographical features. One is the slope up to the fort--an increase in elevation of approximately 35 feet. The other is the "spine" of higher ground that bisects the Esplanade into northern and southern halves. El Morro Road runs along this crest. Both of these topographical features have remained relatively unchanged from earliest times. There is also a significant depression near the Ballajá Barracks that remains from the deep ravine originally found in this area. Despite these features, the surface of the Esplanade appears as a relatively smooth slope. Of some concern is the erosion potential of the steep embankment at the west edge of the Esplanade, near San Fernando Bastion.[89] Outside the scope of the CLR, the long-term solution to this problem is being managed by SAJU, assisted by the U.S. Army Corps of Engineers.

Vegetation

The Esplanade is mostly an open field with a grassy lawn. Sea grapes (Coccoloba uvífera) grow near the edges of the cliff that faces west. Coconut palms (Cocos nucífera), white cedar (Tabebuia heterophylla), royal palm, (Roystonea borinqueña), and mango (Mangifera índica) are among the trees located at the eastern end of Parcel B.[90]

Small-Scale Features

A number of small-scale features exist today. The grassy areas that once comprised the golf greens are readily apparent. A children's play area, tennis courts, steps, ramps, low walls, and remnants of the garden areas are located east of the Powder Magazine in Parcel B. The Commonwealth helicopter pad is also located in Parcel B, southeast of the Powder Magazine. A chain-link fence runs north from the Santa Elena Bastion and the San Fernando Bastion to the moat of el Morro. Partially concealed by the vegetation on the west bank, the fence prevents visitors from falling down the cliff.

Utilities

Existing utilities are identified on the draft 1990 topographical plan.[91] Potable water is supplied to the fort by a supply line that parallels el Morro Road. Other underground utilities--including telephone and electric service and sewer and storm drains--run the length of el Morro Road. Newer sewer lines run south from the fort through the parking area, along San Agustín Road, toward the San Agustín Bastion, to the Santa Rosa Gate. Newer underground sewer and storm drains are also located along Manicomio Road. Storm drainage of the Powder Magazine area is provided via old drains located within the wall of Santa Elena Bastion. Old storm drains are also located in the north-facing bastions of San Antonio, Santa Rosa, and Santo Domingo, but their condition is unknown.

Light fixtures are located near the tennis courts and along the Casa Rosa and San Agustín Roads, within Parcel B. An above-ground electric utility pole sits along Manicomio Road.

Gas distribution lines run underground to the fort and to the area east of the Powder Magazine. Most of these lines date back to U.S. Army occupancy. A ca.-1989 map indicating improvements to the gas distribution system at el Morro[92] shows a system very similar to that seen in an earlier plan.[93]

Views

The sightlines at el Morro are now similar to those that would have existed during Period I. Today, one has a 360-degree view from the fort. No trees or structures obscure views from the fort to the Ballajá Barracks, the Insane Asylum, or the San Antonio, Santa Rosa, and Santo Domingo Bastions. The only development within view of el Morro that would not have been visible during Period I is the 40-car parking area and the Santa Elena, Casa Rosa, and San Agustín Roads. Therefore, contemporary photographs can give a good idea of the

views and the open character of the Esplanade during the Spanish period of occupation, Period I. Several such contemporary photographs are included here: they are figs. 11-13 and 15-17.

Figure 11 is an aerial view looking towards el Morro from the entrance to the Esplanade. This photograph shows el Morro Road, the sloped area in the foreground, and the fort in the background. The Dutch Monument, the 40-car parking lot, and the Powder Magazine are included in this view. Figure 12 is an aerial view looking east showing the parking lot, and the roads and trees in Parcel B. The defensive walls on the north side of the Esplanade and the Ballajá Barracks on the south clearly limit this view of the Esplanade. Figure 13 is an aerial view looking towards Parcel B, showing the pattern of vegetation near the Casa Rosa and illustrating the open character of the Esplanade.

Figure 14 shows the locations from which the composite photographs, figs. 15-17, were taken. The composite photographs illustrate the primary site views. Figure 15 shows the view from the fort looking east toward the city. Figure 16 shows the view from Ballajá Barracks looking west to the fort. Figure 17 shows the view from the intersection of Manicomio and el Morro Roads looking west towards the fort.

Evaluation of Significance and Integrity

This section includes a discussion of the significance and integrity of the site, based on the evolution of the landscape's appearance and a comparison with existing conditions.

Period of Significance

The significance of the San Juan Fortifications was recognized internationally in 1984, when they were designated by UNESCO as a World Heritage Site. This determination of significance will not be reevaluated as part of this report. As stated previously, Volume I of the HSR elaborates on the significance of other portions of the fortifications, including el Morro, San Cristóbal, and the city walls.

National Register Bulletin 18 states that the period of significance of a property is defined as the time period in which the property achieved the qualities that made it eligible for the National Register. Although the San Juan Fortifications were militarily important from ca. 1540 to 1961, they had gained the qualities that made them nationally and internationally significant during the era of Spanish

occupation--Period I, ca. 1540-1898. During Period I, the Esplanade was developed and maintained as an integral part of the military fortifications of el Morro and San Juan. The Esplanade played a critical role in defensive military actions, and was also used as a training ground during these years. Thus, Period I is considered the period of primary significance.

Period II, corresponding to the U.S. Army occupation from 1898 to 1961, is considered to be of secondary significance. The Esplanade's significant historic landscape qualities had already been established by 1898. Also, Period II saw the U.S. Army effect a major change in function for the Esplanade: the area was developed for military-support activities, almost entirely in the area of housing and associated recreation. This was a major departure from the Esplanade's original use during the primary period of significance.

Two distinct landscape character types emerged as a result of the analysis of the cultural landscape. The two types of landscape character reflect the two periods of Spanish and U.S. Army occupation. During Period I the Esplanade was open and undeveloped. It remained as an open, relatively gentle slope that provided unobstructed views from the fort to the city. The views at this time would have included a 360-degree field of vision. Throughout Period I, the Esplanade remained largely devoid of substantial structures and trees.

Esplanade development was also limited during the first 30 years of Period II. However, from about 1930 to 1961 the U.S. Army constructed roads and buildings and planted trees. This substantial development created a landscape distinctly different from the open character of Period I, and resulted in views more constricted than the historical views associated with Period I.

Determination of Integrity

In general, the characteristic features of Period I establish the integrity of the landscape. Some of these features have remained from Period I, while others have been regained after being lost during Period II. Much of the site today appears as it did at the end of Period I. The removal of Calvary Hill and the filling of the adjacent ravine were significant later alterations to the ca.-1540 land form, but both actions occurred well within the historic period. The development that took place during Period II has been largely removed through the cumulative efforts of the U. S. Army, the NPS, and the Commonwealth. All that remains from Period II are the Santa Elena Road and part of the Casa Rosa Road, and the improvements to el Morro and San Agustín Roads. The pressure

of urban encroachment has also been resisted. The parking lot is the only recent intrusion on the historic scene. Thus, the site has remained as a prominent point with commanding views of the city, San Juan Harbor, and the Atlantic Ocean.

The removal of Period-II buildings, utilities, vegetation, and small-scale features (except for the Santa Elena and Casa Rosa Roads) has significantly diminished the integrity of Period II.

An analysis of the Esplanade's appearance and function reveals that the site displays a high degree of integrity. Although the function of the views, structures, and land form has changed from a military use to a public park use, this has not affected the general appearance of these character-defining elements associated with Period I. Originally, the broad, unobstructed views and the long gentle slope of the glacis were essential to the defense of San Juan. Today the views and the existing land form are used for interpretive and passive recreational purposes. The Powder Magazine and the Santa Elena, Casa Rosa, and San Antonio Guardhouses--used for military purposes during Period I--are now used either for academic purposes or to meet other public needs.

With the exception of the removal of the Yellow Fever Hospital, the circulation system, and the appearance of the vegetation and small-scale features and structures, have remained substantially unchanged from Period I. The primary historic routes survive; they still provide access to el Morro from the San Juan Gate and from the city. El Morro Road in particular retains a high degree of integrity in terms of location and function, although it has been raised, realigned, widened, and resurfaced. Vegetation on the Esplanade has changed slightly due to planting different grass species and more recent management policies designed to meet present recreational needs.

Individual character-defining elements were evaluated in terms of the integrity of the "historic location, design, setting, materials, workmanship, feeling, and association."[94] When considered in aggregate, the Esplanade retains a high of degree of integrity. The historic location and general design of el Morro and related fortifications, the extant historic buildings, the Dutch Monument, and the circulation system have not substantially changed from Period I. El Morro Road remains as a direct link between the city and the fort; San Agustín Road remains as a link between San Juan Gate and the fort; and Norzagaray Street remains as a link between the northern part of the city and the fort. The Dutch Monument is the oldest small-scale feature remaining on the Esplanade. The monument appears to have been in its present location for several hundred years, although the base was altered, a plaque was

added, and a fence that once surrounded the monument was removed. These changes are relatively minor and do not diminish the integrity of the monument.

The setting and open feeling of the Esplanade once associated with its Spanish military character are experienced by visitors today. El Morro is still the dominant feature of the Esplanade, presiding above a long sloping area that descends from its moat towards the city. The historic views once important to the defense of the fort can still be seen. The overall open appearance and vegetation have not changed dramatically, although the species of grass/groundcover and the maintenance practices on the Esplanade today are different from those employed during Period I. Because trees were not a part of the Esplanade during Period I, the lack of trees on the Esplanade today reinforces the original setting and feeling. The Esplanade's boundary has remained fairly intact, and encroachments by adjacent properties on the Esplanade have not violated its original design. Historic building materials remain largely intact, and the exteriors of buildings are relatively unaltered from their original appearance.

Most of the small-scale features found on the site today, other than the Dutch Monument, are of little importance. Located in Parcel B, they were associated with now-removed structures built by the U.S. Army, and are not visible from the Esplanade. Their removal or rehabilitation would therefore not diminish the integrity of the Esplanade.

Although historic underground drainage pipes may remain in some sections of the Esplanade, little is known about their condition or their integrity. Because of the lack of information regarding utilities and other subsurface elements, an archeological study should be made to determine their location and condition.

Rehabilitation to Period I (ca. 1540-1898)

This section of the report describes the recommended course of action: rehabilitation to Period I.

In this plan, el Morro Road would be retained and used as the main pedestrian access to the fort. The present alignment and approximate width of the road would be retained, while the sidewalk, gutters, and curbs would be removed. Handicapped-accessible shuttle buses would provide access to el Morro for visitors who are disinclined or unable to walk. The route would be along el Morro Road, which would be divided into two lanes--one for pedestrian use and the other for limited vehicular use. The road also would be resurfaced with a material more typical of materials used in Period I.[95] The turnaround in front of the sallyport would be retained. The Dutch Monument would be retained at its present location, surrounded by lawn. The twentieth-century "Bermuda" grass, predominating in the original location of the golf greens, would be replaced with a more typical grass/groundcover.[96]

Picnicking would be encouraged in the lower half of Parcel B by maintaining the existing shade trees that are in appropriate locations and in healthy condition. Additional shade trees indigenous to Puerto Rico could be planted in appropriate locations a predetermined distance away from historic buildings and city walls. Stressed trees would be removed. Development in this area would have limited impact on the primary views to and from el Morro due to the difference in topography and the distance to the fort.

The upper half of Parcel B, and the Esplanade, would be managed as an open space. The lawn would be maintained in the manner recommended in a vegetation maintenance management plan. No trees would be planted in the area between the Powder Magazine and the fort. The embankment facing west along San Fernando Bastion would be managed to allow vegetation that would prevent soil erosion but not grow high enough to obstruct historic views of the channel and harbor of San Juan. The chain-link fence in this area would be replaced with some other unobtrusive barrier that would still ensure visitor safety. Another area where vegetation could be introduced with limited impact on the open view to the fort would be the sloped area near Norzagaray Street and north of Ballajá Barracks. Such vegetation could include low-growing trees, understory plantings (shrubbery), and groundcover.[97]

Two former U.S. Army buildings remain at the east end of the Esplanade--in Parcel B, north of Norzagaray Street and the new

Fifth-Centennial Plaza and parking garage. These buildings, formerly known as the Cafeteria and the Nurse's Quarters, do not block the view from the Esplanade to el Morro. However, they do hinder the historic view north, and could be removed to provide unobstructed views from the Fifth-Centennial Plaza to el Morro.

Santa Elena Road and the western end of Casa Rosa Road would be removed, because they did not exist prior to 1898 and would no longer have a major function. The present visitor parking lot would also be removed. A small parking area for NPS administrative purposes would be relocated to the small section of Santa Elena Road where it intersects San Agustín Road, between Santa Elena Guardhouse and the Powder Magazine.[98] San Agustín Road itself, even though in Parcel B, could be stripped of its modern paving and resurfaced with a historically appropriate material.

Wayside exhibits could be located at various sites within the Esplanade. For example, a wayside at the Dutch Monument would enhance the visitor's understanding of the Dutch seige of San Juan. Another wayside at the site of the Yellow Fever Hospital would also be appropriate. The signs would be designed to be as unobtrusive as possible and would direct visitors appropriately.[99]

Research indicates that the Esplanade may contain numerous archeological resources. No action that would prevent later data recovery should be undertaken. Landfilling should be fully documented, and appropriate means should be employed to differentiate between existing materials and new fill material. According with existing management policies, development on the Esplanade would require coordination between the PRSHPO and the NPS to ensure the preservation of archeological resources.

Justification for Rehabilitation to Period I

The NPS goal for the Esplanade is neither to strictly preserve nor to recreate any already-disrupted historic scene, but to maintain the individual landscape components that form the historic character of the area and to provide for compatible uses. The plan to rehabilitate the landscape to its Period-I appearance provides the greatest opportunity to meet this goal, in terms of both preservation and interpretation of the site.

The main advantage of the recommended plan is that it returns the Esplanade to an appearance characteristic of most of its 450-year military history. The plan promotes the primary historic views associated with the Esplanade. (Only one major building involved with those views has disappeared,

the Yellow Fever Hospital, and that was built very late in the Spanish period.) It also allows the significant historic period--the Spanish era--to be the primary focus of interpretation.

Adequate separation of pedestrians and vehicles would be provided. The recommended plan removes vehicles from the vicinity of el Morro but still maintains visitor access and administrative parking. The plan provides for visitor amenities, such as shade trees and picnic facilities, while keeping the open character of the Esplanade and encouraging compatible uses. Historic buildings and fortifications would be preserved. As a result, interpretation of the Esplanade will be enhanced.

The recommended plan would result in the removal of portions of roads that have been on the site for a relatively short time. It is recognized that rehabilitating el Morro Road and San Agustín Road, and removing Santa Elena Road and the western end of Casa Rosa Road, would affect cultural resources from Period II. These roads are the only visible landscape elements that remain from Period II; the buildings, trees, recreational facilities, and street furniture have since been removed. These roads have been retained for functional purposes and to provide access to the fort and to Parcel B. Once site circulation is improved, portions of these roads would no longer be required for functional purposes. Their removal would enhance the open character, maintain the historic views, and provide visitors with a greater understanding of the site's historic appearance.

Some funding would be required to rehabilitate el Morro Road and remove the portions of the Period-II roads. Improvements within Parcel B and C would also require capital and additional long-term maintenance funding.

Other Alternatives Considered

Two options for the site other than rehabilitating it to its Period-I appearance were considered. These options were to rehabilitate the site to its Period-II appearance, and to take no action at all. Both of these alternatives are described and evaluated below.

Period-II Rehabilitation

Rehabilitation to Period II would focus on the period subsequent to 1898. Key aspects of this option would include the following:

- Parking along el Morro Road would be eliminated and handicapped-accessible shuttle bus service provided. The shuttle bus route would start near the new underground parking garage at the Fifth Centennial Plaza and proceed along el Morro and Casa Rosa Road to Santa Elena and terminate in a new administrative parking area. This route would provide for two-way traffic, with pull-off areas.

- Pedestrians would use both el Morro Road and its sidewalk. Projectiles that once lined the road, or facsimilies, would be reinstalled.

- Wayside exhibits would be developed at strategic locations to enhance the visitor's understanding of the Period-II military use of the Esplanade and its appearance.

- Vegetation similar to that which existed in Period II would be reintroduced to the extent possible. Parcel B would not strictly reflect its appearance during Period II, since this area would be developed for recreational uses, primarily picnicking.

- The military residences and other buildings would probably not be reconstructed. Although the appearance and location of the structures is known, NPS policy strongly discourages the reconstruction of historic structures.[100] However, the "footprints" of former buildings could be outlined on the ground to indicate the size and location of previous development. This is complicated by the fact that at least one Period-II building was redeveloped on the site of an earlier Period-II structure (the 1901 Commanding Officer's Quarters); it is unclear which time period within the U.S. Army occupation would be featured. The two extant U.S. Army buildings east of the Esplanade--the former Nurse's Quarters and the Cafeteria--would be retained.

No Action

The no-action option would retain the site in its present form with open views across the Esplanade. Key aspects of this option are as follows:

- Pedestrians and vehicles would continue to use el Morro Road as the main access to the fort, with the 40-car parking lot being retained at the entrance to the fort. Trees would not be replaced, all existing small-scale features would be retained, and current uses would continue in the Esplanade.

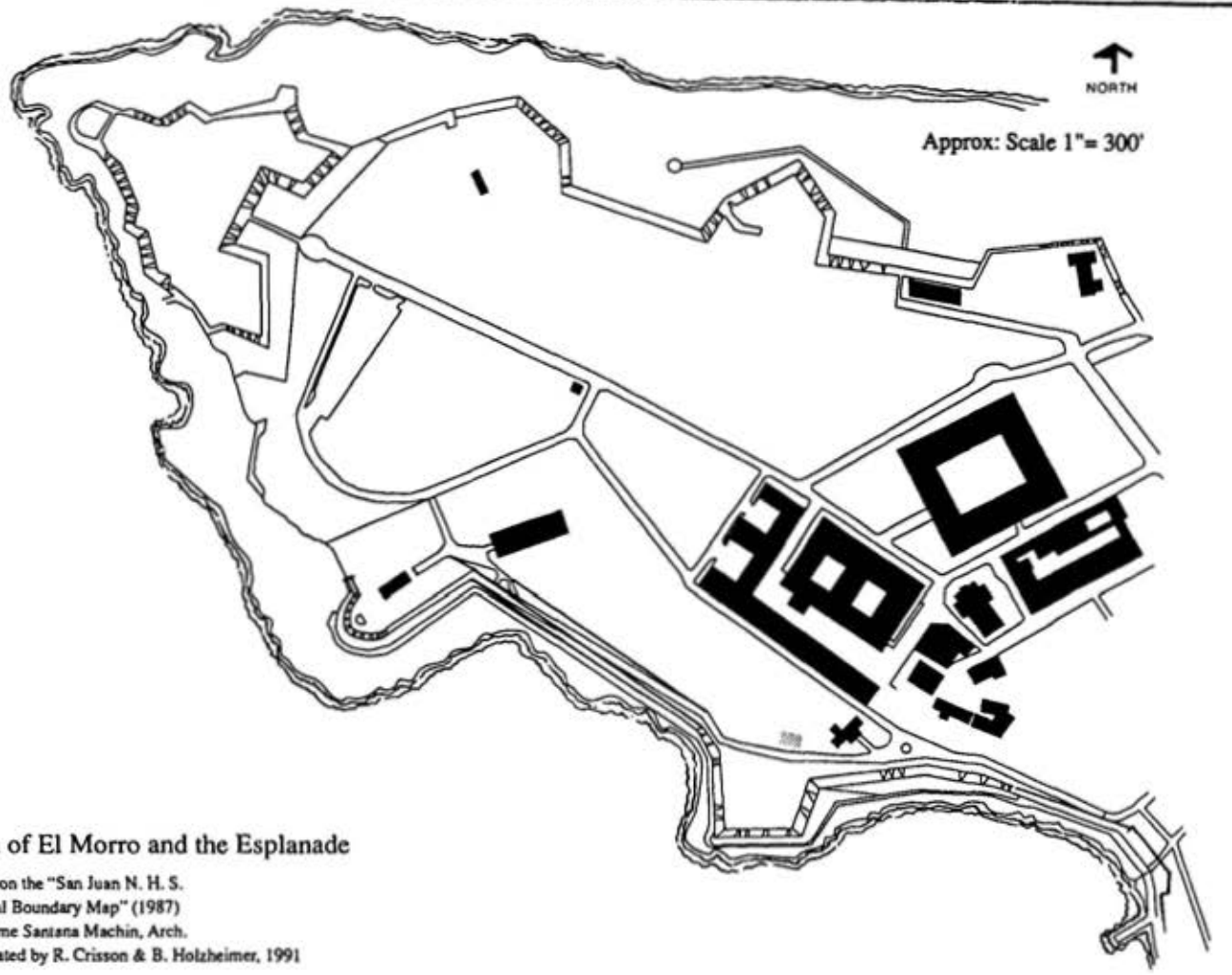
Evaluation of Other Alternatives

The Period-II Rehabilitation option was rejected mainly because its primary focus of interpretation would not be the Spanish period of occupation. The importance of the significant historic period would be diminished; the primary historic views would be obstructed by vegetation. Also, most of the major structures on the Esplanade associated with Period II are gone and probably would not be reconstructed. (Not only is reconstruction contrary to NPS policy, but it would also be prohibitively expensive.) Thus, a Period-II rehabilitation would not provide a satisfactory interpretive experience for park visitors.

The no-action option was also rejected. Like the Period-II option, it would not feature the Spanish period of occupation as the primary period of interpretation, such that the importance of the significant historic period would be diminished. This option would be the least costly to implement. However, it would not enhance the interpretation of the site, nor clarify the issues of management, development, and interpretation of the Esplanade. This option is thus inconsistent with NPS preservation policies.

APPENDIX A.

National Park Service: Official Boundary Map
San Juan National Historic Site
Composite of Partial Set
1987, edited in 1991



Plan of El Morro and the Esplanade

Based on the "San Juan N. H. S.
Official Boundary Map" (1987)
By Jaime Santana Machin, Arch.
Annotated by R. Crisson & B. Holzheimer, 1991

Composite. 4. 6. 1 National Park Service: Official Boundary Map. San Juan National Historic Site. Composite of Partial Set. 1987, edited in 1991

APPENDIX B.

Plants of the San Juan National Historic Site, El Morro
Puerto Rico Department of Natural Resources, 1983

PLANTS OF THE SAN JUAN NATIONAL HISTORICAL SITE, EL MORRO*

Manuel de Llano and Julio Cardona
P.R. Department of Natural Resources: Programa Pro-Patrimonio Natural
May of 1983

Scientific/Common Name	Origin	Habit	Distribution
Adiantum capillus-veneris	pantropical	herbaceous	walls
Albizia lebbeck (Amor platónico)	exotic	tree	road-edge
Alysicarpus vaginalis (Yerba de contrabando)	native	creeper	lawn
Amaranthus dubius (Bledo)	native	herbaceous	lawn
Andropogon annulatus (Pajón)	exotic	weed	lawn
Andropogon pertusus (Huracán)	exotic	weed	lawn
Antigonum leptosus (Coral)	exotic	vine	fence
Araucaria heterophylla (Araucaria)	exotic	tree	road-edge
Bidens pilosa (Romerillo)	native	herbaceous	lawn
Boerhavia diffusa (Tostón)	pantropical	herbaceous	lawn
Borreria verticillata (Botón blanco)	neotropical	herbaceous	lawn
Bouteloua americana (Yerba mesquite)	native	weed	lawn
Calophyllum brasiliense (María)	native	tree	road-edge
Calotropis procera (Bomba)	exotic	shrub	lawn
Capraria biflora (Té del país)	native	creeper	sedim. dune
Casuarina equisetifolia (Pino australiano)	exotic	tree	road-edge
Cassia siamea (Casia de Siam)	exotic	tree	road-edge
Cenchrus brownii (Abrojito)	native	weed	lawn
Centrosema pubescens (Flor de pito)	native	vine	fence
Chamaesyce glomerifera (Yerba niña)	native	herbaceous	lawn
Chamaesyce hirta (Lechecillo)	native	herbaceous	lawn
Chamaesyce mesenbryanthemifolia	native	herbaceous	lawn
Chamaesyce prostrata (Lechecillo)	native	herbaceous	lawn
Chloris inflata (Paraguita)	pantropical	weed	lawn
Chloris petreae (Yerba de deo)	native	weed	lawn
Chrysalidocarpus lutescens (Palma de areca)	exotic	tree	lawn
Cissus sicyoides (Bejuco de caro)	native	vine	lawn
Clusia rosea (Cupey)	native	tree	brushland
Coccoloba uvífera (Uva de mar)	native	tree	brushland
Cocos nucífera (Palma de coco)	exotic	tree	brushland
Codaium variegatum (Croton de jardín)	exotic	shrub	garden
Commelina diffusa (Cohitre azul)	pantropical	herbaceous	wetland
Cynodon dactylon (Pepe Ortiz)	native	weed	lawn

Cyperus brevifolious	pantropical	rush	lawn
Cyperus planifolious	native	rush	lawn
Cyperus rotundus (Coquí)	pantropical	rush	lawn
Cyperus spacelathus	pantropical	rush	lawn
Dactylotecnium aegyptium (Yerba egipcia)	exotic	weed	lawn
Delonix regia (Flamboyán)	exotic	tree	road-edge
Desmodium canum (Zarzabacoa común)	pantropical	herbaceous	lawn
Desmodium triflorum (Zarzabacoa de tres flores)	pantropical	herbaceous	lawn
Digitaria decumbens (Pangola)	exotic	weed	lawn
Diodia rígida	native	herbaceous	lawn
Dracaena fragans (Dracena)	exotic	tree	road-edge
Echinochloa colona (Arrocillo)	native	weed	wetland
Eriochloa punctata	native	weed	wetland
Eleusine índica (Pata de Gallina)	exotic	weed	lawn
Emilia fosbergii (Yerba socialista)	exotic	herbaceous	lawn
Euphorbia heterophylla (Pasqueta)	native	herbaceous	lawn
Ficus elástica (Arbol de goma)	exotic	herbaceous	road-edge
Ficus índica (Arbol de goma)	exotic	tree	road-edge
Fimbristylis dichotoma (Junquito)	exotic	rush	lawn
Galactia striata	native	herbaceous	lawn
Gardenia jasminoides (Gardenia)	exotic	shrub	garden
Gomphrena globosa (Siempreviva)	exotic	herbaceous	lawn
Heliotropium curassavicum (Cotoviera de playa)	native	herbaceous	sedim. dune
Hibiscus rosa-sinensis (Amapola)	exotic	shrub	fences
Hymenocallis declinata (Lirio de mar)	native	herb. shrub	brushland
Ipomoea pes-caprae (Bejuco de playa)	native	creeper	brushland
Ixora coccinea (Cruz de malta)	exotic	shrub	garden
Kallstroemia máxima (Abrojo)	native	herbaceous	lawn
Lagerstroemia speciosa (Reina de las flores)	exotic	tree	road-edge
Malvastrum coromandelianum (Malvavisco)	native	herbaceous	lawn
Mangifera índica (Mangó)	exotic	tree	garden
Merremia aegyptia	pantropical	vine	fence
Mimosa púdica (Moriviví)	native	herbaceous	lawn
Mormodica charantia (Cundeamor)	native	vine	fence
Muntingia calabura (Capulín)	exotic	tree	road-edge
Murraya paniculata (Café de la India)	exotic	shrub	road-edge
Oldenlandia corymbosa	native	herbaceous	lawn
Opuntia dillenii (Tuna brava)	native	shrub	brushland
Panicum adspersum (Millito)	native	weed	lawn
Panicum máximum (Yerba guinea)	exotic	weed	brushland
Panicum reptans (Alpiste cimarrón)	pantropical	weed	lawn

Panicum conjugatum (Horquetilla)	native	weed	lawn
Paspalum laxum (Matojo de arena)	native	weed	brushland
Peltophorum pterocarpum (Flamboyán amarillo)	exotic	tree	road-edge
Phyla nodiflora (Cidrón)	native	herbaceous	wetland
Phyllanthus amarus	native	herbaceous	lawn
Pilea microphylla (Madreperla)	native	herbaceous	lawn
Pityrogramma calomelanos (Helechito blanco)	native	herbaceous	wall
Plumeria alba (Alhelí)	native	tree	brushland
Plumeria rubra (Alhelí rojo)	exotic	tree	garden
Polyscias guilfoylei (Gallego)	exotic	shrub	garden
Portulaca oleracea (Verdolaga)	exotic	herbaceous	lawn
Pterocarpus índicus (Terocarpo)	exotic	tree	garden
Rhynchelitrum repens (Yerba rosada)	exotic	weed	brushland
Ruellia tuberosa	native	herbaceous	lawn
Sansevieria hyacinthoides (Lengua de vaca)	native	herbaceous	brushland
Setaria geniculata (Deshollinador)	native	weed	lawn
Setaria rariflora	native	weed	lawn
Sida acuta (Escobita dulce)	native	herbaceous	lawn
Spathodea campanulata (Tulipán africano)	exotic	tree	garden
Sporobolus índicus (Cerrillo)	neotropical	tree	lawn
Stachytarpheta jamaicensis (Bretónica)	native	herbaceous	lawn
Stenotaphrum secundatum (Grama)	native	herbaceous	lawn
Sterculia apetala (Anacaguita)	native	tree	garden
Stigmaphyllon periplocifolium (Bejuco de San Pedro)	native	vine	brushland
Swietenia macrophylla (Caoba) hondureña)	exotic	tree	garden
Swietenia mahagoni (Caoba)	exotic	tree	garden
Tabebuia heterophylla (Roble blanco)	native	tree	brushland
Tephrosia cinerea (Anil de cenizo)	native	herbaceous	lawn
Terminalia catappa (Almendro)	exotic	tree	road-edge
Tridax procumbens (Pancha)	pantropical	herbaceous	lawn
Tribulus cistoides (Yerba de araña)	pantropical	herbaceous	lawn
Veitchia merrilii	exotic	shrub	garden
Vigna luteola (Frijol silvestre)	native	vine	lawn
Vigna unguiculata (Frijol)	exotic	vine	lawn
Wedelia trilobata (Manzanilla)	native	herbaceous	lawn
Zoisia matrella (Yerba de Manila)	exotic	weed	lawn

* This list has been translated and edited for this report by R. Crisson.

APPENDIX C.

Trees Native to P. R.
Apparently Adapted to Vicinity of el Morro
Institute of Tropical Forestry, 1989

TREES NATIVE TO PUERTO RICO APPARENTLY ADAPTED TO VICINITY OF EL MORRO*

Frank H. Wadsworth
Institute of Tropical Forestry, Rio Piedras, PR
November 2, 1989

Scientific Name	Common Name	Growth
1. Bucida buceras	Ucar (Oxhorn bucida)	Large
2. Hymenea courbaril	Algarrobo (W.I. locust)	Large
3. Manilkara bidentata	Ausubo (Bulletwood)	Large
4. Ficus americana	Jaguey (Wildfig)	Large
5. Ceiba pentandra	Ceiba (Silk-cotton tree)	Large
6. Calophyllum calaba	María (Santa-María)	Small
7. Tabebuia heterophylla	Roble blanco (White cedar)	Small
8. Bursera simaruba	Almácigo (Gumbo-limbo)	Small
9. Roystonea borinqueña	Palma Real (Royal Palm)	Small
10. Acrocomia media	Palma Corozo (PR acrocomia)	Small
11. Anacardium occidentale	Pajuil (Cashew)	Small
12. Crescentia cujete	Higuero (Calabash)	Small
13. Coccoloba uvífera	Uva de playa (Sea grape)	Small
14. Guiaicum officinale	Guayacáan (Lignumvitae)	Small
15. Chrysobalanus icaco	-------- (Cocoplum)	Small

Notes:
a) Nos. 5, 8, 10, and 12 require wind protection.
b) Nos. 13, 14, and 15 are shrubby.
c) Nos. 1, 6, 9, 10, 12, 13, 14, and 15 are in nursery inventories.

* This list has been simplified and edited for this report by R. Crisson.

APPENDIX E.

Glossary

Cultural Landscape: A geographic area, including both cultural and natural resources, including the wildlife or domestic animals therein, that has been influenced by or reflects human activity or was the background for an event or person significant in human history.

Cultural Resources: Those tangible and intangible aspects of cultural systems, both past and present, that are valued by or representative of a given culture, or that contain information about a culture. Tangible cultural resources include, but are not limited to sites, structures, districts, objects, and historic documents associated with or representative of peoples, cultures, and human activities and events, either in the present or in the past. Tangibles also include: plants, animals, and other natural resources culturally defined as food, manufacturing, and ceremonial items--naturally occurring or designated physical features.

Glacis: Long gentle slope beyond the moat kept clear of all obstacles for defensive purposes.

Historic Designed Landscape: A landscape where form, layout and/or designer, rather than significant event or persons, are the primary reason for its preservation, although both may be relevant.

Historic Site: A site where an event or an activity has imbued a particular piece of ground with significance warranting preservation of the historic appearance of the landscape, i.e., battlefieldds, landing sites, and historic routes.

Historic Structure: A constructed work, either historic or prehistoric, consciously created to serve some human activity. It is usually immovable by nature or design. Examples are buildings of various kinds, monuments, dams, roads, railroad tracks, canals, millraces, bridges, tunnels, locomotives, nautical vessels, stockades, forts and associated earthworks, Indian mounds, cemeteries, ruins, fences, gardens, and monumental statuary.

Historic Vernacular Landscape: A landscape possessing a significant concentration, linkage, or continuity of natural and man-made components that are united by human use and past events or aesthetically by plan or physical development.

Integrity: The authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property's historic or prehistoric period.

Period of Significance: The time period in which the property achieved the qualities that make it eligible for the National Register of Historic Places.

Viewsheds: A contained view, or vista, of a landscape that can be defined by historic associations or by geographic parameters.

APPENDIX F.

Memorandum of Agreement and
Task Directive
Cultural Landscape Report
1990

MEMORANDUM OF AGREEMENT
BETWEEN
THE PUERTO RICO STATE HISTORIC PRESERVATION OFFICE,
COMMONWEALTH OF PUERTO RICO
AND THE
NATIONAL PARK SERVICE,
SAN JUAN NATIONAL HISTORIC SITE

This agreement is entered into on between the PUERTO RICO STATE HISTORIC PRESERVATION OFFICE, COMMONWEALTH OF PUERTO RICO (hereinafter referred to as PRSHPO) and the NATIONAL PARK SERVICE, SOUTHEAST REGIONAL OFFICE (hereinafter referred to as the SERVICE).

WHEREAS, the PRSHPO is coordinating the Inner City Rehabilitation Plan for San Juan, Puerto Rico Historic Zone; and

WHEREAS, the Rehabilitation Plan includes the preparation of a Cultural Landscape Report (CLR) for the el Morro parade grounds; and

WHEREAS, the SERVICE is preparing a Historic Structure Report for the el Morro fortification and, in accomplishing this work, has done considerable research including that related to the parade grounds; and

WHEREAS, the Cultural Landscape Report for the San Juan, Puerto Rico Historic Zone will be funded partially using Commonwealth of Puerto Rico monies authorized by the Joint Resolution of the House and Senate of Puerto Rico, number 147, of June 20, 1988 (Resolucion Conjunta de Camara y Senado de Puerto Rico numero 147 del veinte de junio de 1988) and other Commonwealth of Puerto Rico funds to be received; and

WHEREAS, the PRSHPO has professional staff with expertise in Puerto Rico prehistory, history, and architecture but has insufficient in-house staff to conduct the full range of a Cultural Landscape Report.

WHEREAS, the SERVICE has the professional expertise to assist the PRSHPO; and

NOW, THEREFORE, the PRSHPO and the SERVICE do mutually agree as follows:

I. The SERVICE, through the Cultural Resources Center of the North Atantic Region, will provide technical assistance to prepare a Cultural Landscape Report, as part of the el Morro HSR, that establishes historic view sheds and recommends areas for recreation and non-historic landscape design, in the historic landscape of el Morro, San Juan, Puerto Rico.

II. The SERVICE will publish the Cultural Landscape Report as part of the HSR for the el Morro fortification when that report is printed.

III. The SERVICE will prepare the Cultural Landscape Report following the attached, approved Task Directive and guidelines, and will include the input from the PRSHPO in the preparation of the report.

IV. The PRSHPO will fund the Cultural Landscape Report, not to exceed $24,930, funds which have been obligated for these purposes by the PRSHPO under account number 387-155-01-100.

A. The PRSHPO agrees to transfer funds in the amount of $24,930 to a donation account set up by the SERVICE, Southeast Regional Office.

B. The SERVICE, through the Southeast Regional Office, will account to the PRSHPO periodically detailing cost. The PRSHPO will be charged actual costs for all services. Professional staff to be utilized in service performance range from GS-5 through GS-14. Travel expenses and per diem will be in accordance with FPMR 101.7.

C. The work will be performed by the North Atlantic Regional Office with funds transferred through the Southeast Regional Office.

D. The PRSHPO agrees to provide or coordinate certain services available through Commonwealth of Puerto Rico agencies, such as a historian, historic landscape architect, and archeologist, as needed.

E. The PRSHPO agrees to aid in coordination with local utility agencies and companies whose facilities may be present within the project area.

V. General overall project coordination will be performed by the PRSHPO and the SERVICE project coordinators. Day-to-day liaison and coordination of project services and activities will be maintained between the SERVICE and the PRSHPO staff. The names and addresses of the Project Coordinators are:

Mr. Mariano G. Coronas Castro
Puerto Rico State Historic
Preservation Office
Office of the Governor
Box 82, La Fortaleza
San Juan, PR 00901

Mr. E. Blaine Cliver
Deputy Chief, Cultural
Resources Management
National Park Service
Charlestown Navy Yard,
Bldg. 28/2
Boston, MA 02129

The PRSHPO Project Coordinator will be the point of contact for receipt and processing of request for payment for services performed pursuant to this agreement.

VI. It is further agreed that this Memorandum of Agreement may be changed, amended or renegotiated at any time, as needed, at the initiative of either party. Any such changes must be mutually agreed to in writing to be binding on either or both parties.

VII. This agreement will remain in effect for five months, at which time it will be reviewed and reaffirmed, if appropriate. A draft of the Cultural Landscape Report will be completed by the end of September 1990. Work is expected to begin in July 1990. Final approval of the document should be accomplished by the end of November 1990. It may be terminated by either party upon 30 days written notice. Any SERVICE commitments outstanding at the time of notification of termination will be completed by the SERVICE; and as specified in paragraph IV, funding will be provided by the PRSHPO.

VIII. During the performance of this agreement, the participants agree to abide by the terms of Executive Order 11246 on nondiscrimination and will not discriminate against any person because of race, color, religion, sex or national origin. The participants will take affirmative action to ensure that applicants are employed without regard to their race, color, religion, sex or national origin.

No member or delegate to Congress or Resident Commissioner shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

The PRSHPO and the SERVICE agree to the provisions of this agreement as indicated by the signatures of their authorized officers.

NATIONAL PARK SERVICE
SOUTHEAST REGIONAL OFFICE
ATLANTA, GEORGIA

Acting Regional Director

JUL 23 1990
Date

PUERTO RICO STATE HISTORIC PRESERVATION OFFICE
SAN JUAN, PUERTO RICO

State Historic Preservation Officer

AGO. 01 1990
Date

TASK DIRECTIVE

Cultural Landscape Report
el Morro Fortification, San Juan National Historic Site
San Juan, Puerto Rico

Objective:

To establish historic view sheds(vistas) from and to the land side of el Morro, across the open parade grounds, through the study of historic landscapes. This study will be based on the known and collected documents, maps and photographs, and, if feasible, archaeology. In addition to establishing view sheds, the report will recommend areas for recreation and non-historic landscape design. Using the study as a basis, the State Historic Preservation Officer for the Commonwealth of Puerto Rico(PRSHPO), with the assistance of the Association of Landscape Architects of Puerto Rico(ALA), will prepare a landscape design for the designated recreation areas.

Participants:

The cultural landscape report(CLR) shall be accomplished by the Cultural Resources Management Division of the North Atlantic Regional Office(NARO) as part of the historic structures report(HSR) for the San Juan fortifications being prepared for the Southeast Regional Office of the National Park Service(NPS) and, in accordance with the agreement between the NPS and the PRSHPO for the Development of a Landscape Plan of the el Morro Grounds, signed on April 26 of 1990. The CLR will be done in cooperation with the Office of the PRSHPO. Assistance in the preparation of the CLR will be provided by the park (San Juan National Historic Site) and final approval of the CLR will be the responsibility of the Regional Director, Southeast Region, NPS, with the concurrence of the Office of the Governor, Commonwealth of Puerto Rico. For purposes of this task directive the following persons are the designated contacts for the participating organizations:

State Historic Preservation Office - Luis F. Irizarry
North Atlantic Regional Office - E. Blaine Cliver
Southeast Regional Office - Paul Hartwig
San Juan National Historic Site - W. P. Crawford
NPS Washington Office, Historic Architecture - Robert Page
Association of Landscape Architects - Vilma Blanco

Execution:

The CLR will be prepared following the attached guidelines from NPS-28 for the preparation of CLR's, and following the approved recommendations in the current general management plan(GMP) for the park. Also, the report will include documentation of boundaries and parcel designations for reference purposes. Copies of historic plans and photographs that are used elsewhere in the HSR, and that are applicable to the CLR, will be included in a joint graphic section of the larger report so as to avoid redundancy. Since the historical importance of the site and structures is the period of Spanish occupation, the focus of the report will be this time period. Later changes and uses occurring during the Twentieth Century will be documented. The establishing of view sheds will be based on the historical data, and will follow the recommendations set down in the GMP for use and time period of historical significance. Planning documents, to be prepared by the PRSHPO, will use the information included in the CLR. NARO will employ a Cultural Landscape Specialist and an Historical Architect on the project and will work with professionals in the PRSHPO office during the preparation of the report. The CLR will include, but not be limited to:

A. Analysis and recording of all prominent natural and cultural components of the landscape, including the landscape's setting, landform, vegetation, spatial relationships, structures and furnishings; and recommendations for further research should proposed actions affect the study area.

B. The evaluation of documents of all periods of the landscape's development (not just significant periods) and the changes that have occurred.

C. The collection, presentation and evaluation of documentary and field survey research.

D. The analysis and recommendations for treatment of the landscape that is consistent with its significance, integrity and programmed use.

Schedule:

A draft CLR, as part of the larger HSR, will be completed by the end of September 1990. Work on the CLR is expected to begin in July 1990. A trip for purposes of a site survey and research will be scheduled with the park and coordinated with the State Historic Preservation Office. Final approval of the CLR portion of the document should be accomplished by the end of November 1990, in order to facilitate planning. This schedule is dependent upon the transfer of funding by CPR to NPS before the end of June, 1990. The CPR, in consultation with ALA, will develop a schedule for the design plan based upon the above CLR dates.

Funding:

Funding for the preparation of the CLR will be supplied by the Commonwealth of Puerto Rico, through a donation account, to the National Park Service. The following are the estimated costs associated with the preparation of the CLR:

1. Salaries	$20,430
2. Travel	3,000
3. Photography, etc.	1,500
	$24,930

Approved by:

Regional Director, Southeast Region, NPS — JUL 23 1990 — date

State Historic Preservation Officer, PR — AUG 01 1990 — date

Superintendent, San Juan NHS — 7/1/90 — date

Chief, Cult. Res. Management, NAR, NPS — 7/16/90 — date

NOTES

1. This project is referenced in the Memorandum of Agreement (MOA), No. MA-5000-0-9001, signed August 1, 1990. Both the MOA and the Task Directive are included as Appendix F.

2. José Laguna, "Plaza de San Juan: Proyecto de un Hospital para Fiebre Amarilla que ha de Emplearse en el Campo del Morro de esta Ciudad," 1897. Reproduced from Servicio Histórico Militar, Madrid, Spain. Copy at SAJU Archives.

3. Some historians have estimated there were 70,000 Taíno Indians living in Puerto Rico when Columbus discovered Puerto Rico in 1493, during his second voyage. Recent excavations west of the Esplanade documented the earlier habitation by the Aruaca Indians, in 300 B.C. Ricardo Alegría, María de los Angeles Castro Arroyo, and Manuel Mendez Guerrero, San Juan de Puerto Rico (Spain: H. Fournier, 1989), p. 11.

4. Both of these structures are in Parcel B and administered by the CPR; various studies have suggested they be demolished.

5. World Heritage List, UNESCO, accepted January 23, 1984. Copy at SAJU Archives.

6. Juan M. Zapatero, La Guerra del Caribe en el Siglo 18 (San Juan: Instituto de Cultura Puertorriqueña, 1964), p. 397.

7. José Norat Martínez, Historia del Regimiento 65 de Infantería, 1899-1960 (San Juan: Imprenta la Milagrosa, 1960), pp. 28-29. Copy owned by R. Crisson.

8. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications, 1898-1958, Historical Data Section (San Juan: U.S. Department of the Interior, 1984), p. 1.

9. Ibid., p. 1.

10. General Management Plan/Environmental Assessment (San Juan: U.S. Department of the Interior, 1984), p. iii. The GMP was approved in September of 1985. Copy at SAJU Archives.

11. Ibid., p. iii.

12. Ibid., p. 22.

13. The proposed project consists of a plan by Architect José Cotarelo: "Proyecto de Ordenación Interior y Amoblamiento Urbano del Barrio Ballajá, San Juan, PR," 1990. Norzagaray Street is named Boulevard del Valle in this plan and would be redesigned and

slightly realigned as a pedestrian promenade on the north, with a limited-access road to the south, divided by a palm-tree lined median. The proposal would serve as a more formal approach to the Esplanade, capitalizing on the open view north towards el Morro. The project (in Parcel C) would be administered by the CPR.

14. General Management Plan, p. 56.

15. Ibid., p. 14.

16. A. Vingboons, Plan of San Juan, ca. 1625. Original at Cornell University Libraries, Department of Rare Books, Ithaca, NY, and reproduced in Aníbal Sepúlveda Rivera's San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898 (San Juan: Carimar, 1989), p. 81. The same book contains other, similar ca.-1625 maps. The translation of the legends of the various Dutch maps reproduced in this book was done with the assistance of Neil Abelsma, CRC.

17. Plan by Juan Francisco Mestre, 1792. Reproduced in Ibid., p. 128-129; this plan is reproduced as fig. 23 in Vol. I of the San Juan HSR.

18. Rafael Clavijo y Plá, "Plano de la Plaza de San Juan Bautista," 1861. Reproduced in El San Juan Español 1519-1898: Mapas y Planos en los Archivos de España (San Juan: PRSHPO, 1989), p. 57.

19. José Laguna, "Plaza de San Juan: Proyecto de un Hospital para Fiebre Amarilla que ha de Emplanarse en el Campo del Morro de esta Ciudad," 1897. Reproduced from Servicio Histórico Militar, Madrid, Spain. Copy at SAJU Archives.

20. Captain Hodges, "Plan of Grounds and Buildings of the War Department [San Juan, PR]," Washington, D.C., April 13, 1899. SAJU 0543-1864, SAJU Archives.

21. Two masonry posts holding operative iron gates were located here until they were demolished in late 1990 as part of the Fifth-Centennial Plaza and Parking project.

22. Captain Hodges, "Plan of Grounds and Buildings of the War Department [San Juan, PR]," Washington, D.C., April 13, 1899. SAJU 0543-1864, SAJU Archives.

23. Plans of San Juan, ca. 1625. Reproduced in Aníbal Sepúlveda Rivera's San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898 (San Juan: Carimar, 1989), pp. 80-82.

24. Fernando Miyares González, Noticias particulares de la Isla y Plaza de San Juan Bautista de Puerto Rico (Rio Piedras:

Universidad de Puerto Rico, 1954), pp. 9-10. Translated by R. Crisson.

25. San Juan (1678), San Juan y Cercanías (1750), and Plaza de San Juan de Puerto Rico (1766) are reproduced in Aníbal Sepúlveda Rivera's San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898 (San Juan: Carimar, 1989), p. 92, p. 134, and p. 142. The 1766 map has been reproduced by the Library of Congress, from the original by Manuel de la Rueda, Atlas Americano (Havana, 1766.)

26. Antonio Daubón Vidal, "Archeological Assessment for the Proposed San Felipe Del Morro Landfill Area" (CPR: Public Building Authority, 1989), p. 5.

27. "Alrededores del Convento de Santo Domingo, 1765," in Aníbal Sepúlveda Rivera's San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898 (S.J.: Carimar, 1989), p 140. The 1765 O'Daly map is also reproduced as fig. 7 in Vol. I of the San Juan HSR.

28. Thomas O'Daly, Plan of San Juan, 1772. Reproduced in Ibid., p. 144. The plan is reproduced as fig. 10 in Vol. I of the San Juan HSR.

29. Juan Francisco Mestre, Plan of San Juan, 1783. Reproduced in Ibid., pp. 148-149. The plan is also reproduced as fig. 18 in Vol. I of the San Juan HSR.

30. Juan Francisco Mestre, "Plano y Perfiles de un Almacén de Pólvora," 1787. Reproduced in El San Juan Español 1519-1898: Mapas y Planos en los Archivos de España (SJ: PRSHPO, 1989), p. 43.

31. Rafael Clavijo y Plá, "Plano de la Plaza de SJ Bautista de PR," 1861. Reproduced in Ibid., p. 57.

32. "Plano de la Plaza de San Juan de Puerto Rico," 1887. Reproduced in Aníbal Sepúlveda Rivera's San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898 (SJ: Carimar, 1989), p. 332.

33. "Departamento del Interior-Plano del Recinto Amurallado de la Ciudad de San Juan, PR antes de Efectuarse el Derribo de las Murallas al Este de la Ciudad en el Año 1897." Reproduced in Ibid., p. 334. The copy which was reproduced here is a copy done in 1940; thus, it is difficult to accurately date features built between 1897-1940.

34. José Laguna, "Plaza de San Juan: Proyecto de un Hospital para Fiebre Amarilla que ha de Emplanarse en el Campo del Morro de esta Ciudad," 1897. Reproduced from Servicio Histórico Militar, Madrid, Spain. Copy at SAJU Archives.

35. Captain Hodges, "Plan of Grounds and Buildings of the War Department [San Juan, PR]," Washington, D.C., April 13, 1899. SAJU 0543-1864, SAJU Archives.

36. O'Reilly (1725-94) was an influential Irish-born military engineer who--along with Thomas O'Daly--initiated the rebuilding of the San Juan fortifications in 1765. See Volume III, "City Walls," for more information about this work.

37. Ricardo Torres-Reyes, "La Plaza de PR, 1765-1777" (SJ: NPS, 1952), p. 94. Translated for the CLR by R. Crisson.

38. Juan Francisco Mestre, "Plano de la Plaza de San Juan de Puerto Rico y Fortificaciones," 1792. Reproduced in El San Juan Español 1519-1898: Mapas y Planos en los Archivos de España (SJ: PRSHPO, 1989), p. 55.

39. Ricardo Torres-Reyes, "La Plaza de PR" (NPS unpublished manuscript), p. 61.

40. Antonio Daubón Vidal, "Archeological Assessment for the Proposed San Felipe del Morro Landfill Area" (CPR: Public Building Authority, 1989).

41. Rafael Clavijo y Plá, "Plano de la Plaza de SJ Bautista de PR," 1861. Reproduced in El San Juan Español 1519-1898: Mapas y Planos en los Archivos de España (SJ: PRSHPO, 1989), p. 57.

42. Ibid.

43. Antonio Daubón Vidal, "Archeological Assessment for the Proposed San Felipe del Morro Landfill Area" (CPR: Public Building Authority, 1989), p. 7.

44. Angel Rivero Mendez, Crónica de la Guerra Hispano-Americana en Puerto Rico (SJ: Instituto de Cultura Puertorriqueña, 1972), p. 501. Reprint of original 1922 book.

45. Edwin C. Bearss, San Juan Fortifications, 1898-1958 (Denver: NPS, 1984), p. 9.

46. Ibid., p. 106.

47. Juan Manuel Zapatero, La Guerra del Caribe en el Siglo XVIII (SJ: Instituto de Cultura Puertorriqueña, 1964), p 279. Rodrigo de Figueroa's sketch plan of 1519 was reproduced in El San Juan Español, 1519-1898: Mapas y Planos en los Archivos de España, (SJ: PRSHPO, 1989), p. 51.

48. The fragmentary account by Layfield, who accompanied the Earl of Cumberland during the 1598 attack of San Juan, was originally published in 1625 in Purchas His Pilgrimes. It was

reproduced in La Capital Atraves de los Siglos by Rafael W. Ramírez de Arellano (author's copyright), 1950, and reprinted in Crónicas de PR (1493-1797) by Eugenio Fernández Mendez, Vol. I (SJ: CPR), 1957, pp. 135-156. Translated for the CLR by R. Crisson.

49. Plan of San Juan, ca. 1625. Reproduced in Aníbal Sepúlveda Rivera's San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898 (SJ: Carimar, 1989), p. 82.

50. Original at Cornell University Library and at la Bibliotheque Nationale, Paris; reproduced in 1964 by Instituto de Cultura Puertorriqueña, San Juan, PR. A similar view is reproduced in Ibid., p. 53.

51. Luis Venegas Ossorio, Sketch Map, 1678. Reproduced as fig. 1 in Vol. I of the San Juan HSR.

52. Ledrú was part of a group from the expedition aboard the "Triumph," and spent some time in the year 1797 gathering samples and making observations. Eugenio Fernández Mendez, Crónicas de PR (1493-1797), Vol. I (SJ: CPR, 1957), pp. 327-344. Translated for the CLR by R. Crisson.

53. "Los dibujos de PR del naturalista francés Augusto Plée (1821-23)," reproduced in Revista del Instituto de Cultura Puertorriqueña, Vol. 68, July-Sept. 1975, pp. 20-21.

54. This photograph, the earliest documented for this report, is found at the SAJU Archives.

55. Rafael Clavijo y Plá, "Plano de la Plaza de SJ Bautista de PR," 1861. Reproduced in El San Juan Español 1519-1898: Mapas y Planos en los Archivos de España (SJ: PRSHPO, 1989), p. 57.

56. Plans of San Juan, ca. 1625. Reproduced in Aníbal Sepúlveda Rivera's San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898 (San Juan: Carimar, 1989), pp. 78-83.

57. Angel Rivero Mendez, Crónica de la Guerra Hispano-Americana en Puerto Rico (SJ: Instituto de Cultura Puertorriqueña, 1972), p. 66. Reprint of original 1922 book. No archeological investigation has been undertaken to confirm the existence of a counter-mining system under the Esplanade of el Morro.

58. Antonio Daubón Vidal, "Archeological Assessment for the Proposed San Felipe Del Morro Landfill Area" (CPR: Public Building Authority, 1989), p. 7.

59. The fragmentary account by Layfield, who accompanied the Earl of Cumberland during the 1598 attack of San Juan, was reproduced in La Capital Atraves de los Siglos by Rafael W. Ramírez de Arellano (author's copyright, 1950) and reprinted in

Crónicas de PR (1493-1797) by Eugenio Fernandez Mendez, Vol. I (SJ: CPR), 1957, pp. 135-156. Translated for the CLR by R. Crisson.

60. Plans of San Juan, ca. 1625. Reproduced in Aníbal Sepúlveda Rivera's San Juan, Historia Ilustrada de su Desarrollo Urbano, 1508-1898 (San Juan: Carimar, 1989), pp. 81-83.

61. For a more detailed construction history of the city walls, see Vol. III of the San Juan HSR.

62. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications, 1898-1958, Historical Data Section (San Juan: U.S. Department of the Interior, 1984), p. 106.

63. Gambell Collection, SAJU Archives.

64. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications, 1898-1958, Historical Data Section (San Juan: U.S. Department of the Interior, 1984), pp. 138-139.

65. Ibid., pp. 317-323.

66. Ibid.

67. "Completion Report, 1938-39," U.S. Army Ordnance and Artillery File, SAJU Archives.

68. Ibid., pp. 273-274.

69. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications, 1898-1958, Historical Data Section (San Juan: U.S. Department of the Interior, 1984), pp. 135-137. The three structures were built of masonry and had flat roofs.

70. Ibid., p. 482 (Plate XXV, 1913).

71. Antonio Daubón Vidal, "Archeological Assessment for the Proposed San Felipe Del Morro Landfill Area" (CPR: Public Building Authority, 1989), p. 15.

72. For more information regarding the city walls, see Vol. III of the San Juan HSR.

73. Gambell Collection, SAJU Archives.

74. Ibid.

75. John L. Nagle, "Report on Park Development and Tourist Trade Possibilities-Island of Puerto Rico" (SJ: NPS, 1934). Copy at SAJU Archives.

76. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications, 1898-1958, Historical Data Section (San Juan: U.S. Department of the Interior, 1984), p. 65.

77. Antonio Daubón Vidal, "Archeological Assessment for the Proposed San Felipe Del Morro Landfill Area" (CPR: Public Building Authority, 1989), p. 7.

78. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications, 1898-1958, Historical Data Section (San Juan: U.S. Department of the Interior, 1984), p. 482 (Plate XXV, 1913).

79. Antonio Daubón Vidal, "Archeological Assessment for the Proposed San Felipe Del Morro Landfill Area" (CPR: Public Building Authority, 1989), p. 13.

80. Ibid., p. 15.

81. "General Plan of el Morro Castle and Vicinity," 1939, SAJU No.0300-833, SAJU Archives.

82. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications, 1898-1958, Historical Data Section (San Juan: U.S. Department of the Interior, 1984), p. 103.

83. Ibid., pp. 104-105.

84. Ibid., pp. 132-133.

85. Antonio Daubón Vidal, "Archeological Assessment for the Proposed San Felipe Del Morro Landfill Area" (CPR: Public Building Authority, 1989), p. 13.

86. Edwin C. Bearss, Historic Structure Report: San Juan Fortifications, 1898-1958, Historical Data Section (San Juan: U.S. Department of the Interior, 1984), pp. 318-321.

87. A post-1939 plan, entitled "Fort Brooke: Gas Distribution System," shows "old service and the actual service." SAJU 0589-2053, no date, SAJU Archives.

88. "Improvement to Underground Distribution System at el Morro Grounds, Old San Juan," no date. Blueprint provided by PRSHPO to Richard Crisson in 1990, to be transferred to SAJU Archives.

89. This section was the only portion of the city wall never constructed since the steep bank was considered to provide an adequate defense; see also Vol. III, San Juan HSR.

90. According to a study done in 1983 by the Puerto Rico Department of Natural Resources, 110 plant species were found at el Morro (see Appendix B). A 1990 draft topographical survey plan also documents the location, species, and size of plant materials, including trees that remained since Hurricane Hugo in 1989. The topographical plan is incomplete as of this date; its completion date is uncertain, according to the PRSHPO.

91. Ibid., (1990 Draft Topographical Survey).

92. "Improvement to Underground Distribution System at el Morro Grounds, Old San Juan," no date. Blueprint provided by PRSHPO to Richard Crisson in 1990, to be transferred to SAJU Archives.

93. A post-1939 plan, entitled "Fort Brooke: Gas Distribution System," shows "old service and the actual service." SAJU 0589-2053, no date, SAJU Archives.

94. National Register Bulletin, Number 18 (Washington, DC: NPS), GPO 1987-173-5777, p. 6.

95. The type and use of gravel or crushed stone has to be investigated further, taking into account both the historic appearance and NPS maintenance concerns. Subsurface drainage could be developed as needed to maintain the new surface.

96. A maintenance management plan for the lawn and vegetation could be developed; the plan could recommend management practices, plant materials, and both short and long-term objectives.

97. Appendix B and Appendix C include plant materials that either existed on-site or that could be considered in developing a vegetation maintenance management plan for the Esplanade.

98. The specific location and design of this parking area would be addressed through detailed planning; it is expected to accomodate two to four vehicles.

99. Harpers Ferry Center (NPS) is implementing a wayside exhibit plan at both el Morro and San Cristóbal; research executed as part of the CLR and the HSR could contribute to expand the scope of the wayside exhibit plan.

100. Cultural Resources Management Guideline (NPS-28), Release No. 3, August 1985, p. 3-9.

U.S. GPO: 1991—501-425