Sand Island's Military Past 1916-1945

John D. Bennett

Photos by author unless otherwise noted.

Introduction

This article presents a description of the former Sand Island Military Reservation's coast defenses and associated structures as they appeared then and now. In-depth descriptions of the units that manned them have already been superbly reported by William C. Gaines, in "Sand Island Military Reservation," *CDSG Journal*, August 1994.

History

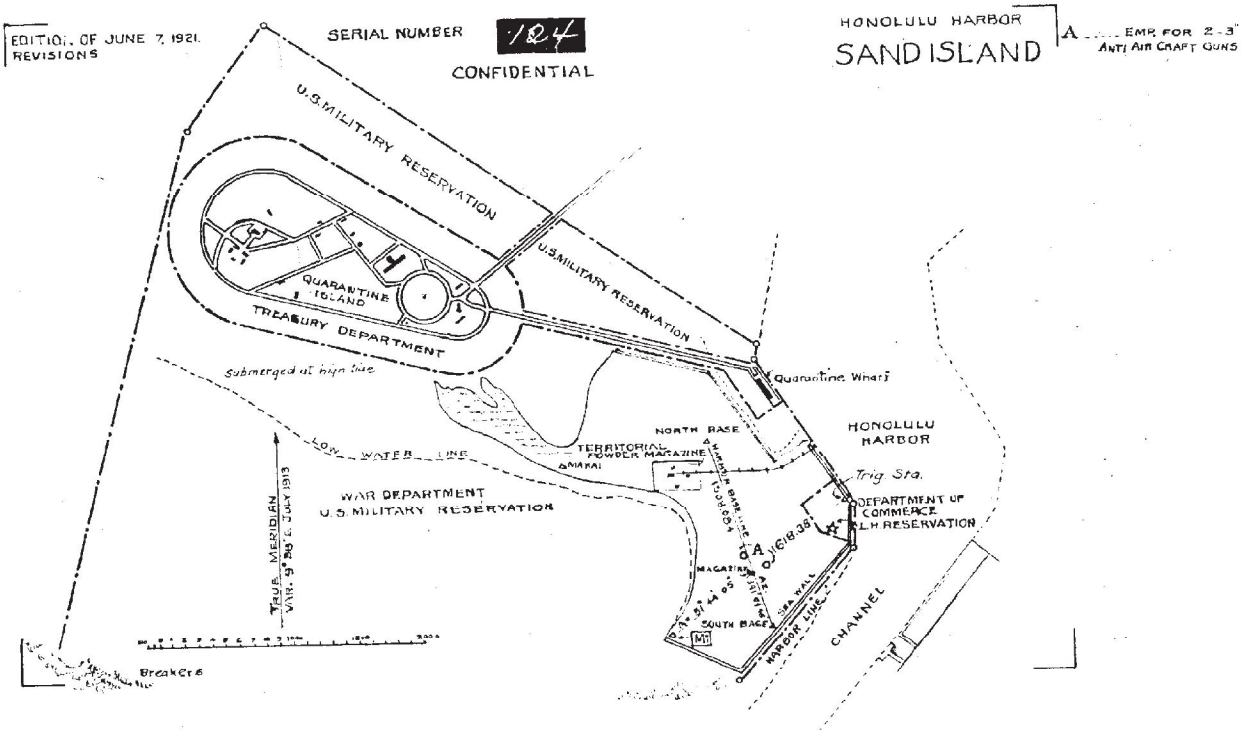
The Sand Island Military Reservation was established in 1916 on an island built upon the Kaholaloa Reef on the west side of Honolulu Harbor, across the harbor entrance from Fort Armstrong. Sand Island had been the site of the immigration and quarantine station for the monarchial and federal governments, where thousands of contract laborers imported to work in the sugar and pineapple plantations in the Hawaiian Islands were processed.

The island consists of some 641 acres of flat land; the highest elevation is 10 feet above sea level. It became known as Sand Island after being joined to Quarantine Island by coral-fill dredged from the main entrance channel into Honolulu Harbor, the "Fort Armstrong Channel." Additional dredged coral from the Kapalama Turning Basin at Honolulu Harbor and the adjacent Keehi Lagoon seaplane runways constructed for amphibious transport aircraft in World War Two also increased the island's acreage.

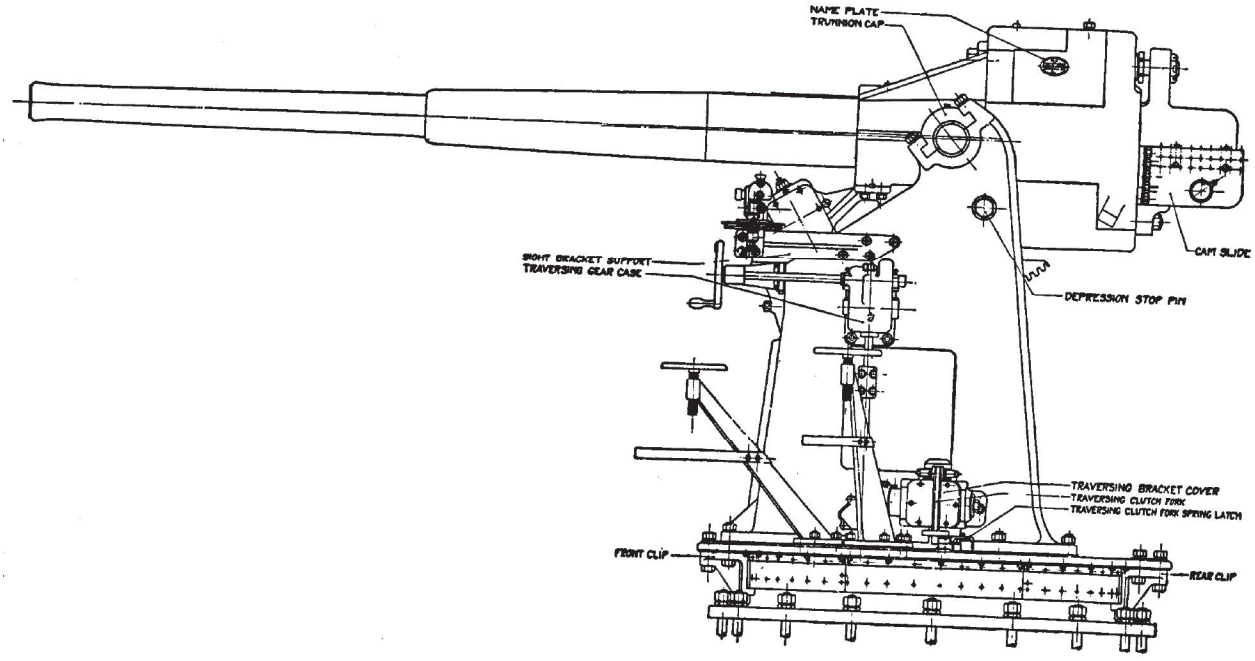
Coast Artillery units manned several installations and gun emplacements on the island on an intermittent basis prior to the start of World War Two. It was used as a firing point for 155 mm batteries and later for 3 in AA guns, as commander's found it increasingly difficult to fire their guns in urban areas due to damage and complaints from the civilian populace. Among the military installations located on the island were a 60 in seacoast searchlight and controller booth built on towers, a submarine cable hut for the cable that ran between Forts Kamehameha and Armstrong, Mine Command 1's secondary station, and one of the 12 original 1934 concrete machine gun pillboxes emplaced on Oahu.(1) Panama mounts for four 155 mm GPF guns, built in 1937, were known as Battery Sand Island. Near the southeast portion of the island was Fixed Antiaircraft Battery No. 7, four 3 in M1917 guns in the early foursquare pattern on concrete gun blocks.(2)

The encampment, known as "Camp Sand Island," initially included a dormitory/mess hall for eight men with a larger mess hall for 118 men, and one officer's and two enlisted latrines of corrugated galvanized iron.(3)

Electricity was provided by the Hawaiian Electric Company and the city supplied water via a six-inch water main connected to the encampment's four-inch pipes; both civil-engineering projects were completed in August 1940. The camp came under the administration of Fort Ruger on Diamond Head Crater. After the December 7, 1941, attack on Pearl Harbor and other military installations on the island, additional accommodations were built to house the influx of troops stationed on the island.



Sand Island, ca. 1934



3 in M1917 AA gun
Courtesy USAMHI

Early dormitory/mess hall on Sand Island
Archives II, NARA

Battery F, 55th CA, had been deployed to the island on November 27, 1941, to guard the government property and to man the coast artillery and antiaircraft guns.(4) The beach defenses were manned by units of the 2nd Bn, 27th Infantry Regiment, "Wolfhounds," stationed at Schofield Barracks after commencement of hostilities with Japan. Under the Hawaiian Defense Project, 1940 Revision (HDP-40), Oahu had been divided into two sectors (North and South), to be manned by infantry and field artillery to thwart any attempted invasion, and the troops were mobilized to man these positions shortly after December 7, 1941.(5)

Maj. Gen. Henry T. Burgin, commanding the Hawaiian Coast Artillery Command, headquartered at Fort De Russy in Waikiki, requested assistance from the army engineers in building numerous defensive positions at coast artillery posts around the island on December 10, 1941, and the Sand Island Military Reservation was slated for 12 AA machine gun mounts to bolster its defenses, with improvised fixed AA mounts for .30 cal. machine guns built of iron pipe or concrete posts with rotating collars and improved pivots for elevation, to be installed in pits.(6)

The vital need to defend Oahu's shores from invasion immediately after the Pearl Harbor attack was of the utmost importance and the navy offered obsolescent guns from their reserve stocks to be used as coastal batteries on a temporary basis.

Among the various naval weapons presented to the army were 12 obsolete 7 in MkII 45 cal. broadside guns to bolster the defenses of the islands of Oahu and Kauai.(7) Kauai's coastal defenses had originally been scheduled to receive eight 5 in navy guns to free the 155 mm gun batteries on the island for duty elsewhere.(8) Oahu's two 7 in batteries were located at Sand Island (Battery Harbor) and at Puu o Hulu (Battery Hulu) on the Leeward Coast; Kauai's 7 in batteries were at Monument near Numila (Port Allen) and Ahukini, between Ahukini and Nawiliwili Harbors.

Production of the newer long-range 6 and 8 in coastal guns could not meet the demand for modern seacoast weapons, so other means had to be employed. Battery Harbor was equipped with four 7-inch/45 cal. MkII navy guns, serial numbers 33, 55, 90, and 92, on MkII carriages, serial numbers 25, 50, 64, and 84, in concrete emplacements with parapets three feet high.(9) The gun mounts were bolted to two-inch steel plates cushioned by two inches of hardwood planking, all of which was anchor-bolted to a large reinforced-concrete gun block.(10)

.30 cal. machine gun mount at Ft. Ruger.

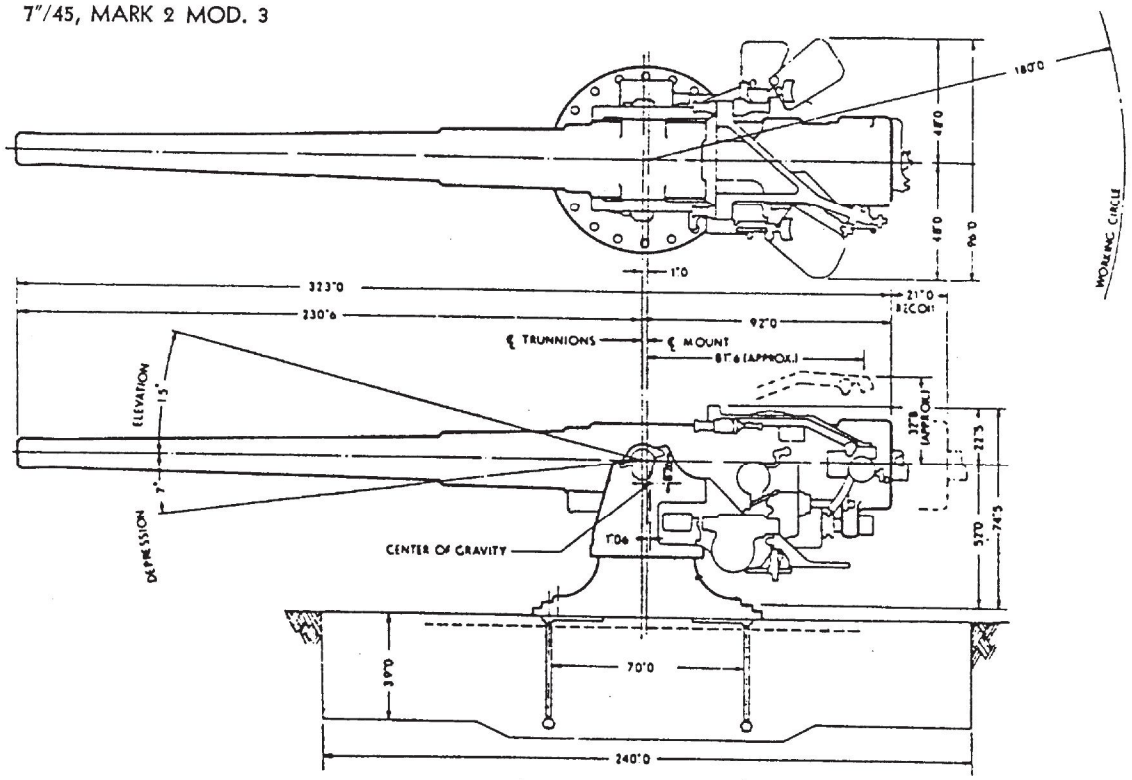
The guns were third-order broadside guns mounted in the last classes of pre-dreadnoughts and armored cruisers and kept in the navy's reserve stocks, and a number were used as emergency coast defense batteries during World War Two.(11)

TABLE 1. Specifications of the 7 in (177.8 mm) MkII/45 cal. navy gun(12)

Elevation (w/naval pedestal mounts): +15° -7°
Weight, incl. mount: 12.81 tons
Length: 26' 9" (323.0 inches)
Shell: 165 lbs
Powder charge: 58 lbs
Primer: Mk. 15 Mod. 1
Range: 16,500 yards (9.4 mi.) @ 15°
Muzzle velocity: 2,700 ft/sec
Gun firing and illumination: 6 V/50 AH battery
Length of recoil: 21 in
Recoil Fluid: 7.4 gal

Each emplacement was provided with two 12 ft by 14 ft splinterproof magazines, one for powder and one for projectiles, and the battery had one splinterproof plotting room that measured 16 ft by 19 ft, which was gasproofed. The stand-by generators were also provided with a splinterproof shelter.(13)

Due to the island's flat surface, the battery commander's station of Battery Harbor was located on the first level of a two-level steel observation station built atop a 50-foot steel rig.(14) The top level included the harbor entrance control post (HECP) and signal station for Honolulu Harbor.



7 in MkII 45 cal. navy gun
Courtesy USAMHI

Battery Sand Island's four 155 mm M1918 GPF guns were transferred to the Punchbowl Military Reservation, which overlooks the city and it's harbor, on December 14, 1942. The 155 mm battery was eventually replaced by an anti-motor torpedo boat (AMTB) battery also called Battery Sand Island, with four 90 mm M1 guns, two fixed and two mobile, plus two 37 mm automatic weapons. The guns were test-fired upon completion of the battery in September 1943, and remained there until the battery's disbandment shortly after the end of hostilities in 1945.(15)

The Army Port and Service Command established its headquarters at the old immigration station on Sand Island in the summer of 1943 and administered the wharves and warehouses on the island and the adjacent Kapalama Military Reservation with its wharves and warehouses. The immigration station had been used earlier in the war to house alien-detainees, citizens of Axis countries arrested by the FBI and Naval Intelligence.(16)

Sand Island Today

The island is owned by the State of Hawaii, except for a 40.8-acre portion occupied by Coast Guard Base Honolulu, which was obtained piecemeal by several presidential executive orders. The Sand Island Coast Guard Base is situated within the 14th Coast Guard District, headquartered in the Jonah Kuhio Kalanianaole Federal Building in Honolulu, and stretches from Hawaii to the Northern Marianas Islands. The base is the homeport to the high-endurance 378-foot cutters *Rush* and *Jarvis*, as well as the 110-foot cutters *Assateague* and *Washington* and two 180-foot buoy tenders, *Mallow* and *Sassafras*.(17)

Major tenants located on the island are the City and County of Honolulu, which operates a large wastewater treatment plant on 50 acres of land, Matson Navigation Company and CSX Lines, which

maintain large shipping-container yards, plus numerous light-industrial businesses, all of which occupied their respective locations there after World War Two.

Sand Island has undergone major transformations with the demolition of the old immigration station and the World War Two-era warehouses and structures. Paved roads, sidewalks, and upgraded utilities have been included in the renovations that have been taken place over the past several decades, which also included the State Recreation Area that presently occupies the southern portion of the island.

Extant Military Structures

Extant military constructions are within the state recreation area, and spread from the harbor channel on the east to the now-closed Kalihi channel on the west. Of the former military constructions, the HECP is the most visible, its observation rooms high above the surrounding tree tops. For almost six decades it has withstood weather and vandalism (vandals set fire to both observation rooms sometime prior to the examinations), and remains the foremost feature of the park.

The HECP controlled the examination battery of Honolulu Harbor, the 155-mm guns of Battery Sand Island until they were relocated to the Punchbowl Military Reservation and this task was taken over by the 3-inch guns of the reactivated Battery Tiernon at Ft. Armstrong, 1200 feet east of Sand Island. Upon completion of AMTB Battery No. 4, the assignment was transferred to that battery until the end of the war.(18)

The HECP tower is atop four vertical steel-pipe legs, each 41 inches in circumference, imbedded in reinforced-concrete piers 36 inches square. The height of the piers varies from three and one-half feet to about two feet as they sit upon a manmade hillside some 15 feet high with a slope on the south face.

HECP at Sand Island, front view

Horizontal steel-pipe cross braces 19 inches in circumference are affixed some five feet above the concrete anchor piers and run around the perimeter of the structure with another horizontal pipe brace in the form of an X that further braces the four legs at the interior aspect of the cross-braces. Steel rods some four inches in circumference in the form of an X brace all four sides of the tower legs, above and below the pipe cross-braces. All major joints of the tower have been welded, which according to a welding engineer was a major breakthrough in World War Two, as metal sections and joints were previously joined either by bolts or rivets.(19)

The double-tiered observation rooms are fastened to four latitudinal and ten longitudinal steel I-beams. The overall height of the tower was given at 50 feet, and the walls were of one-inch steel plate.(20)

Typical Magazine at Battery Harbor.

Suspected fuze/primer magazine locker at Battery Harbor.

The roof has a metal railing with two horizontal rails around three sides, with a steel plate in place of a railing on the north side. A pole mast is attached to the roof with a horizontal cross-arm near the top for signal flags with no halyards present. Several lights are affixed to the mast for signal purposes.

Entry into the observation rooms was by a steel ladder on the outside of the tower that has long been removed, preventing examination of the interior. Steel doors at the right rear provided entry into each observation level.

The observation room at the first-level was used as the battery commander's station for Battery Harbor; it is hexagonal with the front (south) wall protruding slightly forward of the second-level observation room. It was probably equipped with a CRF and an azimuth instrument, but there is no evidence to substantiate this supposition.

Battery Harbor, Emplacement No. 1, looking south.

Battery Harbor, Emplacement No. 1, front view

Narrow horizontal viewing slits run the length of the south, east, and west walls of both observation rooms, with smaller slits on the back (north) wall of each level. The upper observation room appears box-shaped and was used as the HECP/signal tower to monitor shipping traffic to and from Honolulu Harbor. Measurements from ground level indicate the north/south walls are approximately 21 feet, and the east/west walls are some 22 feet long.

There is extensive surface corrosion present underneath the observation room's housing, with surface corrosion and smoke damage prevalent on the back wall of the observation rooms. The structure, less the tower legs, appears in poor condition.

Batteries Harbor and Sand Island occupied a strategic location at the west bank of the Fort Armstrong entrance channel to Honolulu Harbor, approximately 6 1/2 miles east of the Pearl Harbor entrance channel. The 9.4 mile range of the 7 in MkII guns of Battery Harbor was sufficient to cover the approaches of both harbor entrances, although the 90 mm M1 AMTB gun possessed a maximum-effective range of only 4.5 miles.(21) The batteries at Fort Kamehameha to the west of Sand Island were better suited to defend the Pearl Harbor entrance channel from seaborne attackers.

Several decades ago, the state built wooden observation platforms with roofs over each emplacement as part of the park development program, but they have suffered from the effects of weather, vandalism, termites, and lack of maintenance. The platforms disguise the appearance of the emplacements and are an eyesore in their present condition.

Hembolt reports that each of the four gun emplacements of Battery Harbor was equipped with a pair of 12 by 14-foot reinforced-concrete splinterproof projectile and powder rooms, at the rear of the emplacement across from each other. All projectile and powder magazines have been covered with coral, sand, and a top layer of earth planted with grass, vaguely resembling Indian burial mounds.

A possible fuze/primer magazine locker is found at the left rear of each gun emplacement. All emplacements have three-foot high parapets at the front, which face the south shore and the Honolulu Harbor entrance. The floor of all gun emplacements has been paved with a layer of bituminous asphalt; however, a circular impression of the gun mount is discernible.

The projectile and powder magazines have had large concrete pilings and boulders placed over their concrete double-walled entrances, preventing entry into them. Vent outlets for the magazines have been capped with square concrete slabs.

The suspected fuze/primer magazine lockers for each emplacement consist of small, thick-walled, flat-roofed reinforced-concrete structures equipped with steel doors. Emplacement No. 1's fuze/primer magazine, 71 inches high by 68 inches wide by 42 1/2 inches deep, typifies the design and measurements of the lockers found at the three other emplacements. Vandals have broken off chunks of concrete from several of the magazines; otherwise, they have survived in fair condition.

The battery plotting room, some 150-200 feet northeast of the HECP, is the largest cut-and-cover splinterproof ancillary structure present, and is equipped with an escape hatch. The plotting room reportedly measured 16 feet by 19 feet.(22)

The plotting room's concrete double-walled protected entrance on the southwest side of the structure has been covered by large boulders and earth fill. A small, square, concrete escape-hatch housing at the northeast corner of the roof does not display any pyramid shaped roof, as was common with the two other World War Two emergency batteries examined by the author.(23) It may have been originally equipped with a steel trapdoor.

Vandals attempted to break off the concrete slab covering, which now allows a brief view into the shaft leading down to the plotting room. Metal rung ladders on the north wall resemble thick staples, and the bottom of the shaft has been filled with dirt, rocks, and concrete rubble to prevent unauthorized

entry.

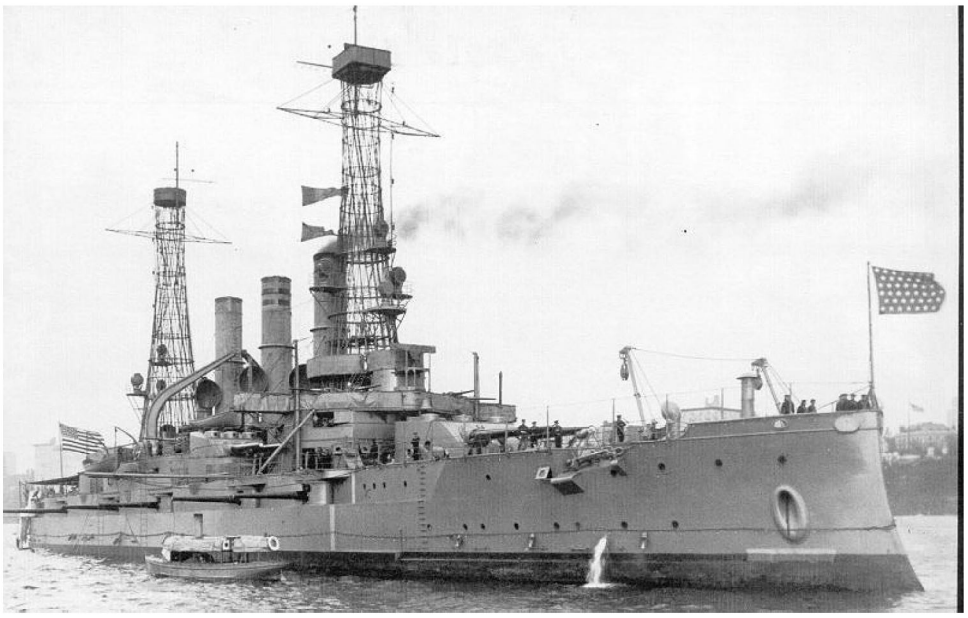
Several other unidentified cut-and-cover splinterproof structures are located at the rear of the gun emplacements on both sides of the HECP tower. These structures, believed to have housed the generators, fire control switchboard, and other ancillary rooms of the battery, have had their entrances covered to prevent entry, preventing further inspection of the interiors.

Battery Harbor has the distinction of having two of its guns (Nos. 90 & 92) extant, although they are located several miles away in Fort De Russy at Waikiki.(24) Both guns are presently mounted in Emplacements No. 1 and No. 2 of former Battery Randolph (two 14 in DC) at the U.S. Army Museum, Hawaii.

The extant guns of Battery Harbor were manufactured by Midvale Steel Company, and were originally mounted in 1907 on the *USS New Hampshire* (BB-25), the last of the six-ship *Connecticut* class. They were removed in 1918 and apparently placed in storage until early World War Two, when numbers of 4, 5, 6, and 7 in guns were turned over to the army for use in seacoast batteries. The other 7 in guns used as seacoast batteries in Hawaii had been mounted on the *Connecticut* (BB-18) and *Mississippi* (BB-23) classes.(25)

One of the two remaining 7 in MkII guns of Battery Harbor, at Battery Randolph, Ft. De Russy.

No evidence was found of the four Panama mounts of Battery Sand Island, or of the successor 90 mm AMTB No. 4 at the southeast corner of the park where they were reportedly emplaced. The author also attempted to locate remnants of the 3 in AA battery and discovered three concrete pads measuring approximately 10 feet in diameter on the southeastern corner of the island, which have been disguised as receptacles for hot coals. Additional measurements that would have assisted in the identification of the pads, which may be possible gun blocks, were hampered by the construction of rock walls that now occupy a portion of the pads; therefore, no definite identification of the pads could be made.(26)



U.S.S. New Hampshire (BB-25) ca. 1911.
Photograph #NH 60574, Naval History Center

Beach Defenses

One of the 12 original 1933-designed concrete machine gun pillboxes emplaced on Oahu in 1934 is extant with a commanding view of the Honolulu Harbor entrance. It is adjacent to the seawall, disguised with a wooden viewing platform around the perimeter of the roof.(27) It is about 13 feet square with a slightly convex roof. Narrow horizontal slits in the four walls are framed with metal around all inside edges. The rotting, termite-infested platform prevents any inspection of the interior of the pillbox. The overall condition of the structure is fair. These pillboxes are particularly significant as the first of hundreds of varying designs used to augment beach defenses in the Hawaiian Islands during World War Two.

Co. F, 2nd Bn, 3rd Engineers, conducted tests at the Schofield Barracks firing range from December 1938 to January 14, 1939, to determine the resistance of several types of machine gun shelters to infantry and artillery fire and aerial bombardment. Another portion of the test determined the suitability of firing .30 and .50 cal. machine guns and 37 mm guns from the emplacement for sustained periods. It was concluded that the emplacements were suitable for sustained firing of the aforementioned weapons, but "The existing concrete machine gun emplacements on the island of Oahu are vulnerable to the fire of light artillery and the more powerful anti-tank guns." It was recommended that revised plans for a light machine gun emplacement be adopted, and that plans be prepared to strengthen existing reinforced-concrete machine gun emplacements to sustain light artillery fire, equivalent naval fire, and anti-tank guns.(28)

Several other remnants of concrete machine gun pillboxes are on the southwest portion of the island approximately one mile west of the HECP Tower; however, these are smaller in size than the 1934 example, appearing to be typical square World War Two-era mass-produced pillboxes built by the army engineers at construction yards and transported by truck to locations around the island.(29)

Each World War Two example measured about eight feet square by three feet in height, measured from the ground up, and was constructed of reinforced concrete with thicker walls than the 1934

example, and was equipped with four small horizontal viewing/firing embrasures, one at each wall. It is doubtful that the two examples found in close proximity of each other were originally placed at the locations where they were found.

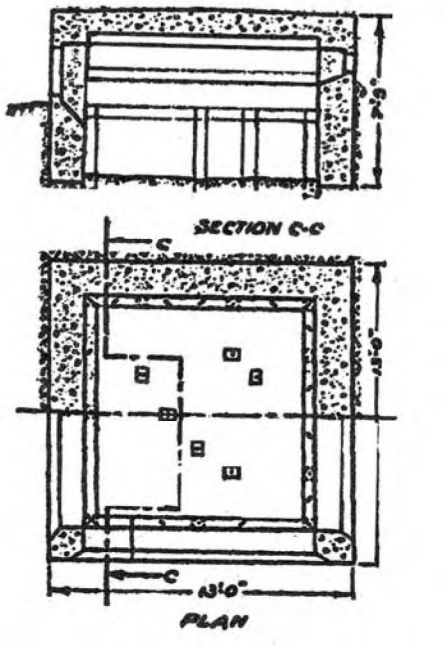
Numerous other machine gun pillbox remnants are used as breakwater foundations off the southwest coast of the island. The 1934-type machine gun pillbox appears to be in better condition than the World War Two-era types, which are in the open and more susceptible to weathering and vandalism.

Battery Harbor's gun emplacements were not casemated during the war, chiefly because Sand Island was covered with a proliferation of antiaircraft guns; those of Battery Hulu (two 7 in) on Oahu's Leeward Coast were casemated mainly due to concern about falling rock from the mountain slope above it; the 7 in guns near Port Allen and Ahukini on Kauai were also casemated.(30)

World War Two machine gun pillboxes at southeast portion of island

Observation slits on north and east walls of 1934 machine gun pillbox.

One example of a suspected antiaircraft gun tower exists at the northeast section of the park, some 10 feet west of the harbor seawall. It is approximately 20 feet high and built of reinforced concrete, sitting on six concrete legs measuring 18 1/2 in. square. The tower platform is surrounded by a perimeter wall, and the access ladder was removed prior to the opening of the park. A small rectangular addition adjacent to the northwest corner of the main structure sits on reinforced-concrete legs 12-1/2 in square. The main structure may have housed antiaircraft automatic weapons, and the auxiliary structure could have held the gun director. There is no documentation known to the author that confirms this theory. Consultation with several CDSG members has failed to positively identify the structure, whose over-all condition is good.



1934-type machine gun pillbox.
Courtesy William C. Gaines

TABLE 2. Location of extant structures on Sand Island (GPS Readings)*

Structure	N. Latitude 21⁰	W. Longitude 157⁰
HECP/BCS Tower	18.034'	52.434'
Battery Harbor:		
Empl. 1	18.089'	52.409'
E. Mag.	18.080'	52.486'
W. Mag.	18.015'	52.490'
Empl. 2	18.075'	52.460'
E. Mag.	18.062'	52.450'
W. Mag.	18.084'	52.450'
Empl. 3	18.060'	52.433'
E. Mag.	18.062'	52.430'
W. Mag.	18.063'	52.430'
Empl. 4	18.053'	52.418'
E. Mag.	18.055'	52.413'
W. Mag	18.054'	52.417'
Plotting Rm	18.088'	52.377'
Esc. Hatch	18.089'	52.373'
Structure 1**	18.061'	52.425'
Structure 2***	18.102'	52.462'
Structure 3****	18.097'	52.429'
1934 Pillbox	17.946'	52.223'
Poss. AA Tower	18.114'	52.168'

* Readings taken with a Garmin Etrex personal navigator on 5/31/01, and recorded in WGS-84 Map (World Geodetic Survey, 1984) Datum format. The readings are +/– 15-40 ft.

** Cut and cover structure approx. 150 ft SW of Plot. Rm.

*** Cut and cover structure NE of Structure 2.

**** Cut and cover structure approx. 60 ft E of HECP Tower.

Unknown tower located at Sand Island

Concluding Remarks

Sand Island played an important role in the defense of Honolulu Harbor and Oahu's south coast. The coast artillery manning the various coastal defenses on the island were overshadowed by the larger role played by the Army Port Service Command, as the development and maintenance of wharves and warehouses grew to major proportions in the area.

The major vestiges of the coast artillery constructions at the former Sand Island Military Reservation (Sand Island State Recreation Area) include the HECP and Battery Harbor's four 7 in gun emplacements, including magazines and ancillary structures. Other constructions extant are the 1934 and the World War Two-era machine gun pillboxes; a suspected antiaircraft gun tower, plus several other bunkers of unknown origin.

In the 1960s the author had the opportunity to briefly examine Battery Harbor's emplacements, which were situated at that time amongst a thick growth of haole koa scrub brush *(Leucaena leucocephala)* and thorny Kiawe or Algaroba trees *(Prosopis pallida),* a relative of the mesquite that grows in abundance in the desert southwestern United States.(31)

The tree cover made it practically impossible to distinguish the emplacements and support structures from the shoreline, and also prevented closer examination of the structures. All were backfilled with chunks of coral and sand, which has since received an additional layer of earth placed over the original cover.

No evidence was turned up of the searchlight position or its power building; two large bunkers on the east portion of the park, which have been disguised, one as a steam locomotive and the other as a train station, have not been identified.

It is just a matter of time before the HECP tower has to be demolished, as its present condition presents a liability to the State Parks Department due to extensive surface corrosion and the burnt-out interior of the structure.

No interpretive signage identifies the structures, and no maintenance program is in place to preserve the World War Two and prior constructions for future generations to view. This may be due to lack of public interest and the state's poor economy.

Acknowledgements

The author acknowledges the assistance and support of CDSG members Alvin Grobmeier, Robert Zink, and especially William Gaines and Bolling Smith, who provided me with reference materials, and whose knowledge of the World War Two coastal gun batteries and constructions on Oahu greatly enhanced the writing of this article. Thanks go also to Mrs. Janet Dorrance, widow of the late William H. Dorrance, who made available the Dorrance Collection of correspondences and notes, and lastly, to Judith Bowman, curator of the U.S. Army Museum, Hawaii, located in Battery Randolph, Ft. De Russy.

Notes

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2. William C. Gaines, "Sand Island Military Reservation", CDSG Journal, August 1994, pp. 49-54. (Hereafter: Gaines, Sand Island MR.)
3. Construction Completion Reports, 1917 - 1942, Buildings Nos.: T-79 (Dormitory & Mess Hall), T-80 (Latrine-EM), T-81 (Latrine-EM), T-82 (Latrine-Officers), Ft. Ruger, T.H., NARA, College Park, MD, RG 77, Entry 391.
4. William C. Gaines, "Sand Island Military Reservation," unpublished MS, p. 123. (Hereafter: Gaines, Sand Is. MS.)
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6. H.T. Burgin, CG, Hawaiian Coast Artillery Command, letter to Engineers, Dec. 10, 1941, Subject: Engineer Assistance, Hawaiian Dept. Engineer, General Correspondence 1920-1946, Entry 118, U.S. Army Forces Middle Pacific and Predecessor Commands, 1942-, NARA, College Park, MD., RG 494, (Hereafter: Hawaiian Dept., Engineer, Gen. Correspondence 1920-1946.)
7. Henry M. Helmboldt, "Hawaii's World War II Seven-Inch Batteries," CDSG News, May 1990, pp. 21-22. Reprinted from U.S. War Department, "Historical Review Corps of Engineers United States Army Volume 1, Covering Operations During World War II, Pacific Ocean Area," RG 494, Entry 125, NARA, College Park, MD. (Hereafter: Helmboldt)
8. Delos Emmons, CG, Hawaiian Dept. to CG, Kauai District, June 1942, Subject: Installation of 7" Navy Guns, Hawaiian Dept., Engineer, Gen. Correspondence 1920-1946.
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10. Helmboldt, p. 22.
11. John Campbell, Naval Weapons of World War Two, (Annapolis: Naval Institute Press, 1985), p. 132.
12. Ibid. Navy Dept., Bureau of Ordnance, Ordnance Pamphlet 1112 (2nd Rev.) Gun Mount and Turret Catalog, 7-in. 45 cal., S.P., Single Mount, Open Pedestal type, corrected as of 15 January 1945.
13. Helmboldt, pp. 21-22.
14. Ibid, pp. 21-22.
15. Gaines, Sand Island MS, pp. 128-129.

16. Gwenfread Allen, Hawaii's War Years 1941-1945, (Kailua, Hawaii: Pacific Monograph, 1999), p. 236.
17. "Coast Guard Fourteenth District," Website: <http://www.globalsecurity.org/military/agency/dot/district14.htm>. June 12, 2002.
18. Gaines, Sand Island MR, p. 51.
19. Scott Tamayori, welding engineering supervisor, Pearl Harbor Naval Shipyard, conversation with the author on May 25, 2002.
20. Helmboldt, pp. 21-22.
21. "General Characteristics of the 90-mm Anti-Motor Torpedo Boat Battery, "<http://www.pirs.mvr.usace.army.mil/fuds/eh/goshenpt/oe/asr/findings/apf.htm> July 26, 2001.
22. Helmboldt, pp. 21-22.
23. The author previously examined the plotting rooms of Batteries Homestead and Hulu on Oahu's West Shore, each of which included a pyramid-roofed escape housing atop the left-rear section of the structure.
24. Mark Berhow (comp.), Modern American Seacoast Defenses, A list of Military Reservations and Concrete Gun Batteries, 1890-1950, p. 328.
25. Naval Historical Center, Washington Navy Yard, RADM John D.H. Kane, Jr., USN (Ret.) to Nancy Bannick, April 7, 1977, on file at the U.S. Army Museum, Hawaii.
26. Mark Berhow (ed), American Seacoast Defenses: A Reference Guide, (Bel Air, MD: CDSG Press, 1999), p. 295: ". . . The M1917 3-inch AA gun mount was designed to be mounted using 16 bolts, on a concrete base 30 inches thick and 18 feet in diameter."
27. Gaines, Sand Is. MS, p. 123.
28. Mason J. Young, CO, 2nd Bn, 3rd Engineers to CO, 3rd Engineers, Feb. 20, 1939, Subject: Tests of Machine Gun Emplacements with Concrete and Earth Overhead Cover. Hawaiian Dept., Engineer, General Correspondence, 1920-1946.
29. William H. Dorrance, "Beach Defenses of Hawaii 1924-1942," CDSG Journal, Vol. 8 No. 4, August 1994, pp. 51-53.
30. Helmboldt, p. 22.
31. It was common practice to plant thorny kiawe or algaroba trees to conceal gun emplacements and associated structures, as evidenced by the large growths at Fort Kamehameha and those planted at Battery Williston at Fort Weaver in the 1920s.

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