Pearl Harbor and the Outlying Islands:
US Navy Base Construction in World War II

Oahu

Development of Pearl Harbor under the National Defense construction program, together with the fortification of other Pacific island possessions, was begun in the fall of 1939.

At that time, the navy yard occupied 498 acres and included one battleship drydock with its supporting industrial establishment, one marine railway, administration offices, two fuel-oil tank farms (above ground), a supply depot, and housing, a total of 190 buildings. The Pearl Harbor naval hospital, occupying 41 acres adjoining the navy yard, was a 1100-bed facility. Ford Island, a 330-acre island within the harbor waters, was the site of the fleet air base. With facilities for seaplanes and a landplane runway 5400 feet long, Ford Island was used jointly by the Army and the Navy. At that time, however, the Army had Hickam Field under construction and was in the process of relinquishing Ford Island entirely to the Navy. The Pearl Harbor submarine base occupied 32 acres of harbor waterfront and was contained in 28 buildings.

Other naval properties on the island of Oahu included a Marine barracks, with a total of 29 buildings on 55 acres of land adjoining the navy yard, an ammunition depot at West Loch and Lualualei, a large radio station at Lualualei, a six-acre reservation at Bishops Point, adjoining Fort Kamehameha at the harbor entrance, a mooring mast for blimps at Ewa, a 152-acre rifle range at Puuloa, a small radio station at Wailupe, and several other small reservations that were used as right-of-way for water supply. An 18-foot macadam highway linked the navy yard with Honolulu, 10 miles distant. Beyond the limits of the Navy-owned property and the land containing Hickam Field, the surrounding countryside was devoted to the cultivation of sugar cane.

Recommendations of the Hepburn Board formed the basis of the first CPFF [Cost Plus Fixed Fee] contract, awarded by the Navy during the war-construction program. As signed on August 5, 1939, the contract covered the construction of a new naval air station at Kaneohe, on the northern shore of Oahu, a major expansion of the existing air base on Ford Island, and the development of air facilities on Midway, Johnston, and Palmyra islands, at an estimated total cost of $15,505,000.

The contractor, designated as Pacific Naval Air Base Contractors, was a combination of three construction companies, each a specialist in its own field.

For some time prior to this beginning, deficiencies other than those concerning aircraft had been manifest at Pearl Harbor. Additional ship-repair facilities were needed; also, fuel storage, housing, electric-power and fresh-water systems, greater anchorage area within the harbor and additional piers and wharves; in fact, improvements and additions of every category were essential to strengthen our main fleet base in the mid-Pacific.

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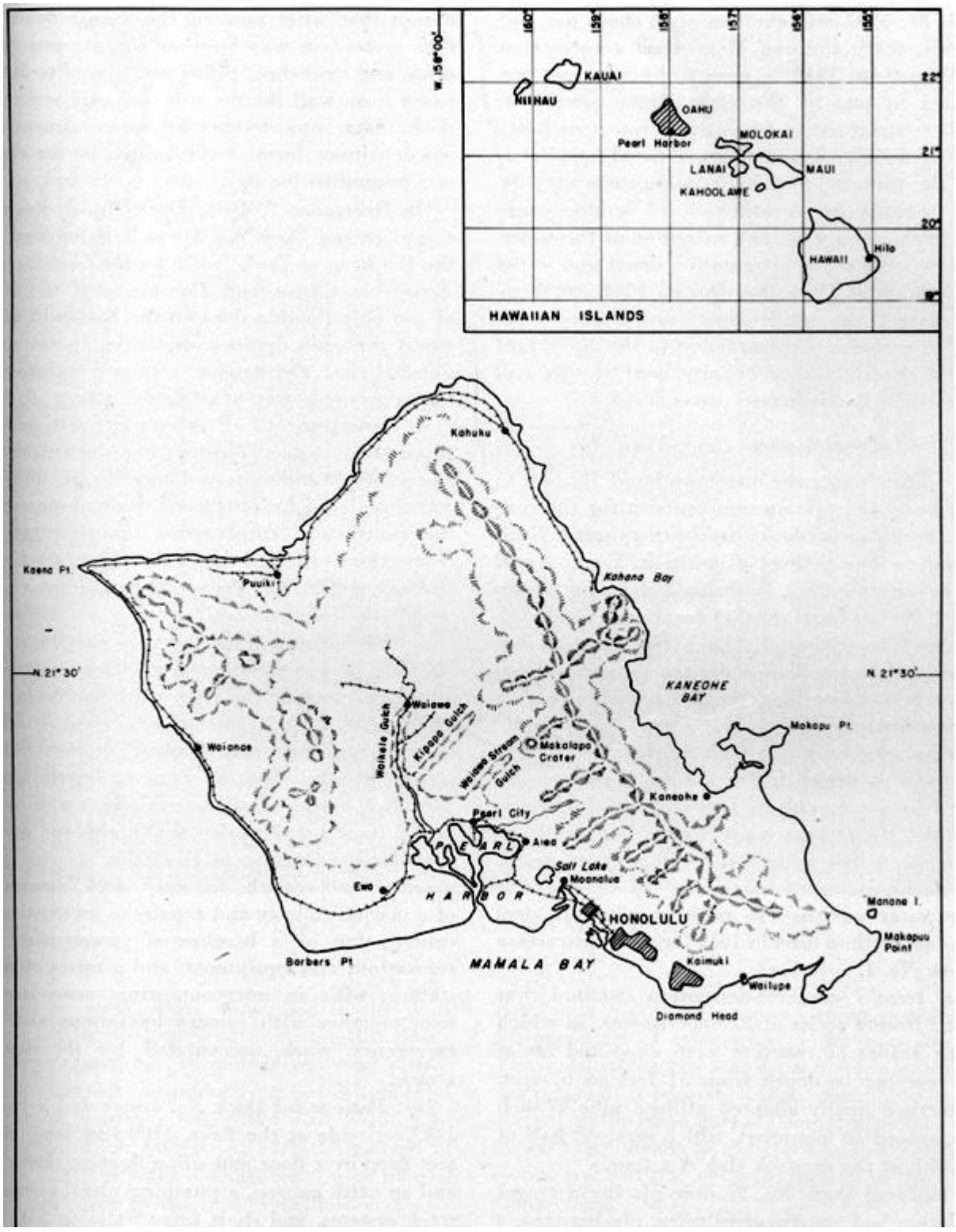
In view of this situation, a second major contract was awarded on December 22, 1939, for the construction of two new graving docks adjacent to the existing battleship dock, then in operation. Dock No. 2 was a 1000-foot battleship dock; Doc No. 3 a smaller structure, 497 feet long, for destroyers and submarines. A lump-sum contract was awarded jointly to two companies for the work at an estimated cost of $7,000,000.
In 1940, two additional contracting firms joined the three known as Pacific Naval Air Base Contractors, and a new CPFF contract, to replace the earlier one, was executed on July 1, 1940, covering construction at an estimated cost of $30,870,000. A year later, in July 1941, three more firms were added to the PNAB [Pacific Naval Air Base] contractors. When the contract was terminated, on December 31, 1943, the total construction and procurement costs had exceeded $692,000,000.
On October 12, 1940, a third CPFF contract was awarded jointly to three local contractors, covering a program of miscellaneous construction areas outside the navy yard.

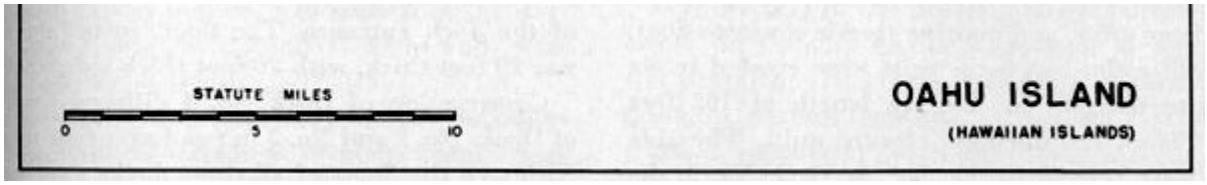
The two-year period between the start of construction in the fall of 1939 and the outbreak of war with Japan was one of intensive and sustained activity. Major extensions were made to industrial facilities in the navy yard, including additional drydocks, power plants, shops, storehouses, piers, wharves, barracks, office buildings, cranes, mechanical equipment, and various utilities. The major undertakings of the approved program for the yard were usably complete by December 7, 1941. Particularly noteworthy was the completion of Dock No. 2, during the week prior to the Japanese attack, to a stage which permitted the emergency docking of the cruiser Helena, which was torpedoed during the attack.
Important construction was begun at Kaneohe and at Barbers Point on Oahu, on the islands of Maui, Midway, Guam, Wake, Johnston, Palmyra, and Samoa, and at Cavite in the Philippines. All these facilities, except those at Samoa and Guam, were in use before December 7, 1941. Extensions to submarine facilities were undertaken at Pearl Harbor and Midway. A new supply depot on Kuahua Island, a tremendous underground fuel-storage project, a new hospital, a new radio station, extensions to ammunition storage, and an extensive dredging program were also in progress at Pearl Harbor. Concurrently with these developments, five major housing projects with a capacity of 20,000, were being built to house civilian and naval personnel. These were accompanied by an extensive program for making personnel, power, and communication structures bombproof.
On October 4, 1941, a fourth fixed-fee contract was awarded for the building of another battleship drydock, Dock No. 4, and a 20,000-kw bombproof power plant. The contractor, already at work on Docks No. 2 and No. 3, began work on these new facilities during November.
To achieve flexible control of the contract, under the emergency conditions following the attack, it was imperative to establish the cost-plus-fixed-fee relationship possible under a CPFF contract. The lump-sum contract was therefore terminated on December 7, 1941, and Docks No. 2 and No. 3, which at that time were 90-percent complete, were finished under a CPFF contract.
In addition to the completion of Docks No. 2 and No. 3, and the construction of Dock No. 4 and the new power plant, the new CPFF contract included construction of a 3000-ton marine railway, several bombproof electrical sub-stations with an interconnecting power-loop system, erection of several 50-ton cranes at each drydock, and salvage operations made necessary by the December 7 attack.
The work under these contracts continued over a period of four and a half years, on sites which extended from Port Hueneme in California to Cavite in the Philippines, a distance of 7000 miles; at one time, 26,000 persons were employed by the contractors.
Extensive dredging operations were required at the outlying islands and at many places in the Hawaiian group. Thirty million cubic yards were dredged; the deepening of Pearl Harbor waters accounted for 13,000,000 cubic yards.
Five quarries were operated on Oahu to obtain the required concrete and paving aggregates. Although the manufacture of cement was considered, no plant was built because of the time element involved. Consequently, cement was shipped from the mainland, largely in bulk, an operation which required the continuous use of two ships.
At Guam, Wake, and Cavite, work was terminated by enemy action. At Midway, Johnston, and Palmyra, the contractors' forces were withdrawn during the summer of 1942 and were replaced by Seabees. The first of these battalions, the 5th, arrived at Pearl Harbor in June 1942, to be followed by the 10th in September and the 16th in October. Each battalion was sent forward immediately to carry on programs left unfinished by the contractors.

Immediately after the December 7 attack, the construction program at Pearl Harbor slackened briefly while a large portion of the contractors' personnel and equipment were engaged in rehabilitation work and emergency defense measures. Following this period, however, the program went forward with renewed vigor and at the same time expanded immensely beyond its pre-war dimensions.

In view of a tightening labor market on the mainland by the spring of 1943, it became necessary to send Seabees to Hawaii to expedite new construction, which had extended far beyond the original navy yard limits. Initially, these battalions undertook new projects, supplementing the contractors' forces, but eventually they replaced the contractors' personnel and brought about a gradual curtailment of contract activities.

The termination of the earlier contracts by





Oahu Island
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March 31, 1944 and the use of Seabees did not, however, mark the end of contract construction. On August 16, 1943, a new CPFF contract was awarded to one of the eight firms comprising PNAB contractors. In its initial form, it included a 3200-bed expansion of the new naval hospital at Aiea, the conversion of 350 housing units into 700 small apartments, construction of a three-story BOQ [Bachelor Officers' Quarters] in the navy yard, and extension of the water-supply system at the ammunition depot and at the radio station at Lualualei. During 1944 and 1945, this contract was supplemented many times to include extensive new construction in the Navy yard and the Pearl Harbor vicinity, and it was still active when the Japanese surrendered.

Pearl Harbor Navy Yard

Two years before the attack on Pearl Harbor, in December 1939, a lump-sum contract for the construction of two drydocks had been awarded. Built adjacent to the existing battleship dock, which had been in use since 1919, Dock No. 2 was a battleship dock, 1000 feet long and 133 feet wide, with a 46-foot depth over the sill; Dock No. 3, a smaller structure accommodating destroyers and submarines, was 497 feet long and 84 feet wide, with a 22-foot sill depth.

Both docks were built of reinforced concrete supported on steel-pile foundations. Four pumps, located in a pump-house between the two docks, controlled the unwatering. Closures were made by steel caisson-type gates. In building portions of these docks, the tremie method of placing concrete under water was used in preference to the steel cofferdam method used in 1910 for the construction of Dock No. 1.

The tremie concrete-deposition method was evolved from a series of 22 experiments, in which various grades of concrete were deposited under water varying in depth from 51 feet to 67 feet. The method finally adopted utilized nine 17-inch pipes, spaced 10 feet apart, which serviced half of the width of the drydock slab at a time.

In building Dock No. 2, after placing a gravel foundation bed, driving steel piles, placing tremie truss floor units, and pouring tremie concrete floor, side-wall cofferdam form units were erected in six opposite pairs of an average length of 162 feet with 90-foot intermediate closure units. The side walls were poured in the dry.

At Dock No. 3, the construction was similar to that for Dock No. 2, except that, after pouring the tremie floor, a closure cofferdam was built at the entrance to the dock, and steel sheet piling was placed to form the outer form wall for the side and end walls of the dock. After unwatering the entire structure, the wooden inner forms were built, and the concrete was poured in the dry.

On December 7, 1941, Dock No. 2, was usably complete and Dock No. 3 was half finished. After the blocking of Dock No. 1 by the burning of the destroyers *Cassin* and *Downes*, and the sinking of the only floating dock in the harbor, Dock No. 2 was the only drydock available. It was not yet finished, but the caisson gate was in place and emergency use was practicable, a fact of the utmost importance to all subsequent salvage operations. The cruiser *Helena* was docked here on December 10 and remained until the 21st. The dock was unwatered by pumpwell drainage pumps and the contractors' construction pumps. Temporary connections provided the ship with air, fresh water, and salt water. The dock was completed while in use.

A CPFF contract for the construction of Dock No. 4, a power plant, and mooring facilities for aircraft carriers at the navy yard, had been signed on October 4, 1941. After the Japanese attack, the assigned projects were changed in part and augmented. Specifically, the work under the contract consisted of the completion of the two docks then being constructed under the lump-sum contract, and the construction of Dock No. 4, with appurtenances and services for each dock, construction of a marine railway and repairs to an existing one, construction of a bombproof power plant with substations and equipment, and a series of switch-stations with an interconnecting power-loop system, together with salvage operations and other emergency work necessitated by the Japanese attack.

Installations for Dock No. 4 included a drydock, 147 feet wide at the floor, 1100 feet long, and 47 feet deep

over floor and sill, 1100 feet long, and 47 feet deep over floor and sill, a floating caisson gate and an extra caisson, a pumping plant, service and track systems, and short quay walls on both sides of the dock entrance. The floor, including finish, was 19 feet thick, with 20-foot thick side walls.

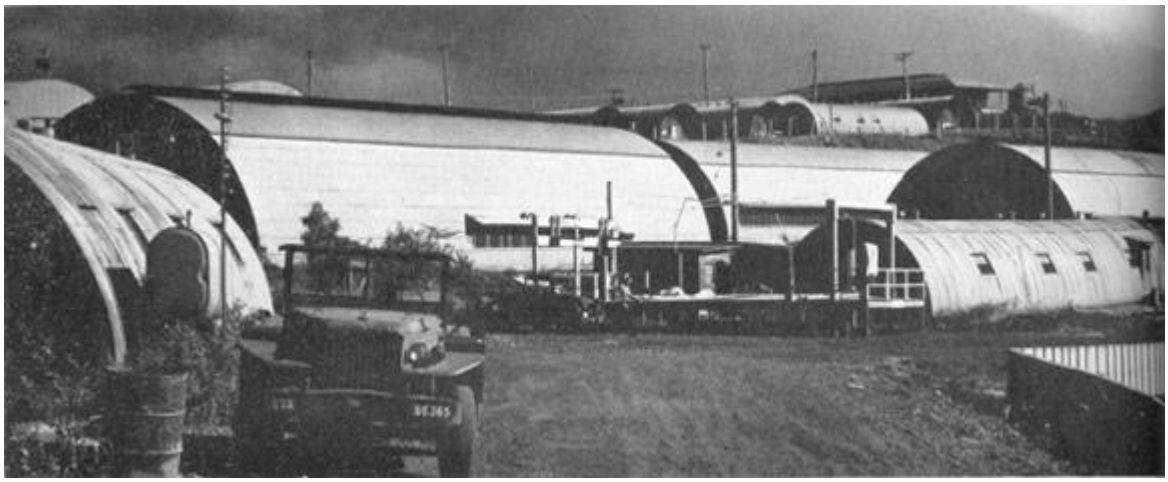
Construction of Dock No. 4 differed from that of Docks No. 2 and No. 3 in two important respects. Although the floors of all three docks were poured by the tremie method, Docks No. 2 and No.3 were

Dry Dock No. 1, Pearl Harbor Navy Yard

supported on steel piling, imbedded in the floor slabs, to aid in resisting hydrostatic uplift. Dock No. 4, in contrast, was supported on wood piling, driven to compact the underlying soil. These piles were cut off 6 inches below the slab bottom, to insure against their interfering with the placement of forms. Also, the walls of Dock No. 4 were poured to high-water line by the tremie method, and only the top, or gallery section, was poured in the dry; whereas, in Docks No. 2 and No. 3 the walls were poured entirely in the dry.

The success of construction operations depended upon the skillful integration of many plant set-up items. For example, the 350-foot-span gantry crane, which had been used in the construction of Docks No. 2 and No. 3, was moved without disassembly, by extension of its tracks to the new location. The original gantry cantilever extension was removed and a second bridge gantry crane was erected on the same tracks. These two gantries were the primary means of constructing and placing all forms, and carrying concrete buckets to the tremie rigs.

Pile driving, in the dock's inboard portion, was begun on October 12, 1942, as soon as dredging was complete. This was done for a sufficient distance to permit handling of floating equipment without interfering with the dredge. A total of 9,694 piles, averaging 30 feet in length, was driven. The work was completed on December 22.



Barracks at the Staging Center, Pearl Harbor

Piles were cut off by an underwater circular saw, driven by a barge-mounted motor through a vertical shaft. Cutting-off operations were begun on November 4, 1942, and completed on January 14, 1943. Placement of the rock blanket, the foundation for tremie concrete, was begun on November 9, using 3-inch quarry waste. Rock was placed through a 36-inch steel pipe from a 12-yard steel hopper at the upper end, through the water, to a flat-bottomed section at the lower end, set at the elevation of the top of the rock blanket. A 2-foot layer of rock, topped by a 3-inch layer of sand, furnished a smooth, even bed for setting the forms, which were begun December 7, 1942; the first concrete was poured on December 19.

Tremie concrete for the dock floor was poured through eight 17-inch pipes, supported by pontoons. These pipes led from eight hoppers to the bottom of the floor slab, with an individual drum for each, operated by hoisting engines, which raised and lowered the pipes. This arrangement poured half a bottom form at one pour. For the side walls, two 3-pipe tremie rigs operated simultaneously on opposite sides of the dock. The gantries picked up six-cubic-yard buckets, brought by truck from the concrete plant, carried them out, and dumped them into the pipe hoppers. A form containing 785 cubic yards of concrete was thus poured in three and a half hours. Side-wall forms nearly 50 feet long were poured slowly, in one lift to a height of 69 feet. It required 24 hours to finish both sides of one section.

By May 20, 1943, all tremie concrete had been placed. Unwatering was begun on June 11, with the caisson in place and the side walls complete, except for pumpwell sections which were enclosed by steel sheet cofferdams. The dock was completely emptied on June 13 and slab surfaces were leveled by chipping and blasting, before the 18-inch floor finish was begun. A 125-man detail from the 62nd Construction Battalion assisted in this operation.

The dock was ready for emergency use by July 19, 1943. By October 1, 1943, the main pumps were ready for operation and the floor and bottom altar were complete, with keel blocks in place and all lines connected. The first docking occurred on October 6, 1943.

The new 3,000-ton, 836-foot marine railway for handling destroyers and submarines, was begun on January 1, 1943, and placed in operation September 15, 1943. It was constructed under water by tremie concrete methods. Dredging entailed the removal of 50,000 cubic yards.

In constructing the marine railway, reinforced concrete groundway sections, in units approximately 18 by 120 feet, were precast on a casting wharf erected adjacent to the railway site. A 150-ton floating crane lifted sections from the wharf, placed them upon previously driven timber piles, and, after being exactly positioned with jacks, they

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Supply Department Warehouse, Pearl Harbor Navy Yard

were fixed, by masses of tremie concrete poured around each girder, for the entire length.

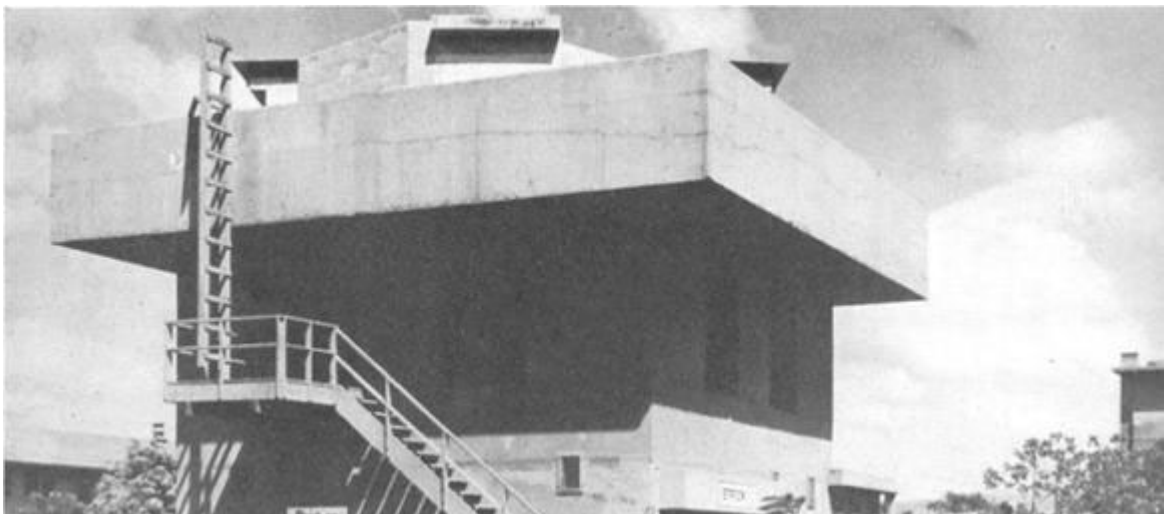
As originally planned, the service wharf for the marine railway was to be 60 feet wide and 450 feet long. Upon investigation, it developed that a wider pier would be required to afford sufficient operating range for a 50-ton traveling crane operating on a 28-foot-gauge track, and the dimensions were increased to 70 by 570 feet.

The wharf consisted of a concrete deck, half of which was supported on land and half on piles. In addition to the tracks for the 50-ton crane, it carried narrow-gauge rail tracks. Both tracks connected with Dock No. 3. Heavy reinforced-concrete girders were constructed for the crane rails and bore chiefly on the concrete piles. These girders rested, at their inboard ends, on concrete columns which bore on stepped spread-footings. The remainder of the wharf rested on concrete piles driven into the hard underlying coral sandstone. Wood form-work was built on the piling, and the concrete was poured in the dry.

The power plant, substations, and associated buildings were of bomb- and splinterproof construction. All bomb-proof construction was of heavy reinforced concrete.

The bombproof power plant, simple in design, was notable for its massive, windowless construction. It was divided into four nearly equal areas, containing boilers, turbo-generators, and air compressors.

Protected fuel-oil storage was provided in two



Small Bombproof Power Substation, Pearl Harbor

pairs of 25,000-gallon underground tanks, shielded by a reinforced-concrete mat.

Two 10,000-kw turbo-generators, with necessary boilers, and with switch-gear and all control devices, were installed.

The new electrical-distribution system designed to provide 11,500-volt, three-phase, 60-cycle power characteristics, augmented the existing navy yard system. This new system was a modification of the existing service in that it effected a change from radial distribution from the central power house, to a network transmission system in which the navy yard was divided into approximately equal power areas, each supplied from switching stations interconnected to the several independent sources of supply.

Installation of cables, nearly all in underground ducts, was complicated by the necessity for performing the work in the face of constantly multiplying yard activities and power load, by the progress of new construction projects of major importance, and by the demand for temporary power facilities. Wherever possible such temporary services were so installed as to permit their later incorporation into the permanent system.

Major additions were made to the industrial shop facilities, principally in areas adjacent to the drydocks. The administration building was enlarged; water, sewer, and communication facilities were expanded. A bombproof communication center was built, together with concrete personnel shelters and casualty stations. Available berthing space was greatly increased by constructing quay walls and bulkheads. Additional barracks, housing for transient naval personnel, an elaborate system of paved roads, extensive railroad trackage, several laundries, a fuel station, warehouses, and many miscellaneous buildings were also constructed.

In making improvements to the harbor and channels a total of 13,000,000 cubic yards was dredged. The initial dredging program, which was started in May 1940, to provide a turning channel around the periphery of Ford Island, grew to include the

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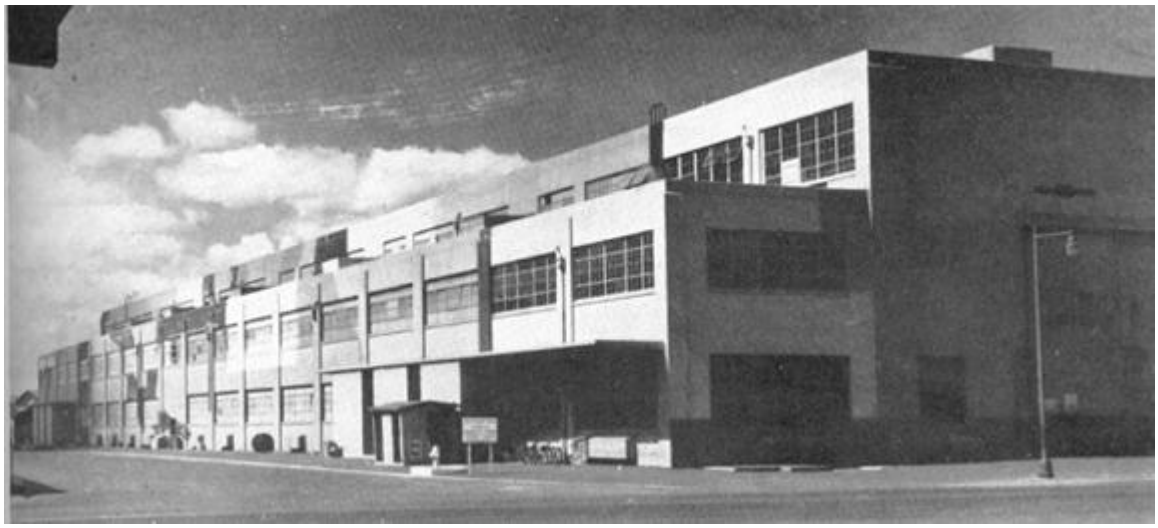

Ordnance Shop, Pearl Harbor Navy Yard

deepening of West Loch, Middle Loch, East Loch, and Magazine Loch to provide a mooring area for fleet units within the harbor. The channel to the sea was also deepened.

Salvaging of ship and property and the rescue of personnel began December 7, 1941.

For salvage operations, methods were developed for underwater patching with timber, steel, and concrete, or combinations of these materials; an elaborate system of struts, anchors, tackles and winches was used to right capsized ships.

Salvage work was of two kinds: repairs to damaged vessels still afloat, although seriously flooded, as in the case of the*Pennsylvania*, *Maryland*, *Tennessee*, *Helena*, *Honolulu*, *Raleigh*, *Vestal*, and *Curtiss*; and the raising, flotation, and repair of the sunken or grounded vessels *Shaw*, *Nevada*, *California*, *West Virginia*, *Oglala*, *Arizona*, *Oklahoma*, and YFD-2 [Floating Drydock, No. 2].

Much of the material and equipment necessary for salvage operations had to be shipped from the mainland, and did not arrive until February 1942. Without waiting for its arrival, however, the contractor's forces began work. Divers and available equipment were diverted from work on Docks No. 2 and No. 3 to patch holes in the *Nevada*. Beneath 30 feet of water, holes were patched with concrete or with combinations of timber and steel and were sealed with tremie-placed concrete. The ship was then pumped out, floated, and placed in drydock, where repairs were made by the Navy.

In salvaging YFD-2, the contractor designed, constructed, and placed a 40-foot-square patch under the bottom shell, so designed that it created a chamber 4 feet deep below the hull, which permitted repairs to the frames and bottom-shell plates. Divers patched more than 200 holes.

From surveys made and data furnished by the Navy, the contractor also designed and constructed steel and timber patches which were applied, under 40 feet of water, to the *West Virginia*.

The contractor's engineers then prepared to raise the *California*. Deck cofferdams, assembled on shore in large units, were placed forward and aft, and the torpedo holes were closed with tremie concrete. When salvage work had reached the pumping-out stage below decks the ship was turned over to the Navy for flotation.

It was decided to occlude water from the main-deck openings by building a fence-type cofferdam around its edge and pumping out the vessel without patching. The ship was successfully floated on March 24, 1942, permanent repair of all underwater damage was made by yard forces, and on June 7, 1942, she was released from the dock.

The *West Virginia* had been moored outboard the *Tennessee* on December 7. She took several torpedoes, and two large bombs damaged the

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vessel's port side and amidships superstructure. There was also extensive oil-fire damage from internal explosions and the fire which had spread from the *Arizona*, moored a few yards astern. As a result, the *West Virginia* rested on the bottom, with a three-degree list, the port side of the main deck slightly immersed.

Visible damage was extensive, and underwater survey indicated that flotation would be difficult. The initial plan, to drive a sheet-piling cofferdam around the ship which would expose underwater damage and permit temporary repairs, proved impracticable because of the porosity if the coral bottom. Finally, two large cofferdam patches were set, installed in sections 13 feet long by 50 feet deep, with the ends sealed by underwater concreting. The ship was floated on May 17 and drydocked June 9.

On December 7, the *Oglala* had been berthed, port side to, outboard the *Helena*, when an aerial torpedo passed under her and struck the *Helena*. The resultant pressure wave sprung the *Oglala*'s port bilge area and permitted slow flooding. As capsizing was likely to foul the *Helena*, the *Oglala* was towed clear, and capsized against the dock, astern of the *Helena*.

It was necessary to salvage the *Oglala* at once as she obstructed a needed berth. The plan was, first, to right her, and then raise her by means of a deck-edge cofferdam. She was righted by attaching ten submarine salvage pontoons to the main weather decks and was placed in Dock No. 2 on July 3, 1942.

In contrast with the foregoing salvage projects, the operations connected with the *Arizona*, *Oklahoma*, and *Utah* were major undertakings. Cables and winches, installed on Ford Island, were used to right the *Oklahoma* and the *Utah*. The *Arizona*, however, was resting on the bottom, her back broken.

The *Oklahoma* had capsized, after rotating through an arc of 150 degrees; masts, cranes, stacks, turrets,and all superstructure were buried in the mud.

The vessel was righted by utilizing submarine-salvage pontoons attached to the mud-buried structures, then reducing the internal water level by air pressure, and, finally, by hauling winches rigged on Ford Island to exert a turning moment through wires running over a leverage strut built on the ship's bottom and attached to the starboard side-blister. She was then raised by means of a fence-type cofferdam, installed around the entire

the starboard side blister. She was then raised by means of a fence-type cofferdam, installed around the entire main deck.

As the ship was pumped out, small leaks were plugged by divers. A number of leaks had developed through the hull of the ship, but were concealed by the blister, which had been crushed against the hull when the ship rolled over. Divers had to cut their way through a tangled mass of blister steel to find and plug the leaks in the main hull, a task which required three months. The *Oklahoma* was afloat on November 17, 1943, and was towed into Dock No. 4 on December 28.

The *Utah* (a target ship) had been moored on the west side of Ford Island. She had been struck by three torpedoes on the port side, which caused her to rotate through an arc of 165 degrees, before capsizing. Naval forces effected considerable salvage of material before any righting operations were undertaken by the contractor. The ship was rolled over, by using approximately the same equipment and methods as those used for the *Oklahoma*. However, after the ship had been raised to within 38 degrees of normal, work was suspended by Navy order.

The *Arizona* had been struck by several bombs and a torpedo. Navy divers found that the forward structure had been completely wrecked. The two forward turrets and the conning tower had dropped 20 feet vertically, indicating collapse of the hull.

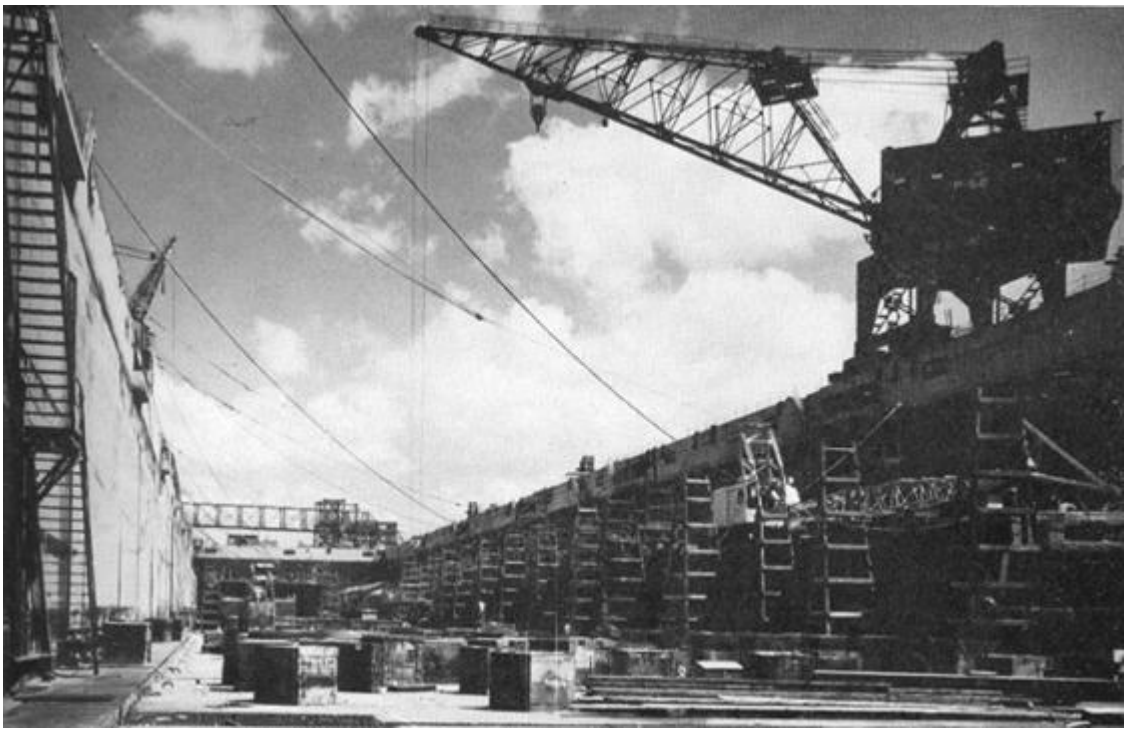
It was possible that the after part of the ship might have been floated, after severance from the forward structure, but the value of the salvaged half would not have been sufficient to warrant the work involved and the tying up of drydock facilities. Porosity of the coral bottom prevented use of a sheet-piling cofferdam around the ship.

Work actually done by the contractor had included only exploratory work, method design, and estimates for raising, when, on May 22, 1943, salvage operations were ordered cancelled.

Submarine Base

The Pearl Harbor submarine base was established in 1920 on a 32-acre site adjacent to the industrial section of the navy yard. Under the war program, existing facilities were expanded to the limits of the land available. New work provided additional personnel and industrial facilities and major improvements along the waterfront to supply additional berthing area.

A fourth story, of temporary frame construction,



Dry Dock No. 4, Pearl Harbor Navy Yard

was added to the existing barracks, together with six, 200-man barracks and additions to the officers' quarters. Within the industrial area, several storehouses, a two-story fire station, a warehouse for submarine spare parts, several shop buildings, and additions to the torpedo-overhaul shop were built. The existing waterfront

several shop buildings, and additions to the torpedo overhaul shop were built. The existing waterfront structures were extended by a 1520-foot quay-wall, equipped with fuel, air, and water lines. A berthing area was developed, with two finger piers and extensive quay-wall area. The battery-charging shop and the electrical-distribution system were enlarged and improved.
During 1944, the 62nd Battalion built a machine shop and a compressor building and developed a related program of minor construction.

Storage Facilities

Before the course of the war required the establishment of bases and staging points in advanced areas, Pearl Harbor was the storage and issue point for most of the stores, fuel, and equipment used in the Pacific. For advanced operations, after the outbreak of the war, these supplies had to be stock-piled in such quantities as to provide for unforeseen demands, a problem which was solved by the construction of warehouses, storage yards, and fuel tanks.
When the program began, early in 1940, storehouses were added to those already within the navy yard, but, as the demand for space increased, it became necessary to develop new areas outside the yard, a process which continued steadily until the Japanese surrendered. The new areas included Kuahua Island, Iroquois Point, Pearl City Peninsula, Waipio Point, Wiawa Gulch, leased areas in the city of Honolulu, and a wide area which was developed as an advance base supply depot, a Marine Corps storage area, and a supply depot annex.
Kuahua Island.--Kuahua Island was the site of the fleet supply depot. Before large-scale development began, Kuahua was a 47-acre island, connected to the mainland by a narrow causeway. Spoil from dredging operations in Pearl Harbor was used as fill material to extend the island until

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it formed a peninsula with an area of 116 acres. Reinforced-concrete quays were erected around the periphery of this peninsula to confine the fill and provide additional berthing space.
Existing buildings on Kuahua Island, in the fall of 1941, consisted of eight one- or two-story structures, six of which were ultimately used as storehouses. The other two were converted into shops, one for mine craft and the other for torpedoes.
Six multi-story, reinforced-concrete storehouses were erected for dry provisions and miscellaneous stores, in addition to a five-story cold-storage building. The main portion of this structure was 280 feet long by 120 feet wide. On each floor were two rooms, 120 by 60 feet, each, in which a temperature of four degrees could be maintained. These rooms were flanked by service corridors, each containing two elevators. Other rooms in the building could be maintained at varying temperatures. One-story extensions, 30 feet wide, housed offices and refrigeration machinery. This work was completed by the contractors in the fall of 1943.
To increase berthing space at the depot and to facilitate transshipment of cargo, a 150-by-600-foot pier was built of concrete on concrete piles. It was equipped with railroad tracks and an open transit shed, 75 by 450 feet. Berthing space on each side of the pier brought to twelve the total number of ships which could be docked at the depot at one time.
Merry Point.--Merry Point was also used by the supply department as a storage and shipping area. Prior to the expansion program, quays had been built on two sides of this triangular spit of land and the waterfront developed for ship mooring. There were two buildings; one, near the center of the triangle, was converted to use as a lubricating-oil storehouse, and the other, a one-story frame structure, had recently been constructed as a cold-storage building. The contractors erected five temporary wooden storehouses along the north quay and paved the area at its eastern end for cargo sorting and handling.
Within the navy yard, a five-story reinforced-concrete storehouse was built for general and miscellaneous dry stores. This building, 180 feet wide and 500 feet long, was provided with an 18-inch concrete roof slab, which made it partially bombproof. A bombproof command center was constructed on the ground floor. Six freight and two passenger elevators served the building.
Interposed with the other facilities within the yard, many other warehouses were erected. Most of them were of one-story wood-frame construction, varying in size from a small office building to a temporary shed. Railroad spur tracks and paved roads were provided to facilitate the movement of material.
To relieve congestion in the yard and to disperse supplies, several sites on the island of Oahu were developed for additional storage. A plot of ground, known as the Damon Tract, was one. Here, the contractors erected 25 temporary one-story wood-frame buildings, the largest of which was 240 by 500 feet. One building, 300 feet long, with four 100-foot wings, was used by the Seabees as brigade headquarters. Another, 61 by 160 feet, was used as a dry-cleaning plant, and included equipment for the repair, renovation, and storage of special

winter clothing.

Two battalions, the 64th and the 90th, were assigned the completion of the project after the contractor's forces were withdrawn upon termination of the contract. Minor construction was finished by a maintenance unit.

Pearl City.--The base of the Pearl City Peninsula was selected as the site for another storage area. The contractors erected three 130-by-550-foot one-story frame warehouses with concrete floors. A railroad spur was installed with three shorter spurs extending between the buildings. The ground around the structures was paved with asphaltic concrete. A 100-by-500-foot oil-drum shed, was also erected. Two smaller open sheds for cable storage and a Marine guard building completed the development.

Pearl City Peninsula was also the site of the spare parts distribution center and other supply depot warehouses, known as the Manana Supply Center. The spare parts distribution center, built by the 117th Battalion, between March and September 1944, contained 18 warehouses which provided 626,000 square feet of covered storage space. Portions of other battalions assisted the 117th in developing 20 buildings for the supply depot.

Waiawa Gulch.--An aviation supply depot was built at Waiawa Gulch, where 50 wood-frame structures were erected by the contractors. Open-storage areas, which stretched along the banks of Waiawa stream for 2 miles, were connected by paved roads. A road also connected the Waiawa development to an auxiliary area, just south of the Manana storage

Reinforced Concrete Storehouse, Naval Supply Depot, Pearl Harbor

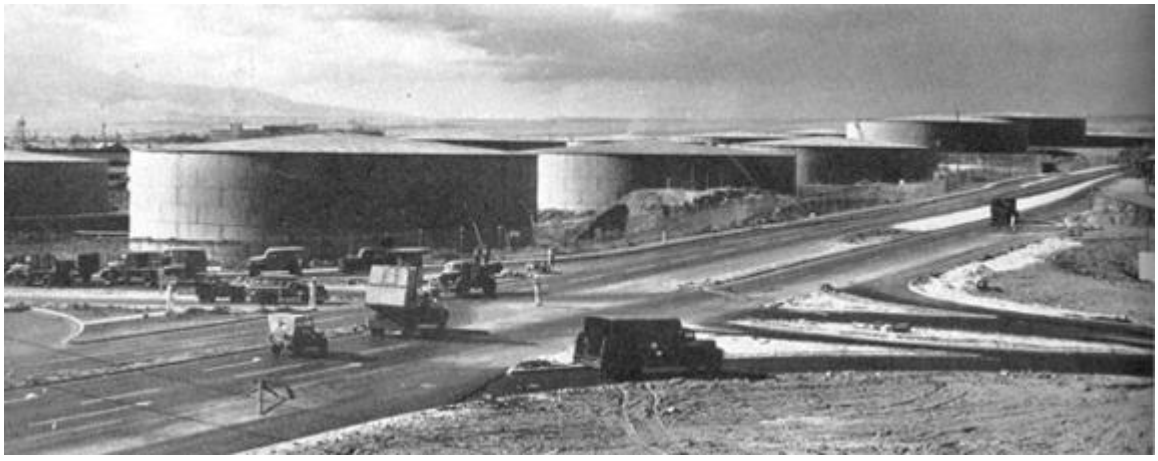
area, containing 20 warehouses, erected by the Seabees.

A waterfront terminal for the aviation supply depot was built at the southern tip of Pearl City Peninsula, adjacent to the Naval Air Transport station. Two wharves, each 400 feet in length, were built for mooring carriers and supply ships, and six wood-frame sheds were erected for the sorting and temporary storage of cargo.

ABCD Salt Lake.--At the Salt Lake storage area and advance base construction depot, eighteen 80-by-190-foot wood-frame warehouses, together with several smaller utility structures, were erected by the contractors. One of the larger buildings housed a coffee-roasting plant which had been transferred from Mare Island. Seabees set up fifteen 40-foot-by-100-foot quonset warehouses and graded the entire area, including 20 acres for open storage. They also erected a heavy equipment overhaul depot, consisting of 8 quonset warehouses and 12 wood-frame buildings.

Miscellaneous Storage Construction.--A supply annex, including shipping facilities for the advance base construction depot, was built by Seabees at Iroquois Point. The 98th Battalion started the work in May 1944; it was relieved by the 43rd, which completed the work in the spring of 1945. An area of 342 acres was graded and surfaced with coral, and 24 quonset warehouses, six 96-by-283-foot, one-story, wood-frame warehouse, and 4 miles of railroad were built. Approximately 2,000 feet of docking space were provided for the receiving

and shipment of material.
Within the city of Honolulu, more than 30 buildings and areas were leased by the Navy for the use of the district supply department and for the storage of aviation supplies for the Honolulu naval air station. Five piers and wharves were also leased for use by the supply department and the contractors.
Waipio Point.--A salvage area at Waipio Point was developed for use by the supply department. This activity, which reclaimed usable parts and metal from ships which were damaged beyond repair, was equipped with a 225-foot T-wharf, a 60-by-160-foot warehouse, and a paved working area of concrete and macadam.
Underground fuel storage.--The military risk involved in fuel-oil storage at Pearl Harbor had long been the subject of discussion. In its 1938 report, the local shore station development board had pointed out that experience had proved fueling facilities inadequate for considerable fleet concentrations, even in time of peace. Studies were undertaken to determine the best method of solving the problem. The Bureau of Yards and Docks



Upper Tank Farm, Pearl Harbor

suggested several methods, including tanks placed underground to the point of concealment only; pre-stressed, circular, reinforced-concrete tanks, concealed by cut-and-cover methods; steel-lined concrete tunnels; and underground steel tanks. It was decided that tunnel-type storage, with vertical-type cylindrical, domed vaults of prestressed, reinforced concrete, with inner steel linings, was the most practical.
The underground fuel-storage project, in its completed form, provided for the storage of 5,400,000 barrels of fuel oil and 600,000 barrels of diesel oil, a total of six million barrels, stored in twenty vaults arranged in two parallel rows. The vaults were cylindrical in shape, 250 feet high and 100 feet in diameter, with dome-shaped tops and bottoms. The interiors were lined with sheet steel and backed with concrete. The tanks were connected by pipelines through a tunnel which was excavated from beneath the vaults, to an underground bombproof pumphouse. Oil was received and issued at a concrete fueling pier and transferred from the pumphouse to the pier through underground pipelines.
Construction of the storage vaults involved numerous features for which no precedent was found in design or construction methods. Although many tunnels had been built in lava in the surrounding areas, no construction had been attempted which required the 10-foot rock span necessary in the building of these vaults. The tank structures were designed to use the rock rather than the steel and concrete to resist pressures.
Work was begun late in December 1940.
Construction methods included first the excavation of two concrete-lined tunnels: an upper and a lower access tunnel. The center lines of the tunnels within the tank area were parallel with, and midway between, the center lines of the two rows of tanks. The upper access tunnel entered the ridge on the north side and was driven at the same grade as the tops of the tanks. The lower access tunnel, which was later used as a portion of the pipeline tunnel, entered the ridge three-fifths of a mile west of the first tank and ran at a grade slightly below the tank bottoms. Cross-tunnels were excavated from the access tunnels to the center of each tank. A belt-conveyor system was installed in the lower tunnel to facilitate removal of excavated material. A crusher and screening plant, erected in the adjacent valley, processed the rock excavated for use as concrete aggregate in the construction of the tanks and tunnels.
On December 16, work was begun on the sinking of pilot shafts, 4 by 5 feet in cross-section, on the vertical

center lines of the first four vaults. When these shafts had penetrated to the lower access tunnels, work was begun on the vaults.

The first work done on the tanks themselves was the construction of the upper domes. In order to avoid the necessity of working above a considerable depth of excavation, only enough rock was

excavated to allow room for the building operation. A ring tunnel, timbered where necessary, was first driven around the spring line of a dome, and a concrete curb ring was placed with a channel-iron bed in its top. The concrete ring was to serve as a sill for the dome while the main portion of the tank was excavated and the walls formed. To speed the disposal of the excavated material, that portion of the pilot shaft from the dome down to the lower access tunnel was enlarged to 12 by 12 feet. Because of the arch action of the rock formation, it was possible to remove the material in the dome are to make a hemispherical excavation, 10 feet high, and to use the channel iron in the curb as a foundation upon which to erect a structural steel falsework, braced against the undisturbed rock, for the steel dome lining. After the reinforcing steel and lining had been placed and welded, the dome was concreted in one continuous pour of 75 hours. Pumped concrete was piped through the pilot shaft from a mixer at the surface. Next, the dome, 8 feet thick at the spring line and 4 feet thick at the crown, was pre-stressed by forcing grout between the concrete and the surrounding rock.

For the excavation of a vault's main cylinder, the pilot shaft was enlarged to 30 feet in diameter. After the shaft enlargement was completed, excavation was begun at the top of the vault, just below the concrete dome, to bring the tank to its final diameter. This operation consisted of blasting the rock in such a manner as to cause the excavated material to slide down the sides of the pit to the shaft and then into the lower access tunnel, where it was removed from the site on the conveyor belt. When the tank was excavated, the exposed rock surface was coated with pneumatically placed concrete. A wash of mud and water then was applied to prevent bond between the concrete lining and the coated rock.

A steel tower, extending the full height of the tank, was erected in the center of each vault. The tower supported concrete chutes, poser cables, and other construction equipment. Piping connections were installed from the lower tunnel to the vault.

For the first, or bottom, section of the lower dome, templates were carefully set along the joint lines for the steel lining. The pre-formed steel-lining sections were welded in place and used as forms for the concrete poured around and under the bottom of the tank. This operation was repeated for the remaining sections of the lower dome, a ring at a time, until the dome was brought to the spring line.

Construction of the vault side-walls, with a thickness of reinforced concrete varying from 4 feet at the bottom to less than 3 feet at the top, was then begun. The walls were built in 5-foot lifts, using quarter-inch steel lining plates as the inside forms. Delivery of concrete into place behind the lining was made as the lining was installed. In general, lining operations were kept two lifts ahead of concreting. The cycle of operations was repeated until the previously completed upper dome was reached. At this junction of the side walls with the upper dome, an expansion joint was introduced to take up possible settlement and to minimize the possibility of rupture to the lining.

Grouting to pre-stress the concrete was then done. Pre-stressing was necessary because of the practical and economical limitations of providing sufficient reinforcement in the walls to take the hydrostatic pressure of the stored oil. The vaults were designed in such a manner that most of the liquid pressure in the tank was resisted passively by the surrounding natural material rather than by the reinforcement in the walls. Grouting of the annular spaces between the walls of the vault and the material around them was intended to fill any voids, to compress any weak areas in the rock envelope, and to place the inner concrete shell under the compressive pre-stress. The reinforcement in the concrete was relied upon for general consolidation of the structure, redistribution of reaction pressures, and to take care of special stress concentrations.

Grout was supplied by a plant on the surface, directly above the tanks. Grout pipes had been inserted in the concrete walls during their construction, and these were used to introduce grout between the rock and the concrete. Grout was fed into the pipes, at one elevation, under a pressure 20 per cent greater than the computed hydrostatic pressure form the oil at the point where the grout was introduced, until the grout was visible in the next series of pipes, 35 feet higher in the tank. The lines were then moved to these pipes and the operation repeated. This cycle was carried out until the entire tank was pre-stressed.

Grouting completed, the tank lining was scrubbed down, with particular emphasis on the joints. The tank was

then thoroughly tested by introducing air under pressure beneath the steel lining, applying soapy water to the inner surface,

and locating leaks by bubbles. As testing of the bottom section was completed, water was introduced into the vault and testing crews worked their way around the walls in boats. Rise of the inflow was arrested every 5 feet to test horizontal joints. After all disclosed leaks had been stopped, the vault was filled with water as a final check.

Work on the twenty tanks was carried on more or less by an assembly-line method. When a crew finished one portion of the work, it moved on to repeat the same operation on the next tank. In this way, it was not necessary to train a large number of men in all phases of the intricate methods of construction that were developed. The first vault was brought to usable completion on September 28, 1942, and by July 20, 1943, all tanks were ready to receive oil.

In addition to the upper and lower access tunnels and the cross tunnels, there also was a long pipe tunnel leading to the pumphouse. Work on the tank end of this tunnel started as soon as the other tunneling was completed, and as more workmen became available, work was started at the pumphouse end. The tunnel was holed through December 27, 1941. The entire amount of tunnel work on the project, including the access tunnels, was more than 7 miles. Within the tunnels, more than 32 miles of pipe was installed, varying in size from 8 inches to 32 inches.

While construction of the first domes was underway, work on the receiving pumphouse and surge tanks was begun. Both were built in open cut, with heavy reinforced concrete, bombproof walls and roofs. Automatic-closing, oil-tight doors were built to prevent flooding of the pumphouse if breaks occurred in either the tunnel or the surge tanks.

A 54-by-1300-foot fuel-oil pier, built of reinforced concrete, provided berthing space for four ships. The installed equipment made it possible to issue oil from the pier at the rate of 20,000 barrels per hour.

Housing

The tremendous expansion of facilities in the Pearl Harbor area gave rise to a concomitant program of housing construction, which began during the fall of 1940 and continued throughout the war period. This housing was built to accommodate civilian employees of the yard, contractors' employees, and naval personnel on duty in the area or in a transient status.

Altogether, five separate housing areas were built, each planned as an independent community, with schools, fire protection, and recreational facilities.

Area One, occupying 90 acres, contained 500 housing units in 155 buildings. Area Two occupied 61 acres and was identical in every respect. Area Three, built on a 192-acre site, had 1000 units in 238 buildings, and was equipped with a laundry, fire station, two large mess halls, and four recreational buildings. Schools were provided in Area One for the combined housing development. These buildings were all two-story wood and cinder-block structures, built to minimum standards.

Area Four, a 2000-man cantonment, erected to house the bachelor employees of the contractors, was also a complete community.

The fifth area, set apart as officer housing, was built on a 362-acre tract at Makalapa Crater. Designated "Makalapa," this area contained 104 houses of varying size and pattern, five large barracks, the administration headquarters for CinCPac, a radio station,. and two large office buildings housing Navy Intelligence. The CinCPac headquarters building was a reinforced-concrete bombproof structure, 60 feet wide, 200 feet long, and two stories high.

Built to house the many thousands of enlisted personnel staging through Pearl Harbor, Aiea receiving barracks was located on a 130-acre tract. Planned to accommodate 10,000 men, the project, begun during the summer of 1942, included two identical camps, each with a capacity of 5000 men. Buildings erected included 117 single-story barracks, two large mess halls, four recreation halls, a dispensary, a dental clinic, a laundry, a bakery, and an administration building. Minimum frame construction was used throughout.

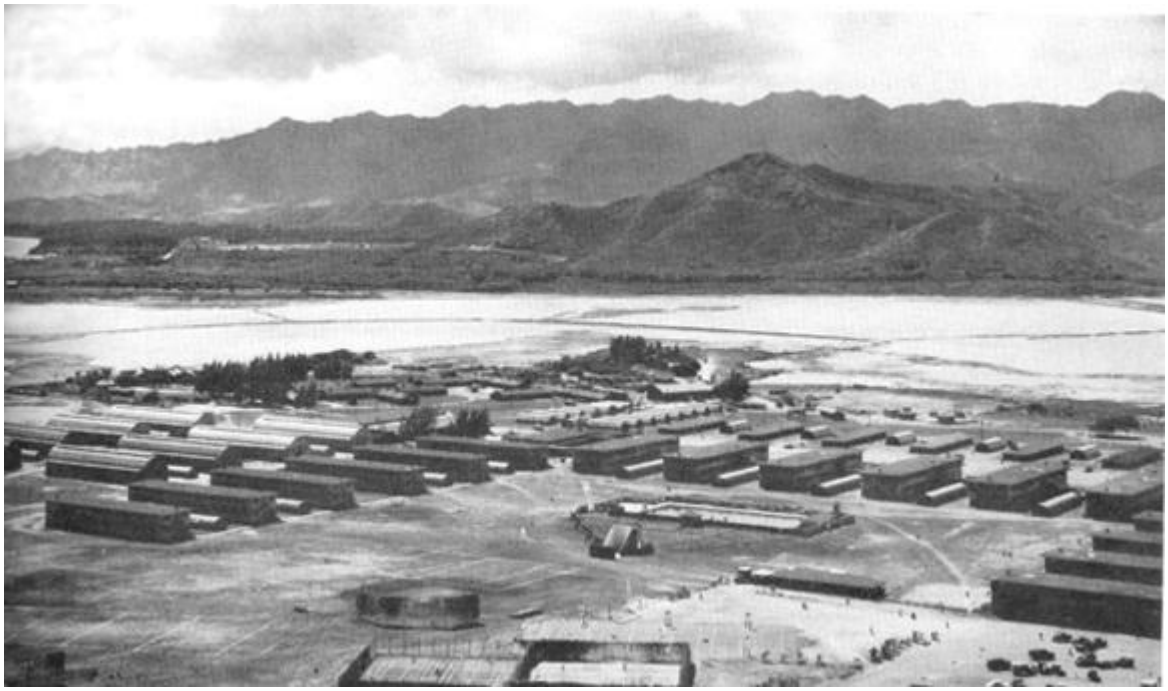
In January 1944, construction was started on a third camp area to house an additional 6000 men in 16 large, two-story frame barracks. This camp was built by the 94th Construction Battalion.

Recreational facilities were developed on a 25-acre site across the highway from the Aiea Barracks, designated Richardson Recreation Center.

Naval Air Stations

Ford Island.--Ford Island, in Pearl Harbor, is flat and entirely covered with pavement and buildings.

At the start of the war-program construction, on November 30, 1939, about one-third of the



Barracks and Recreation Field at Kaneohe Naval Air Station

island was occupied by the Army, and the waterfront was devoted principally to fleet moorings. Construction was begun by a crew of 40 men, who performed hand excavation to locate buried utilities. By mid-December the construction force had grown to 400 men, engaged in the establishment of material yards and construction plants.

Reconstruction of the Army airfield required removal of the existing pavement and grade correction. Asphaltic concrete was used for the landing mat, which, upon completion in June 1941, was 4,500 feet long and 650 feet wide. A concrete warm-up platform, 1300 feet long and 600 feet wide, landplane hangars, administration building, dispensary, bachelor officers' quarters, underground gasoline storage facilities, the main wharf, seaplane ramps and parking areas, the final assembly shops, and miscellaneous storage buildings were essentially complete by December 7, 1941.

During the attack, one seaplane hangar and the dispensary were damaged, and considerable damage was done to the seaplane parking area. Although repairs were quickly effected, the construction program was disrupted for many days while the landing field and hangar area were being cleared of wreckage.

Revetments, personnel shelters, a bombproof command center, and much splinter-proofing were provided, and one of the old hangars was converted into an emergency barracks. A new 16-inch water main was laid across the channel, and the power cable was repaired.

The advent of war also brought heavy air-traffic to Ford Island, necessitating additional gasoline storage. Forty-eight 25,000-gallon tanks were built underground, and the existing surface tanks were splinter-proofed. The original seaplane area was augmented by an engine overhaul shop, five concrete ramps, and extensive parking and warm-up areas. Revetments were built, and mooring facilities repaired.

On the northern shore of the island, two T-wharves of reinforced concrete were built on precast concrete piles. The dredging incidental to their construction provided material which was used to enlarge the island to the extent of seven acres. On the southern shore, a bulkhead, a wharf, and several small-boat slips were built, and a T-

Assembly and Repair Shop, Kaneohe Naval Air Station

wharf was rehabilitated. Many buildings of steel and concrete were erected for the various shops, warehouses, training buildings, and administration offices.

A 10-inch gasoline-distribution loop, completed in January 1943, was installed to supply the fueling pits. Most of the initial construction was complete by this time, and until the termination of the contract in December 1943, attention was directed toward the extension and improvement of existing installations.

Kaneohe.--Pursuant to the Hepburn board recommendations, an adjunct to the Ford Island fleet air base was built at Kaneohe, on a 1830-acre tract on Mokapu Peninsula.

As originally planned, the station was to be a seaplane base with facilities to support five squadrons of seaplanes. Construction commenced in September 1939, under the Pacific Naval Air Base contract, on 42 projects. The major project entailed extensive dredging operations to provide the necessary seaplane runways within the sheltered waters of Kaneohe Bay. Dredging continued for three years, during which time 11,000,000 cubic yards of material were removed.

In the summer of 1940, an airstrip was added to the facilities, with accompanying increases in housing, hangars, parking area, gasoline storage, and industrial buildings. The completed runway, 5,700 by 1,000 feet, was paved with asphaltic concrete.

Facilities built for aircraft operation and maintenance included five steel hangars, five seaplane ramps, concrete parking area, two warm-up aprons, a maintenance hangar, two seaplane hangars, and two Midway-type hangars. Twenty-foot lean-tos for shops and offices were built adjoining all hangars. As most of the buildings were on filled ground, pile foundations were required. Both corrugated asbestos and asbestos-protected corrugated metal were used as walls, partitions, and as roof sheathing on hangars and similar structures.

The gasoline storage and distribution system consisted of 136 underground steel tanks, each holding 25,000 gallons, and was connected with the water-displacement distribution system and five 50,000-gallon and four 25,000-gallon underground, pre-stressed, concrete tanks, equipped with motor-driven, deep-well pumps. The gasoline was pumped from tankers at the fueling pier, through an 8-inch line, to the tanks.

The distribution system included 20 fueling pits on the warm-up apron, each capable of issuing 100 gallons per minute. The 8-inch main around the runway was connected to the concrete tanks and cross-connected to the issue lines, allowing the runway pits to be serviced either directly by pumps from the concrete tanks or from the water-displacement system of the tank farm. Gasoline from the concrete tanks, in addition to being pumped directly to the fueling pits, could be pumped into

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the storage tanks or directly to the fueling pits at the warm-up apron.

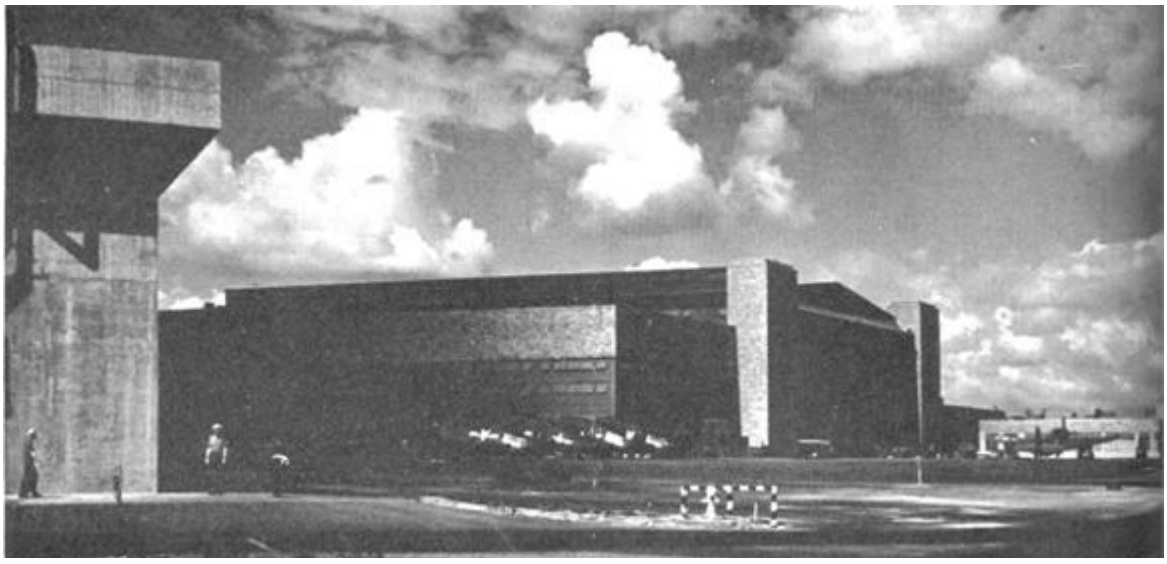
Administration buildings, housing and messing facilities, a hospital, shops, and a storage building were constructed to meet the expanding needs. To care for 9000 men, 23 married officers' quarters, 52 enlisted men's quarters, 15 officers' barracks, and 54 enlisted men's barracks were built. Before the Japanese attack, all barracks were constructed of reinforced concrete, but after the outbreak of war all personnel facilities were built of wood, to conserve critical materials. When the Seabees arrived, they built 16 additional barracks, two-story wood-frame structures which housed 240 men each. Some 30 magazines were built for ready storage of bombs, torpedoes, and small arms.

After the Japanese attack, 50 plane revetments were constructed; vital installations were splinter-proofed; and

After the Japanese attack, 90 plane revetments were constructed, vital installations were splinter proofed, and personnel shelters were constructed.
The Seabees arrived on April 1, 1943, to replace the contractor's forces and take over further construction. The 56th Battalion, the first to arrive, began completion of unfinished projects and undertook the construction of a new bombproof powerhouse and an electrical-distribution system which included 14 concrete substations. They also built an assembly and repair building, 160 by 240 feet, a plating shop, a building for testing engines, and an engine-overhaul building. In February 1944, the 112th Seabees started construction of a second runway, 400-by-5000-feet. This field, paved with asphalt, was completed by the 74th Battalion, which replaced the 112th in November 1944. Major construction at Kaneohe was completed during May 1945, and the following month CBMU 596 arrived for maintenance.

Bachelor Officers' Quarters, Kaneohe Naval Air Station

Barbers Point.--The naval air station at Barbers Point was originally designed as an auxiliary, or outlying airfield, of Ford Island. Construction of the field and related facilities was accomplished under the PNAB contract. Original plans were designed to supply accommodations for land-based operations of two aircraft-carrier groups, with provision for station personnel. Included were plane runways, two hangars, necessary shops, storage, and utilities, and quarters for 2,000 men, 250 officers, and 800 civilian workers.
Additional authorizations after the outbreak of war increased the station's capacity to a point at which it could support four carrier groups. Personnel accommodations were increased to a capacity of 4,000 men, 450 officers, and 1,200 civilian workers. Additional magazines and training facilities were added; the size of runways and plane-parking areas was increased.
Barbers Point development had an advantage over earlier projects in that it was authorized in virtually its final form before work had progressed beyond the preliminary stage. Some changes, both in plan and in type of construction, were made;



Industrial Area, Barbers Point Naval Air Station
Assembly and repair shop in center background

but they were made immediately after December 7, when the work was just getting underway.
In the original conception of the air station at this location, the area now designated as the Ewa Marine Corps station was included. However, as the need for operational strips in the Hawaiian area became more urgent, it was decided to develop additional runways in the Ewa location for use during the construction of Barbers Point, which was expected to be a relatively long-time operation. Field work was started on the Ewa project in September 1940, but after the outbreak of the war the plan to relinquish the field was cancelled, and it was developed as a Marine Corps air station.
Work at Barbers Point was begun in November 1941. Some clearing was started, but with the advent of war the men were needed for the early completion of Ewa Field. As crews completed the work at Ewa, they were immediately transferred to the Barbers Point project. The two main runways at Barbers Point, 8,400 feet long and 1,000 feet wide, were originally laid out with four runways, forming an X, or modified radial layout. These runways were to be 500 feet wide with lengths varying from 3,400 feet to 4,800 feet. Later, it was decided to enlarge the runways by increasing the width to 1000 feet and the overall lengths to 8,400 and 8,300 feet, respectively. With this radial arrangement of runways, control of flight operations was facilitated and the necessity for long taxi-ways obviated, with resultant greater operational economy and traffic capacity.
The only adverse condition encountered during construction was that of voids in the sub-grade, some of them 600 cubic yards in extent, which necessitated filling to provide a stable base for the strips. This condition was cared for by a sluicing operation. Beach sand was dumped on the area and washed into the voids by the use of fire hose. After the sluicing, coral was applied over the whole area to the depth required to bring the sub-grade to the proper elevation. The finished surface of the runways was asphaltic concrete.
An asphalt hot-mix plant with a 4,000-pound batch capacity was installed adjacent to the site. It supplied all the asphaltic mix for the 1,650,000 square yards of paving on the runways, warm-up platforms, and taxiways, for the paving on the Ewa runways, and for all the roads, sidewalks, and parking areas in the southwestern portion of Oahu.
Next to the airfield in importance, and even greater in scope, were the buildings for personnel, housing, hangars, storage, and schools, many of which were planned as permanent construction.

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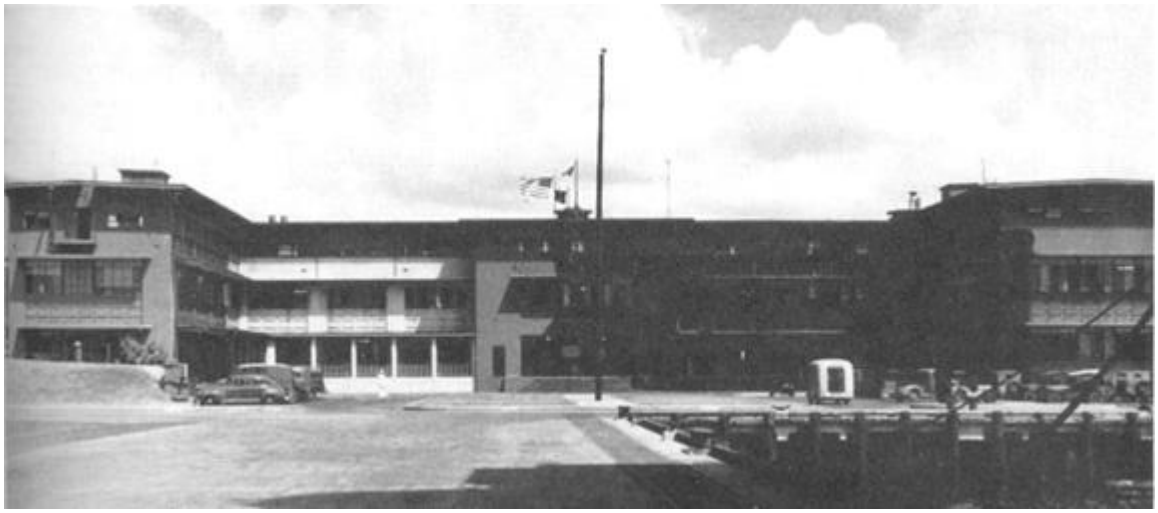

Administration Building at Pearl Harbor Naval Air Station

After the Pearl Harbor raid, plans were revised to substitute temporary frame buildings, to conserve critical materials and time.
The contractors, however, had stockpiled in the Hawaiian area and on the west coast of the United States some of the materials considered critical, and to conserve the time needed for reordering supplies for the temporary buildings, construction was begun on some buildings, utilizing this material. The administration building, aviation operations building, torpedo and bombsight building, aircraft storehouse, command center

building, aviation operations building, torpedo and bombsight building, aircraft storehouse, command center, power house, and telephone buildings were built of reinforced concrete. Other buildings were wood frame, temporary structures.
Two steel-frame 370-by-240-foot hangars, with 25-foot wide two-story lean-tos at either side for offices and shops, had exterior walls of asbestos-protected corrugated metal.
The assembly and repair shops were housed in a steel-framed, concrete, block-walled structure. For this building, the only one at the base which required extensive foundation work, 500 concrete piles were driven to depths varying from 40 to 100 feet in order to obtain the necessary bearing values for the foundations.
Housing and messing accommodations for 2,000 enlisted men were provided in nine barracks, a mess hall and galley, and a bakery and cooks' quarters. In August 1942, these facilities were ordered increased to care for 4000 men. The original group of buildings and 70 per cent of the second group were completed before termination of the PNAB contract. The buildings were of wood-frame construction. The barracks were H-shaped, two-story structures. Housing for 400 officers was provided in several two-story, frame buildings.
One-story, wood-frame buildings were erected for a 150-bed hospital. Included in one interconnected building were mess hall, boiler plant, and morgue. Medical stores, the garage, and nurses' quarters were in small separate buildings.
Storage space was provided in 92 buildings. The original plan called for one large warehouse, but later, in conformity with the policy for dispersing stores, eight scattered groups of small storehouses were substituted. These buildings were of light, temporary construction, on concrete slabs. In addition, four larger storehouses were built in the main station area.
Aviation-gasoline storage was provided in twenty-four 25,000-gallon, underground, steel tanks, equipped with a water-displacement system. The underground receiving tank, also of steel, had a capacity of 570,000 gallons. Delivery was designed to be by truck or by railroad tank-car. The storage tanks were buried in coral rock. In line with the Navy's policy to disperse important stores, the tanks were built in widely separated groups of four tanks each, with a distance of at least 100 feet

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between any two tanks. As a further protection against bombs, the pumphouse was built with its floor elevation 24 feet below ground level. Diesel oil and fuel oil were each stored in two 25,000-gallon, underground, steel tanks.
The contractors had completed an estimated 98 per cent of the original contract and its various supplements by July 15, 1943, when the contract work was terminated. During the 18 months they were employed, they had built, in addition to the installations already described, more than 8 miles of paved and 11 miles of unpaved roads, more than 3 miles of narrow-gauge railroad, and a large sewage-disposal plant. They had also excavated a total of 4,000,000 cubic yards of rock and coral, including the work on the runways, cleared 1500 acres, and installed 54,000 feet of fencing. For various projects, the contractors used 27,000,000 board feet of lumber, 6000 tons of structural steel, 6000 tons of reinforcing steel, and poured a total of 80,000 cubic yards of concrete.
The 16th Seabees, sent to Barbers Point in April 1943, were quartered in the former contractors' camp, midway between the Ewa and the Barbers Point landing fields. They took over maintenance work and the completion of minor construction left undone by the contractor. This included installation of a 1000-line automatic telephone exchange and a 12-mile pipeline connecting the Ewa Junction aviation-gasoline depot with the storage tanks at the Marine Corps air station and the naval air station at Barbers Point, Ewa Junction was interconnected with the fueling pier at Pearl City, and the bulk-storage tank was provided with a transfer pump which allowed transfer of gasoline between any of the four locations.
CBMU [Construction Battallion Maintenance Unit] 522 relieved the 16th Battalion on March 1, 1944. In November of that year the 14th Battalion sent a detachment to Barbers Point, which, together with personnel that could be spared from the regularly assigned maintenance duties, carried out the last of the major construction work. They erected several wood-frame barracks, a messhall, some small buildings to be used as offices, and two hangars.
Honolulu.--During 1942, the Navy enlarged the facilities at the Pan American Airways terminal on the southern tip of Pearl City Peninsula, for use by the Naval Air Transport Service. However, as ship traffic in the adjacent Pearl Harbor waters increased, it became evident that the continued use of these waters by seaplanes would be impractical. Consequently, the Navy took over the John Rodgers Airport, a commercial facility at Keehi Lagoon on the south shore of Oahu, midway between Pearl Harbor and Honolulu,

subsequently designated Naval Air Station, Honolulu.

When the Navy acquired the property, early in 1943, the commercial airlines had four hangars, several small buildings, and two short, intersecting runways. With the exception of the area surrounding these buildings and runways, the land was low and swampy, and only 2 feet above high tide.

Work was started on the project in February 1943, when the contractors brought a dredge into Keehi Lagoon and began the dredging necessary for the seaplane runways. Spoil from this operation was used as fill to bring the land areas to a 10-foot elevation. In April it was decided that Army engineers would do the necessary dredging for the runways and Seabees would perform the other work at the station.

The seaplane landing area, as dredged by the Army, consisted of three runways, each 1,000 feet wide by three miles long. The dredged material was handled on the beach by the 5th Seabees, who placed, compacted, and graded the land upon which the landing strips were built.

The 5th Battalion, upon its re-assembly at Pearl Harbor in May 1943, had also taken over the completion of the buildings started by the contractor and begun the erection of aviation-gasoline storage facilities, including twenty 50,000-gallon pre-stressed concrete tanks, a control tower, several barracks and warehouses, a 10-plane nose hangar, and two seaplane ramps.

In May 1944, the 133rd Seabees were assigned to the air station; during their five months stay they increased the aviation-gasoline storage capacity to 500,000 gallons and completed the two concrete seaplane ramps. They also built eight floating piers for docking seaplanes, five aviation-material storehouses, machine shops, several 250-man frame barracks and two-story, 40-by-100-foot, quonset barracks, an officers' mess, WAVES quarters, and did additional work on the landing field.

The 133rd was augmented by the 13th Battalion in June 1944. This unit assisted on the landing field and road work, in addition to constructing utility systems, a 60-by-205-foot cold-storage building, six line storage sheds, a concrete block paint and oil storehouse, and three underground 5,000-gallon oil tanks. The 13th also installed concrete-slab ripraps along the waterfront and moved 35

Nose Hangars at Honolulu Naval Air Station

Nose Hangar Shop NAS Honolulu

houses several miles. The 13th Battalion left in September 1944, and the 133rd followed in November.

From June to September 1944, a portion of the 50th Battalion was engaged in barracks construction. These crews were relieved by the 64th Seabees, to whom was assigned the completion of the air station. The 64th completed the construction that was underway, made additions to the landing field, and did finish-grading throughout the area. They left in March 1945, when the station was turned over to maintenance crews.

The main runway of the completed field was 7,400 feet long, paved for a 200-foot width, and intersected near its western end by a 6,800-foot runway. Two 6,600-foot parallel runways were also built. These runways, as well as all of the connecting taxiways and parking areas, were paved with

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Barracks for Civilian Housing, Marine Corps Air Station, Ewa

asphaltic concrete. Shops, repair facilities, and a large paved parking area were provided, together with housing and living facilities and an administration area.

Marine Corps Air Station

Ewa.--Early in the 1930's, the Navy secured a lease to a 700-acre tract at Ewa, northeast of Barbers Point, and on it erected a dirigible mooring mast and built an oil-surfaced, 150-by-1500-foot emergency landing field. Field work was started in September 1940 on the grading required for the extension of the existing runway and for a new cross-runway; the strips were in usable conditions in the spring of 1941. By June of that year, the paving of the two strips was complete, and Marine personnel moved in, erected their own living facilities, and operated a small number of planes.

In July, work began on two groups of barracks with a total capacity of 3,000 men, a 100-man BOQ, a storehouse, shops, a dispensary, mess facilities, and an operations building.

Two additional runways were laid down, a 300-by-950-foot warm-up platform was added, and one hangar was provided, an old structure moved from Ford Island.

For some time after the Japanese attack on December 7, which destroyed all the planes stationed at Ewa but left the strips and buildings undamaged, all civilian forces in that portion of the island concentrated on completing the authorized facilities. One runway was brought to usable completion in less than two months; buildings were hastily erected, and splinter-proofing of power transformers and other vital installations was rushed.

In September 1942, Ewa was established as a Marine Corps air station.

Extensive passive-defense facilities were included in the expansion that accompanied the designation of Ewa as a separate base. These measures included 75 reinforced-concrete half-dome revetments, 91 sandbag bunkers, a dressing station, and blast protection for vital installations.

The airfield had four runways, each 300 feet wide, with lengths varying from 2,900 feet to 5,000 feet.

Gasoline storage was built underground in four 25,000-gallon and five 50,000-gallon pre-stressed-concrete tanks, which were dispersed in small

groups. The work was not completed when the contract was terminated and the Seabees took over on April 1, 1943.

The 16th Battalion, the first Seabee unit in the area, constructed a pipeline connecting the aviation-gasoline storage with the entire southwest portion of the area.

In June of 1943, sixty men of the 10th Battalion were sent to Ewa. By the end of July they had erected 20 quonset huts for their own camp and had completed nine wood-frame barracks, several squadron workshops and storage buildings, an administration building, and a warm-up area, with accompanying taxi-strips.

Maintenance was taken over in October 1943 by CBMU 530, who also engaged in some small construction; any personnel who could be spared from their maintenance duties were loaned to other units whose primary function was construction.

In March 1944, the 10th Battalion was relieved by the 130th, which, during the next eight months completed the administration building, a parachute loft, shops and garages, nose hangars, warehouses, a public-works building, messing facilities, and reinforced-concrete magazines. It also operated a coral pit which supplied material for roads and airstrips.

In November 1944 the 130th was augmented by a portion of the 14th Battalion which undertook the construction of a recreation building and a dispensary, finished the warehouses, garages, the 3,000-man messhall, and began work on the WAVES barracks. The 123rd Seabees arrived early in January 1945 and were assigned the task of erecting 23 buildings for civilian housing. However, when 20 per cent of this work was completed, on February 28, the remainder of the work was turned over to civilian contractors.

Ammunition Depots

Lualualei.--This depot was originally established by the Navy on February 5, 1931. The 7910-acre site had at one time been a forest preserve, and was transferred to the Navy by the Territory of Hawaii. No additional real property was required for expansion.

Magazine construction under the PNAB contract included fifty-three 25-by-80-foot, eleven 50-by-100-foot, and eight 20-by-25-foot concrete structures buried in the hillside, and 24 frame buildings for storage of projectiles and inert material. Other construction included housing for 600 station personnel, shops, administration buildings, roads, walks, and 15 miles of railroad track.

The 125th Construction Battalion arrived at Lualualei in April 1944 to design and construct additional facilities. Among these were 28 miles of asphalt-paved roads, 10 miles of railroad, sort-

Covered Concrete Revetments, Marine Corps Air Station, Ewa

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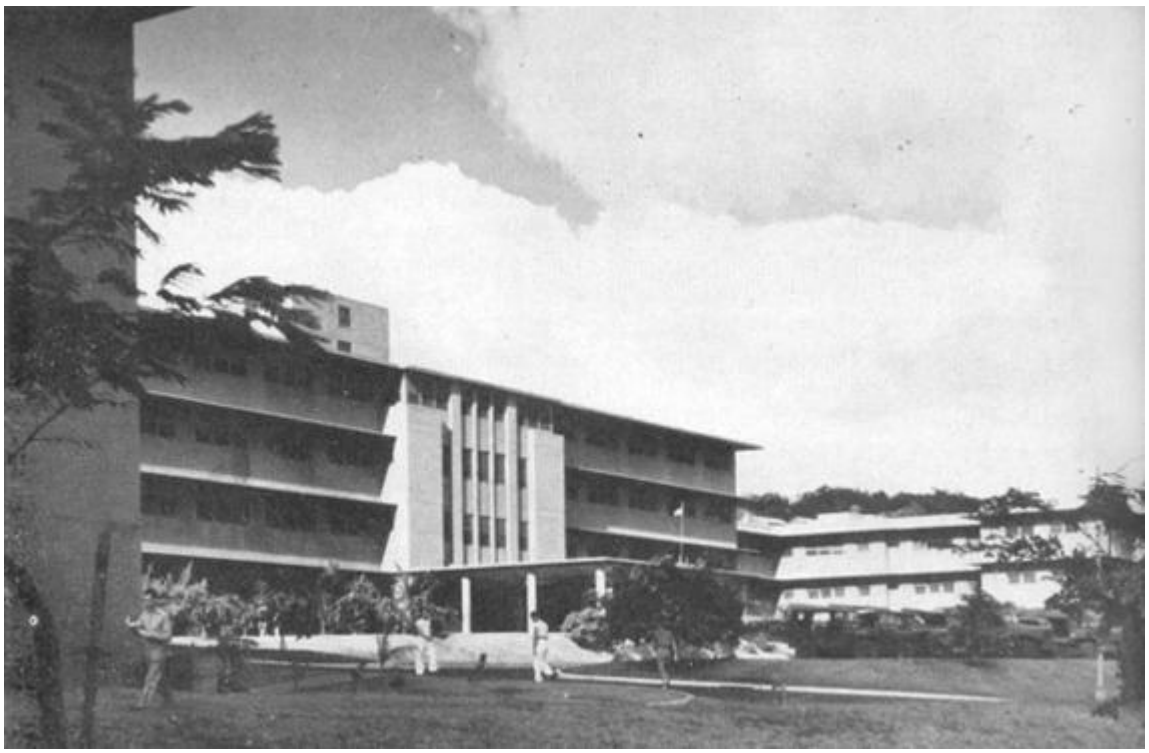

Aiea Naval Hospital
Entrance to the main building

ing sheds, shops, utilities, and housing. this work was completed in 10 months and the 125th left in May 1945. The 52nd Battalion arrived in October 1944 and built 18 miles of roadways, additional railroad facilities, and housing. CBMU 581 arrived in March 1944 and took over all maintenance and minor construction.

West Loch.--For the expansion of the West Loch ammunition depot, 358 additional acres were purchased, which enlarged the tract to 537 acres.

New construction included twelve 25-by-50-foot, high-explosive magazines, fifteen 50-by-86-foot, assembled-mine magazines, five 10-by-14-foot and three 20-by-25-foot magazines for fuses and detonators, and 11 magazines for dispersed torpedo storage. In addition, 12 other buildings were constructed to store pyrotechnics, inert material, mine anchors, fixed ammunition, and projectiles. Work on the waterfront included extension of an old wharf and the construction of a new 1000-foot wharf. Also constructed were 9 miles of railroad and personnel structures for 600.

Additional railroad facilities, test buildings, recreational facilities, patrol roads, and sorting sheds were built by the 43rd Seabees. Station maintenance and minor construction were accomplished by CBMU 581.

Waikele Gulch.--The pressing problem presented by the vast amount of explosives stored in the open among the hills and valleys of southern Oahu crystallized in mid-June 1942, when the Commander-in-Chief of the Pacific Fleet directed that "underground ammunition storage of major proportions" be constructed in a location that would "both be readily defended by, and accessible to, Pearl Harbor."

A 350-acre site was selected where steep-banked ravines made possible tunnel construction in such a manner that no two entrances faced each other, and a railroad spur could be built to service the installation.

Most of the tunnel roofs were concreted, and the floors were built of reinforced concrete. Concrete sidewalls were carried to a 7-foot height, mainly as

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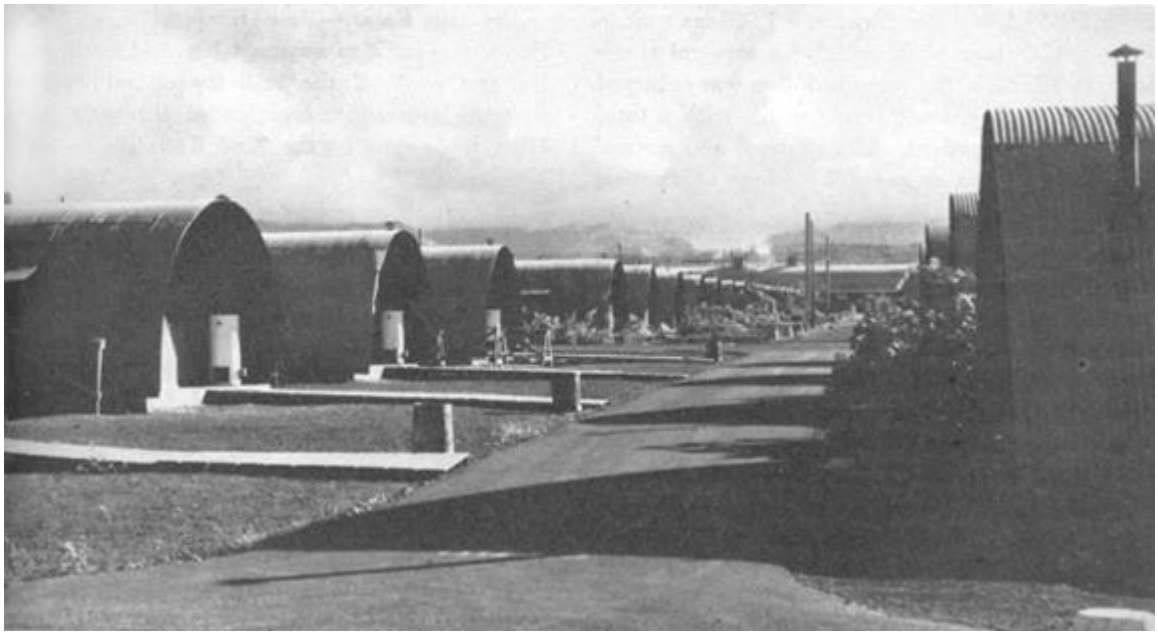
gravity retaining walls. The loading platforms were of concrete.

Facilities included 120 tunnels, each 240 feet long, which required 9 miles of railroad, 10 miles of paved road, 9 miles of patrol road, four bridges, and housing and messing facilities for operating personnel. Work on

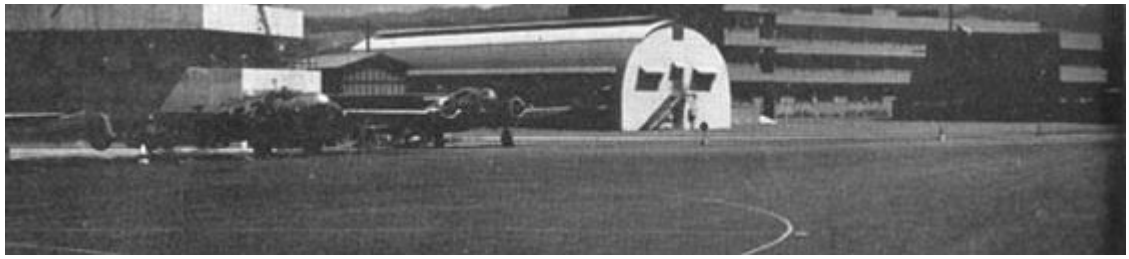
road, 9 miles of patrol road, four bridges, and housing and messing facilities for operating personnel. Work on this project, begun in September 1942, was completed in December 1943.
In April 1944 the 125th Battalion arrived, followed in May by the 95th, to carry out additional construction, upon completion of which the depot was turned over to CBMU 581.

Hospitals

Aiea.--The Aiea Hospital was constructed on the upper slopes of Aiea Heights, whose gentle slope was modified into a series of terraces on levels, 10 to 20 feet apart. The principal ward-and-administration building was built on the upper terrace; quarters and recreation grounds on the lower terraces; and the sewage-treatment plant on the lowest corner of the site. In the original planning the wards were oriented to receive maximum benefits from the sun and tradewinds, and the hospital facilities conveniently arranged to service the wards.
Field work, under the PNAB contract, was started in July 1941. Plans then called for a permanent type of construction, principally reinforced concrete, for the main hospital building, a subsistence building, a bachelor officers' quarters, a powerhouse, and nurses' and corpsmen's quarters.
Although the Japanese attack did not damage any of the hospital facilities, it had an immediate effect on the construction program in that all Japanese, regardless of their place of birth, were not allowed to be employed on any naval project. As most of the carpenters on the hospital job were of Japanese blood, work was almost completely stopped until the order was revoked a month and a half later.
In February 1942, the extent of the project was increased to include an addition of two ward-wings on the main building and the construction of a laundry and a medical storehouse, all of the same construction as those erected under the original authorization. Also built were temporary frame structures to house five wards for 500 patients, an extension of the nurses' quarters, and a BOQ for 100. By October 1942 the hospital was brought to a usable state of completion. However, work continued until the termination of the contact in December 1943.



Wards at the Naval Hospital on Moanalua Ridge



NAS Pearl Harbor

In August of 1943 it had been decided that existing facilities at Aiea could not care for the load of casualties expected as a result of projected operations in the Pacific. Accordingly, a new CPFF contract was awarded for a 3000-bed addition to the hospital, construction of which was begun in September 1943.

The major portion of the expansion consisted of fifteen 148-bed, two-story wards, a 1,000-man messhall, a cold-storage building, and a medical storehouse. In addition, the main building was enlarged by four two-story, wood-frame wards with a total capacity of 800 patients. The officers' and nurses' quarters were also enlarged by wings to existing buildings.

Construction was completed in April 1944; in July, CBMU 600 was assigned the maintenance of all hospital facilities on the island of Oahu.

Moanalua Ridge.--The hospital on Moanalua Ridge was built as a temporary facility, to assist the main hospital at Aiea to care for casualties from the forward areas. Construction was begun in October 1943 by the 90th Seabees.

The hospital, which covered 115 acres, was of quonset-hut construction exclusively, with the exception of a few wood-frame buildings used for boiler houses, messhalls, galleys, garages, and small miscellaneous storage. The wards, consisting of three quonset huts placed end to end, were 175 feet long by 20 feet wide and had a capacity of 3000 patients in 100 buildings. A group of twelve large quonset huts, used as storehouses, separated the quarters from the wards. A recreational area, containing an open-air theater, was located in the center of the quarters for use by both corpsmen and convalescent patients.

McGrew Point.--Base Hospital 8, at McGrew Point, was built to augment hospital facilities during the peak of the military operations in the forward areas. Construction of this 1,000-bed facility was begun by the 92nd Battalion during November 1943.

The area was swampy, which necessitated excavation of 50,000 cubic yards of material to drain and reclaim the marsh. For wards, operating rooms, and quarters, 214 standard quonset huts were erected. Galleys, messhalls, and storage space were provided in six large quonsets, and 35 wood-frame structures were erected for shops. Ninety days after the start of construction, the hospital was usably complete, although the Seabees continued work on it for another ninety days.

Bishops Point and Iroquois Point

A section base and net depot was built at Bishops Point, and an annex was constructed directly

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across the Pearl Harbor entrance channel at Iroquois Point.

Bishops Point, before dredging and filling started, was a gently sloping, sandy beach, rising from the sea to an elevation of about 10 feet at the northern edge of the site. Iroquois Point was level area, a few feet above sea level.

The section base at Bishops Point was initially planned to provide a base and a training establishment for the net-and-boom craft stationed at the harbor entrance. Construction was started on this basis in September 1940; five months later, in February 1941, a net depot at this location was authorized, and the contractor was directed to increase the scope of the project. Still later, in the fall of 1942, work was started on the sub-section base at Iroquois Point.

As practically the entire Bishops Point area required fill, dredging was the first operation. This entailed the moving of 450,000 cubic yards of material.

The 1,000-foot quay was built on precast concrete piles, with a reinforced-concrete deck. After the wall was completed, two concrete piers, 20 by 300 feet, each, were added. Docking space for small boats was provided by a floating timber platform.

To provide drydock facilities for target barges, a 60-ton marine railway was built. Sheet-steel piles were driven to form a cofferdam at its water end, with about 135 feet of piling on each side which later formed the

driven to form a cofferdam at its water end, with about 150 feet of piling on each side which later formed the side walls of the railway. For the submarine portion of the railway, precast concrete piles were driven, and capped with reinforced concrete. Tracks at right angles to the railway were installed to facilitate handling and storing of target floats, and racks were built along these tracks to provide target storage. A wood-frame and corrugated-iron building was erected for target-repair shops.

With the exception of an air-raid shelter of reinforced concrete, all other buildings at Bishops Point were of wood-frame construction. They included two 2-story buildings, for barracks and an administration building; one-story frame buildings for the messhall, officers' quarters, storehouse, and shops; two 100-man barracks; and a recreation hall.

At the Iroquois Point annex, the major construction consisted of a 600-foot timber wharf connected to the shore by 140 feet of causeway. The area between the wharf and the channel line was dredged.

Except for the air-raid shelter of reinforced concrete, all buildings were of wood-frame construction. Housing facilities for base personnel were provided in four 30-by-120-foot barracks and a similar structure for officers. A recreation building and a messhall completed the living facilities. Storage was provided in a 60-by-125-foot structure; small buildings were erected for shops, offices, and the dispensary. The contractor completed the project in the spring of 1943.

Haiku Radio Station

The Haiku radio station was constructed at a point where two high, parallel ridges afforded natural supports for an elaborate antenna system.

Construction was begun under the PNAB contract during May 1942. The main projects of station construction included antenna erection, a bomb-proof building for the radio equipment, and housing for the operating personnel.

As the first step in the antenna erection, men picked their way to the tops of the nearly vertical mountain ridges, dragging with them thin manila ropes to be used as pilot lines for the heavier cable. Subsequently, a cable way was installed from the valley floor to the anchorage sites on the ridge tops. This was used to haul men as well as materials. These anchorage sites on opposite sides of the valley supported antenna cables which could be raised and lowered for periodic inspections.

Moanalua Ridge

The 127-acre, Marine Corps transient center was built as a tent city to house Marines staging through Pearl Harbor.

Begun in October of 1943 by the 92nd Seabees, the camp was completed in four months. A 10,000-man center, it was broken into two 5,000-man areas, each containing a complete system of utilities.

Housing was provided in 1,250 tents erected over concrete floors, and eight 40-by-100-foot and fifty 20-by-48-foot quonset huts. Wood construction was used for special buildings such as administration offices and post office.

The Seabee encampment on Moanalua Ridge was built by the combined efforts of many construction battalions. Equipped to quarter 25,000 Seabees, the encampment was divided into 20 separate areas,

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14th District Quarters for Permanent and Transient Officers, Moanalua

each large enough to house one battalion. Completely self-contained, each area included six two-story wood-frame buildings, one 1,200-man galley, one 1,200-man messhall, eight standard quonset huts for offices and a dispensary, and one large quonset hut for a ship's service store.

More than 4 miles of 24-inch water main serviced these areas, and sewers adequately handled sanitation and drainage requirements. Electricity was supplied to all buildings. There were approximately 19,000 feet of 24-foot roadways, surfaced with 6 inches of crushed rock, throughout the camp area, in addition to 154,000 square feet of similar construction for shops and parking areas. The camp covered 120 acres.

The 73-acre Marine base depot was located adjacent to the Seabee encampment area. The 90th Seabees began the construction in October 1943. Upon completion of the project six months later, in April 1944, they had erected 40 warehouses, 48-by-190-feet each, arranged in four rows separated by paved streets 60-feet wide. They also constructed four larger storehouses and four special buildings for radar storage and shops. About 36 acres were graded to provide open storage.

Waianae Training Center

Naval Anti-Aircraft Training Center, Waianae, covered 42 acres on the west coast of Oahu, about 30 miles from Pearl Harbor.

The installation, authorized in July 1942, was built under the PNAB contract. It included barracks, a messhall, and utilities for 300 enlisted men and 20 officers; a school with 18 classrooms, a trainer building, an armory, and gun mounts. Each of the four barracks accommodated 75 men. Storage was provided in two 25-by-125-foot buildings. All buildings were of temporary construction.

Puuloa Rifle Range

The Puuloa Rifle Range, on the southern coast of Oahu, was already in use as a rifle range in 1940. Under the PNAB Contract, the existing installations were enlarged to increase training facilities.

This improvement, begun in September 1940, included the addition of an armory, a frame magazine building, an armory rifle range, a recreation building, a galley and messhall, and 48 additional targets. Later additions were made to provide barracks for 300 men and 20 officers, a 25-by-123-foot dry-storage building, a cold-storage building, and fire-protection service.

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Maui

NAS [Naval Air Station] Puunene

The island of Maui, second largest island in the Hawaiian group, is 90 miles southeast of Honolulu and 100 miles northwest of the island of Hawaii. The three principal naval activities were the naval air stations at Puunene and Kahului, and the Kahului section base.

On June 17, 1940, when the PNAB contractors began work it was planned to develop a small base for the use of a naval experimental unit at Puunene, where there existed a landing strip built by the Territory of Hawaii. While Army engineers improved the existing airfield and constructed a cross-runway and taxiways, the contractors built quarters and messing facilities for the 500 men attached to the unit.

Before the work was completed, plans were altered to include facilities for one carrier group. Two 50,000-gallon gasoline tanks were erected and a warm-up platform was laid down. Additional personnel and training facilities were added, including bomb and ammunition magazines. Revetments were constructed and aircraft utility shops erected to service the additional planes. The work was nearly complete in March 1942, when all work was taken over by Army engineers.

In November 1942, the contractors were recalled to construct facilities for a second expansion of plans at Puunene. Four 25,000-gallon tanks and three 50,000-gallon tanks were erected. Work was also begun on seven reinforced-concrete arch-type magazines. A bombsight shop, four storage buildings, and additional improvements to the landing field were other projects completed by the contractors.

On April 1, 1943, the 48th Seabees replaced the contractors and assumed responsibility for the completion of the air station.

Plans were again expanded to permit advanced training and staging for fighter, torpedo-bomber, and dive-bomber pilots. Each airstrip was lengthened 2,000 feet and paved with asphaltic concrete. Upon completion, one strip measured 6,900 feet and the other 6,000 feet.

Base facilities, including an assembly and repair building, bakery, dispensary, torpedo shop, theater, and

additional housing and warehouses, were constructed by the Seabees. In addition, they installed complete water and sewerage systems, including a 500,000-gallon circular reinforced-concrete water-storage tank, and a power-distribution system supplied by the local company's existing transmission lines.
The existing 350,000-gallon aviation-gasoline storage system was augmented by five 50,000-gallon and five 25,000-gallon underground reinforced-concrete tanks. On May 15, 1944, the 48th was relieved by the 127th Battalion.
Magazine construction comprised a large portion of the work taken over by the 127th. Seven concrete arch-type magazines, two torpedo warhead magazines, and nine other magazines for fuses and detonators, ready service ammunition, and inert storage were added.
Grading and paving of roads and taxiways, installation of fences, together with additions to existing buildings, constituted the remaining work assigned to the 48th Battalion and completed by the 127th.
Projects assigned directly to the 127th included additional quonset barracks, a large nose-hangar, galley expansions, shop buildings, and warehouse improvements. The fire-protection system was also extended to afford adequate security for the additional facilities.
The 127th Battalion continued to operate on Maui until May 2, 1945, at which time the CBMU 575, which had reported in February 1944, assumed operating duties.

NAS Kahului

The site of Kahului Naval Air Station was leased from a commercial sugar company. About one-third of the 1350 acres was cultivated cane land; the remaining portion was pasture containing swamps and fish ponds. The only existing facilities were power and telephone lines, and a narrow-gauge railroad which ran along the highway connecting the villages of Kahului and Sprecklesville. The nearest water supply was in the village of Kahului.

The work of developing a new airfield for

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carrier-group operations and training was begun by the PNAB contractors, when they were recalled to Maui in November 1943. They established a complete construction plant, including a camp and utilities, and accomplished the construction of 12 barracks, about 50 per cent of two messhall-galleys, and one bakery, and performed about 25 per cent of the clearing and grading preparatory to runway construction, before April 1943, when they were replaced by the 39th Construction Battalion.
The battalion's first efforts were concentrated on runway excavation and barracks construction. Two strips were prepared, each 500 feet wide by 5,000 and 7,000 feet long, respectively, with work made difficult by the considerable blasting operations required. A warm-up platform, 1500 by 650 feet, was constructed, approximately 190,000 square yards of parking area were laid down, and three nose hangars were erected in the center of the area. Nine ready-rooms, two machine and metal shops, a battery shop, a carburetor shop, and a radio-radar shop were built. Adequate taxiways and parking bunkers were constructed, and the field and taxiways paved with asphaltic concrete. Buildings of the cheapest and most temporary adequate construction were erected for barracks.
Five 25,000-gallon above-ground tanks were erected for aviation-gasoline storage; three were installed underground; and two large bulk-tanks were erected.
Ammunition was stored in 19 magazines, served by paved access roads.
The 39th also constructed a malfunction range, a moving-target machine-gun range, a skeet and trap range, and a machine-gun school. A sewage-disposal plant, sewage lines to the plant, water mains, and an electrical distribution system were installed, together with adequate ditching for drainage. Warehouses, theaters, and supply buildings were erected, built of temporary construction as the need arose. The 39th Battalion was relieved on June 15, 1944 by the 142nd Battalion, which continued operations until the spring of 1945.
CBMU 563 reported for duty in December 1943.

Kahului Section Base

When construction was started at the Kahului section base by Army engineers in 1942, all utilities, power, water, telephone, a railroad, and a paved highway, existed at the site. The harbor had been developed and was being used by a commercial sugar company. Included in the harbor facilities were two 900-foot piers with fuel and water lines, 123,000 square feet of storage sheds, and two unloading cranes.
Personnel facilities, the only new construction undertaken, included an administration building, a messhall, quarters, and two storehouses. Nine major buildings were started by the Army, continued by the contractors

quarters, and two storehouses. Nine major buildings were started by the Army, continued by the contractors, and completed by the Seabees.

Other Maui Activities

In addition to the two air stations and the section base, several smaller activities existed on Maui. These included the Fourth Marine Division headquarters, when the division was not engaged in combat, as well as several specialized branches of the Navy.

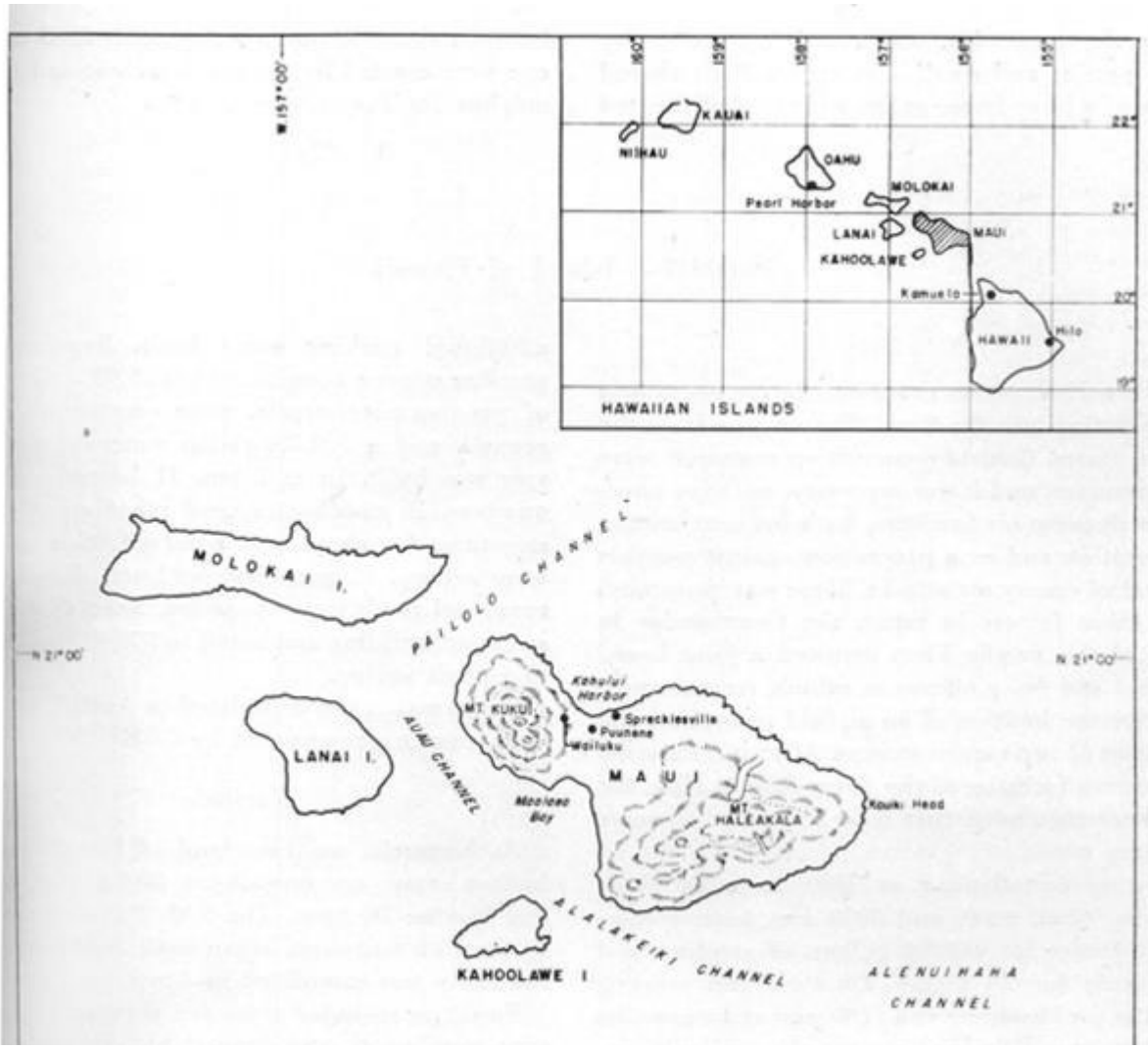
The Fourth Marine Division camp, built on the side of a mountain overlooking Kahului Harbor, was a 30,000-man center with all facilities, completed in four and a half months by the 48th Seabees. It consisted mainly of framing for 16-foot square tents used as quarters, augmented by quonset huts for galleys, messhalls, ordnance buildings, and shops. The main difficulties encountered during construction were the long haul to an 1800-foot elevation for all materials and the rain, the annual fall of which is 200 inches.

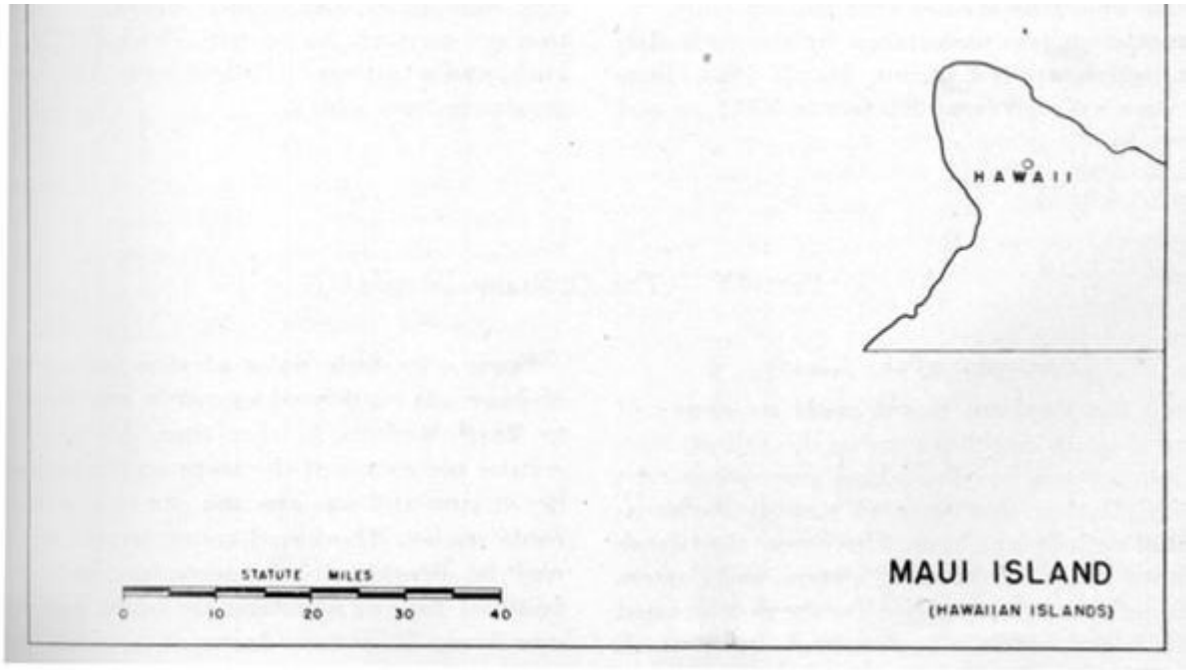
An amphibious tractor camp was erected on Maalaea Bay for the training of Fourth Marine Division amphibious tractor crews. Using tents for quarters and large quonset huts for shops and storage, the 5,000-man camp was completed, with all facilities, in one and a half months. A rifle range with 50 positions and firing lines up to 500 yards was also provided.

The Marine Corps storage depot comprised 40 large quonset huts, on 4-foot concrete walls. A 2,000-foot retaining wall and loading platform was constructed in front of the huts, together with 3,500 feet of railroad siding. This project was started by the 48th Seabees and completed by the 127th. A large open-storage area was utilized to store rolling stock.

With facilities for approximately 800 men, the Naval Amphibious Training and Experimental Base was located in a tent city on Maalaea Bay south of Kamaole. The center was used for the advanced training and staging of underwater demolition teams before sea duty.

Adjacent to the demolition camp, and approxi-





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mately the same size, was a training center for beach parties and small-boat crews. Both shared the use of a large frame galley and messhall located between them. A few wooden sheds for food storage were erected by Seabee detachments from the neighboring Puunene air stations.

Hawaii

NSA Hilo

In June 1942, planes to support future operations were pouring into the Pearl Harbor area from the United States. Critical construction materials were at a premium, and it was necessary, as far as possible, to disperse air facilities, both for convenience of operation and as a precaution against possible renewal of enemy air attacks. Time was important. With these factors in mind, the Commander in Chief of the Pacific Fleet directed a joint board of Army and Navy officers to submit recommendations for the location of an airfield to support the operation of two carrier groups. After investigating the existing facilities of the Army field at Hilo, the board recommended that it be expanded to meet the Navy needs.

Existing installations at Hilo included three runways, 6500, 6000, and 3000 feet long, respectively, storage for 450,000 gallons of gasoline, and revetments for 24 planes. Quarters and messing facilities for 70 officers and 1200 men and a gasoline pipe line from Hilo Harbor were also available.

Construction was undertaken by the 59th Battalion, which arrived during March 1943. Runways were widened from 200 feet to 500 feet, and additional parking areas built. Supplementary gasoline storage, comprising ten 50,000-gallon tanks of prestressed concrete, were constructed underground, and a 500,000-gallon water-storage reservoir was built. In addition, 11 barracks, officers' quarters, 16 storehouses, and other miscellaneous structures for shops and administration purposes were set up. Communication lines, drainage systems, and roads were expanded. Runway surfacing and road building amounted to 800,000 square feet of asphalt paving.

Construction was completed in April 1944, when maintenance was assumed by CBMU 562.

Kamuela

At Kamuela, on the island of Hawaii, Seabees built a camp, accommodating 20,000 men for the 2nd Marine Division. The 59th Battalion, assisted by the 18th Battalion, began work in January 1944; the camp was completed in April.

Facilities included tents for personnel, quonset-type warehouses, and quonset huts for administration and messing. An airstrip, 75 by 3000 feet, was built, and a taxiway, 7000 feet long, and a parking area were later added.

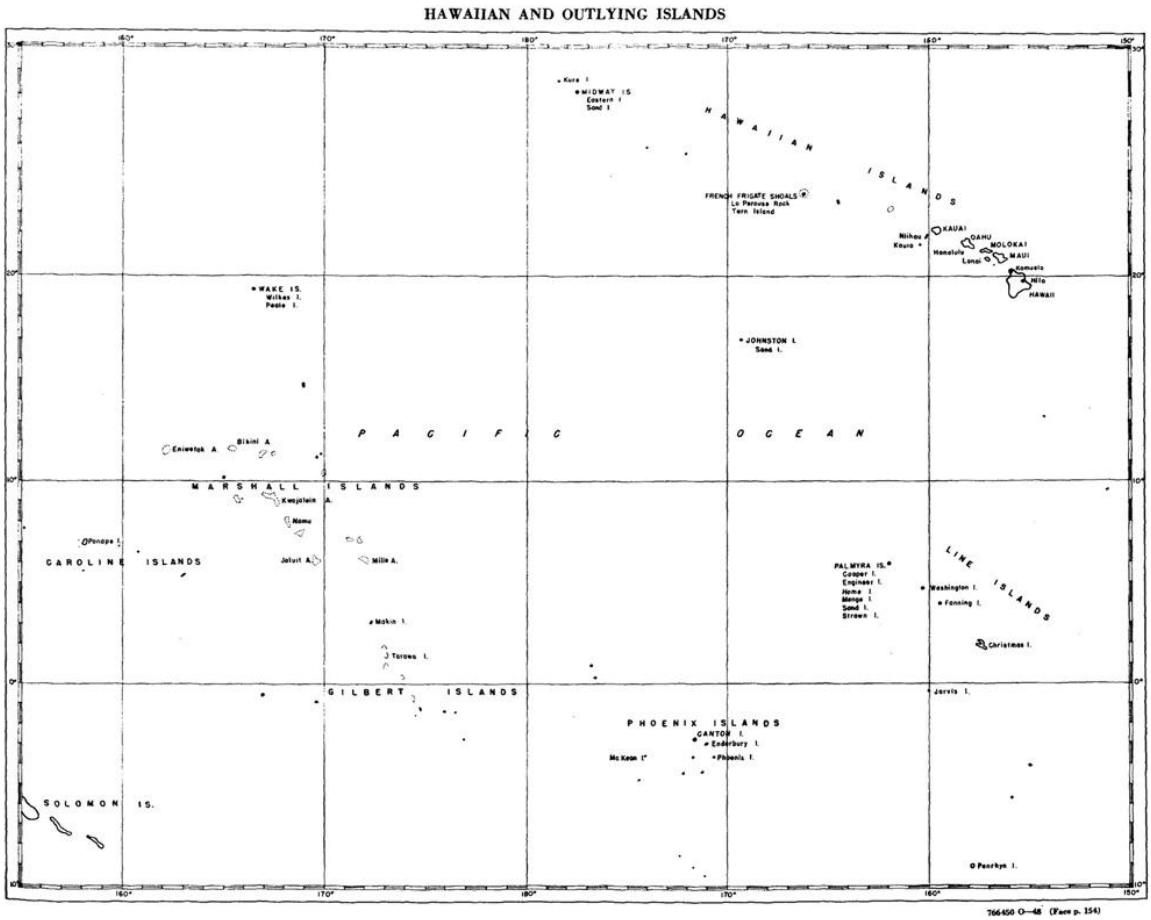
The Outlying Islands

Importance of the Islands

Importance of the Islands

When the Hepburn Board made its survey of the naval shore establishment in the fall of 1938, the United States had five island possessions west of Pearl Harbor that were of strategic value as potential patrol-plane bases. These were the islands of Midway, Wake, Johnston, Palmyra, and Canton. The board's recommendation for the development of each island were the basic criteria upon which their subsequent fortification was predicated.

From a strategic point of view, an air base at Midway was considered second in importance only to Pearl Harbor. At that time, Midway was in regular use as one of the stops on the air route to the Orient, and was also the site of a commercial cable station. The board recommended that Midway be developed as a secondary airbase with facilities for two permanently based patrol-plane squadrons. These facilities were to include a pier, a channel, and a turning basin, with the lagoon



Inserted Map of Hawaiian and Outlying Islands

dredged to accommodate a large tender or a tanker. Wake Island, considered next in importance to Midway, and also, a station on the commercial air route to the Orient, was adapted to, and recommended for, development similar to the one proposed for Midway.

Johnston, Palmyra, and Canton islands were to be developed to permit tender-based patrol-plane operations. This would require the dredging of channels into the lagoons to permit entry of small tenders and the clearing of coral heads within the lagoons to provide sufficient area for full-load take-off.

Construction of these bases, together with the new air station at Kaneohe Bay, was begun in the fall of 1939 under the PNAB contract.

The greatest difficulties attending execution of this work were the wide geographical dispersion, the isolation, and the lack of docking facilities which characterized each of these outposts. Consequently, the sequence of construction operations progressed through three stages: the initial "rowboat stage," in which approach was in small boats and a tent colony was set up, supported for several weeks by a ship lying offshore; next, the erection of rough tent-camp buildings, with portable power plants, distilling plants, and radio, upon completion of which the supporting ship was released; and, finally, the gradual erection of permanent

completion of which the supporting ship was released, and, finally, the gradual erection of permanent barracks and the completion of the station.
Individually and collectively, these five islands were our first move westward from Hawaii into the Pacific under the new defense measures. They were built before the advent of Seabees and without benefit of the standardized and prefabricated advance-base equipment that came into use during 1942. As coral was the prevalent soil material at each location, it was widely used for the first time as concrete aggregate.
Originally begun as seaplane bases, each of these islands was subsequently equipped with runways for landplanes and with waterfront structures to permit fueling of submarines. Eventually, Midway became a major submarine base and a fueling point for destroyers and cruisers, with two large airfields and extensive seaplane facilities.
The contractors' civilian forces were withdrawn during the spring and summer of 1942 and were replaced by Seabees, who carried the unfinished projects to completion and undertook further expansion of the facilities at each base during 1943 and 1944. In August 1945, Seabees were functioning as maintenance units.
With the exception of Wake, which was captured by the Japanese on December 24, 1941, each of these bases functioned extensively throughout the Pacific campaign. During the early months of the war, Midway, Johnston, and Palmyra supplied aerial reconnaissance on a wide arc westward of the Hawaiian Islands, and with their tactical aircraft formed an outer defense ring around Pearl Harbor. As a submarine base, Midway gave strong support to the fleet as our attack moved westward. Palmyra Island, with its air facilities, was an important stop in the air-transport route to the Southwest Pacific. Johnston Island came into importance after the capture of the Gilbert and Marshall islands as an air station on the route through the Central Pacific.

Midway

In the initial plans for Midway, it was proposed to develop it as a base for one patrol squadron of seaplanes. Subsequently, it became a major submarine base, a major air station for both land- and seaplanes, and a fueling and repair base for ships.
Midway is a coral atoll situated in almost the exact center of the North Pacific Ocean. Hemmed in by jutting coral reefs enclosing about 28 square miles of shallow lagoon, the two islands of Sand and Eastern, collectively known as Midway, lie 300 miles north and 900 miles west of Honolulu. Sand Island, the larger, measures about a mile and a half long by a mile wide, and was originally capped by a hill rising 42 feet above sea level. Eastern Island, triangular in shape and flat, measured a mile and a quarter long by three quarters of a mile wide.
In 1938, Navy funds to the extent of $1,100,000 were made available to the Army for harbor and channel improvements. The Army was to dredge a channel through the southern reef between Sand and Eastern Islands, scoop out a seaplane basin, and dredge a channel 30 feet deep and 300 feet wide to a proposed submarine basin and an anchorage for small ships. A turning basin was to be provided adjacent to the submarine basin, northeast of Sand Island, and a breakwater was to be built. The Army completed this work in 1940.
The Hepburn report had recommended that a naval air station be built on Midway and facilities for a submarine base be provided. The air station was to be large enough to base one patrol squadron

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of seaplanes permanently, with emergency provisions for one visiting squadron. All of this work was to be on Sand Island, but subsequent changes provided for an airfield on Eastern Island.
The development of Midway under the Pacific Naval Air Base contracts began on March 27, 1940. A dredge was towed in, and the contractors directed their efforts toward the enlargement of the existing basins and channels. A small-boat channel, 12,000 feet long, 50 feet wide, and 10 feet deep, was dredged between Sand and Eastern islands, and a mooring berth, protected by sheet-piling, was built on the latter. Approximately 3,000,000 cubic yards of material were removed in these dredging operations.
Three asphalt-paved runways were constructed on Eastern Island; each was 300 feet wide and 3250 feet, 4500 feet, and 5300 feet long, respectively. Two hangars were constructed, with parking areas and warm-up mats. Small industrial areas were erected, which included the various necessary shops and storage facilities.
A large seaplane hangar, a parking mat, and one concrete ramp were constructed, and an ordnance shop, radio shop, engine shop, and a storehouse and tool room were built around the seaplane hangar to facilitate major overhaul work.
Fighter, bomber, and patrol ready-rooms were constructed, and housing and messing facilities set up for operational personnel. Quonset huts were extensively used.

Approximately 2800 feet of sheet-piling bulkhead was installed on Sand Island. Dredged material was pumped behind this bulkhead, and upon this fill, a large seaplane parking-mat was constructed. Four, concrete, seaplane ramps were built, together with an additional emergency ramp and approach to the mat, and a large, steel, seaplane hangar was erected on the edge of the mat.

Construction was started on underground gasoline storage in twenty-two 2500-gallon steel tanks.

A naval hospital was built by the contractors, who utilized three of the four existing buildings owned by the commercial cable company. These buildings, located on Sand Island, were later augmented by a large underground structure of concrete.

Barracks for naval and Marine personnel were built, together with all necessary accessories such as messhalls, warehouses, administration buildings, commissaries, and cold-storage buildings. The power plant for Sand Island was housed in a bombproof structure of reinforced-concrete and steel.

Midway was subjected to surface shelling by the Japanese on December 7, 1941, which caused considerable material damage and many wounds to personnel.

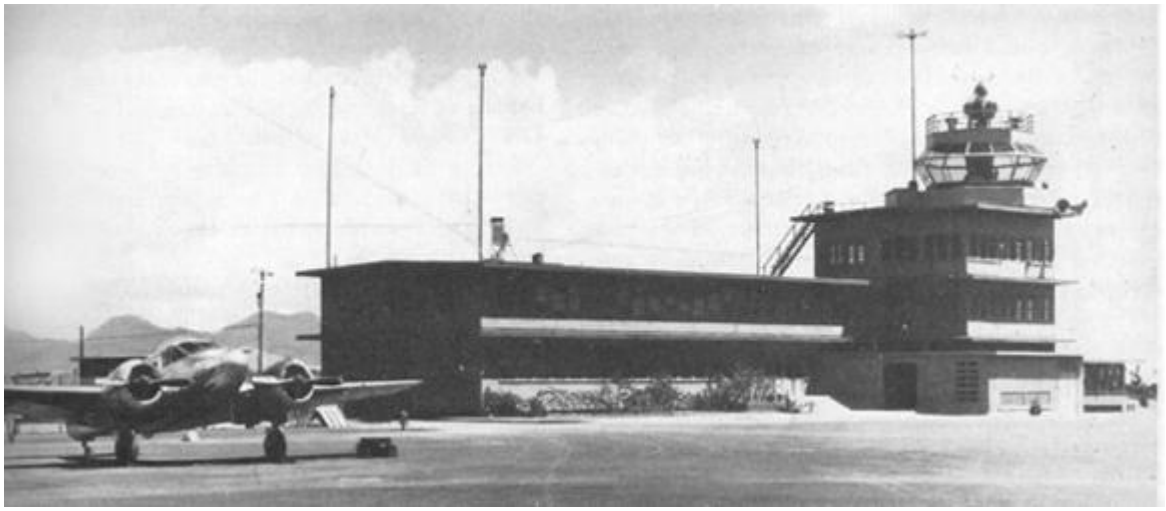
As a result of the declaration of war, the construction program was modified to meet the emergency, and all efforts were directed toward defense fortifications and damage repair. Late in December, 800 civilian workers were removed from the island and only the garrison was left to continue repair work. Repeated air attacks after the initial shelling did much to retard the work, although no major damage was experienced until the morning of June 4, 1942, when the Japanese launched a major air attack which caused heavy material damage to many installations. The hospital, a group of fuel-oil tanks, a partly completed torpedo shop at the submarine basin, and other buildings were completely destroyed, and serious damage was done to the administration building, the laundry, and the seaplane hangar.

At the Navy's request, 100 of the contractors' men returned to make repairs and install such replacement equipment as refrigerators, distillers, and power units. When this was accomplished, they returned to Pearl Harbor.

On July 17, 1942, a detachment of the 5th Construction Battalion arrived. This detachment of 225 men and 4 officers directed their first efforts toward preparing living quarters for themselves and the remainder of the battalion, which arrived during August to bring the Battalion's total to 550 men and 12 officers. Work was immediately begun on the construction of an airfield and an underground hospital of reinforced concrete and steel at Sand Island. In September 1942, two full companies of the 10th Battalion arrived, and with these additional men, the work of developing a submarine base on the northern tip of the island was begun.

Construction completed by the Seabees included three strips on the Sand Island airfield, revetments, magazines for high explosives, airfield lighting, and additional quarters and messing facilities.

Early in the spring of 1943, the function of Midway was changed from a defensive to an offensive base, and the construction of a major submarine base was begun. The 50th Battalion, assigned to Midway for this purpose, arrived on



Control Tower, Marine Corps Air Station, Ewa

April 4, 1943, to relieve the Fifth, which returned to Pearl Harbor, the 50th and the 10th Battalions, acting as

a unit, lengthened and paved the Sand Island airfield, two strips to 7,500 feet and one to 8,600 feet; erected four 13,500-barrel underground welded-steel tanks for diesel oil and four 27,000-barrel tanks for fuel oil, complete with piping, and underground pumphouses; constructed six timber finger-piers, complete with electrical, oil, air, and water services; and installed 2,900 feet of cellular steel-sheet piling. They also operated the Navy dredge YD-69.

Late in April 1943, the contractors' men again returned to begin work on an enlarged dredging program. The existing ship channel was widened from 300 feet to 400 feet and deepened to 35 feet. The anchorage area was expanded to a mooring capacity of six cruisers, five destroyers or submarines, and one repair ship.

Three areas were dredged, and 5,000,000 cubic yards of material removed.

CBMU 524 arrived in October 1943 to take over maintenance duties, complete the large underground hospital, and set up a recreation and recuperation center at the submarine base. The 10th Battalion which departed for Pearl Harbor in November 1943, was replaced by CBMU 531. The two maintenance units were then combined and continued to carry on their duties as a unit.

In January 1944, the 50th Battalion began waterfront construction near the submarine base. This work included three 471-foot piers, a 769-foot tender pier, and an ARD wharf, all of wood-pile construction. A 1,600-kw power plant at the submarine base was built to augment the bombproof structure previously completed on Sand Island. Inter-island electrical and fuel lines were begun and were complete in March.

As a result of severe weather, portions of the shoreline were washed away, necessitating the installation of 1,200 feet of sheet-piling bulkhead on Sand Island and 300 feet on Eastern Island to halt the erosion.

The 123rd Battalion and the 10th Special Battalion reported to Midway in April 1944. These two units continued the waterfront work and enlarged the fuel storage capacity. They also built two additional tender piers at the submarine base, four additional submarine piers, and seven shop buildings.

The 50th completed its work in December 1944, leaving CBMU 534 to continue maintenance operations.

Wake

Conversion of the atoll, collectively known as "Wake Island," into an outlying base was recommended by the Hepburn Board in 1939, and construction work, by a civilian contractor, commenced in January 1941. This work was about 65

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per cent complete when it was interrupted by Japanese hostilities and our entry into the war. As originally conceived, the base was to provide an unloading pier, a channel through the reef, a turning basin capable of accommodating a tender or a large tanker, complete facilities for one squadron of patrol planes, and a garrison force of one company of Marines. Later, construction was authorized for a submarine base to support one division operating without a tender.

Lying 2000 miles west of Honolulu and 1700 miles east of Tokyo, Wake forms a rough "V," four and a half miles long and two and a half miles wide at the opening. Wake, the largest of three islets, forms the apex, with two narrow peninsulas jutting from its main body. Separated from the end of the northern peninsula by a narrow channel is Peale Island; Wilkes Island is separated by a similar channel from the end of the southern peninsula. The lagoon, three miles long and a mile and a quarter wide, is almost landlocked as the two channels are narrow and the open end of the "V" is virtually closed by the reef which surrounds the group. Land area comprises 2,600 acres, with a maximum elevation of 24 feet.

Wake was placed under the jurisdiction of the Navy Department in 1934, and in 1935 permission was granted Pan American Airways to establish a way-station airport on Peale Island. This work was completed prior to the start of naval construction.

The first of the contractor's personnel, 80 men, arrived on January 9, 1941, accompanied by large amounts of construction materials and equipment, which included an 80-ton crane on caterpillar treads, two heavy bulldozers, and a large tractor.

The channel between Wilkes and Wake islands was first chosen for development, but surveys indicated that this was an excavating rather than a dredging job, so the preliminary work was done with pneumatic-hammers, bulldozers, and a crane. Sufficient width and depth was obtained by this method to permit entrance into the lagoon of a 1000-ton barge loaded with construction materials.

Work was also started on two of the three airstrips planned and access roads were built. Simultaneously, erection of a camp and headquarters for civilian workers was begun.

Considerable construction had been accomplished, such as the installation of evaporators and refrigerators

and general camp improvements, when the hydraulic dredge "Columbia" was brought in. However, due to its many breakdowns, only one channel, necessitated by construction requirements, was ever developed.
Tanks were installed for the storage of 150,000 barrels of gasoline, 20,000 barrels of fuel oil, and 6,000 barrels of diesel oil.
Living facilities for the Marines were about 50 per cent complete in December, but very little work had been done on defense installations and fortifications.
On December 8, Japanese planes truck, and during the 16 days before the island's surrender, it was subjected to 14 bombing attacks. Construction work came to an abrupt end, and all resources were turned to defense.
During the siege, construction personnel maintained power, water, and communication systems and worked on dugouts. Nearly all construction material was destroyed by bombing and resultant fires.
Heroic but futile delaying action was carried on by the garrison of the island. Fourteen civilians lost their lives, and 1132 were interned by the enemy
Our forces repossessed Wake in August 1945, after the completion of surrender negotiations. No resistance was encountered.

Johnston Island

Johnston Island, lying 720 miles southwest of Oahu, is a coral atoll roughly 8 miles long and 3 miles wide. The enclosed lagoon contains two islands, of which Johnston, with its 40 acres, is the larger; the other is Sand Island.
Before development, Johnston Island was approximately 3000 feet long and 600 feet wide. Sand Island, roughly circular in shape, contained six acres. Both islands were composed of sand and guano overlying the coral and sandstone reef. Vegetation was practically non-existent, and there was no fresh water.
The first use of Johnston Island by the Navy was in 1935, when the personnel of Patrol Wing 2, during the course of patrol-bomber training operations performed some minor construction to develop the atoll for seaplane operation. They erected a few rough buildings and a small boat landing on Sand Island and blasted coral heads within the lagoon to clear a 3600-foot area for use as a runway. A narrow ship-channel was also cut through the reef to afford entrance to the lagoon.
Further development of Johnston Island was undertaken in 1939 with the purpose of providing facilities to support the operation of one squadron

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of patrol planes with tender support. Civilian forces, under the PNAB contract, began work on November 9, 1939, at Sand Island, for which the initial development was planned.
During January 1940, a barge equipped with a crane and a 6-foot clamshell was brought in and put to work widening and deepening the shallow entrance channel. After the barge had worked its way into the lagoon and had excavated a small turning basin, it was dismantled and moved ashore. A 12-foot clamshell dredge arrived on May 5, and continued dredging within the lagoon; a turning basin 1000 feet square, was dredged and a narrow channel projected in the direction of Sand Island. Excavated material was used to make a plane parking area, 800 feet long and 300 feet wide, adjacent to the ship channel and connected to Sand Island by a 2000-foot causeway. This parking area was equipped with a 60-foot bulkhead, a concrete seaplane ramp, 50 feet wide, supported on steel piles, and two 25,000-gallon steel tanks for gasoline. The buildings on Sand Island included barracks for 400 men, a messhall, an underground hospital, a radio station, two water tanks with evaporating equipment, an electric power and boiler house, a laundry, and several storehouses. A 100-foot steel tower served as a combination standpipe for the fresh-water system and control tower for plane operation.
Dredging meanwhile was continued in the lagoon to provide safe water for seaplane runways. Three such runways were developed, the major one, 11,000 feet long and 1000 feet wide, with two cross-runways, each 7,000 feet long and 800 feet wide. These were cleared to a depth of 8 feet at low tide.
In September 1941, work was begun enlarging the land mass of Johnston Island to provide an airstrip. The initial plan called for a filled-in area, 200 feet wide and 2500 feet long, to be developed along the south shore of the island, but when this area had been completed, the operation was continued to extend the landing mat to a length of 4000 feet and a width of 500 feet. Material was obtained from the lagoon dredging. With all operations concentrated on Johnston, the contractor vacated the buildings on Sand Island to the naval personnel who moved in to operate the seaplane facilities.
Under the contract, the building program which progressed simultaneously with dredging and runway construction, accomplished the erection of two 400-man barracks, two large mess halls, a 30,000-cubic-foot

construction, accomplished the erection of two 400-man barracks, two large mess halls, a 50,000-cubic-foot cold-storage building, a powerhouse, a 50-bed underground hospital, a fresh-water evaporating plant, several shop buildings, three 8-room cottages, 16,000 barrels of fuel storage, and the installation of five 25,000-gallon gasoline tanks. These features were all usably complete by December 7, 1941.

When the news of the attack on Pearl Harbor reached Johnston Island, construction work was temporarily abandoned and all personnel were used for immediate defense preparations. On December 15, 1941, the island was shelled form an enemy submarine firing from beyond the reef. Several buildings were damaged, but none of the personnel were injured.

Landplane facilities on Johnston Island now became a strategic imperative in the defense plans for the Hawaiian Islands. A large hydraulic dredge was brought to the island to speed the work. The dredge remained until January 1943, and completed the main seaplane runway to a length of 5200 feet and a width of 500 feet, and extended the north shore of the island to accommodate an auxiliary runway, 3400 feet long by 200 feet wide, and a large seaplane parking area.

All civilian personnel, with the exception of the dredge crew, were replaced during July 1942 by a force of 500 men drawn from the 5th and 10th Seabees, who took up construction where the contractors left off and carried the current program, except for the dredging, to completion. The 5th Battalion departed during January 1943; but 250 men of the 10th remained until the following December.

Seabee construction included two 13,500-barrel diesel tanks, two 17,000-barrel fuel-oil tanks, and thirteen 25,000-gallon tanks, with associated pumping, filtering, and issuing equipment; a pier, 460 feet long and 30 feet wide, supported on steel piles; a small-boat pier; a float for seaplanes; a concrete power house; a recreation building; an aviation repair shop; 90 quonset huts for housing; a radio station; and 50 concrete magazines, in addition to the installation of new evaporating equipment which brought the total daily fresh-water production to 30,000 gallons. The 10th was replaced by CBMU 554 in January 1944.

During the summer of 1943, air traffic increased steadily as our war effort gained momentum. Johnston Island was, in addition to being a base for patrol planes and a submarine fueling stop, rapidly

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becoming an important stop along the westward air-transport route.

As a result, it became necessary to increase the length of the main landplane runway to enable it to accommodate heavy long-range bombers and transports, and a detachment from the 99th Seabees arrived during December 1943 to do this work. By use of a hydraulic dredge, the island was lengthened 800 feet to provide a 6000-foot runway. Ten acres of parking area were also added adjacent to the seaplane operating area.

By the summer of 1944, when the final dredging program and other improvements were substantially complete, Johnston Island covered an area of 160 acres, as compared with its original 40 acres.

Palmyra

Palmyra Island, 960 miles south of the Hawaiian Islands, is a coral atoll, composed of more than 50 small islets arranged as an elongated horseshoe.

Field work at Palmyra began on January 27, 1940, under the PNAB contracts.

A temporary boat channel, 25 feet wide and 5 feet deep, was developed during the first two weeks. In March 1940, work was begun to enlarge this channel to a width of 80 feet and a depth of 15 feet by use of a dredge towed form Pearl Harbor. Once inside the lagoon, it also dredged access channels to Menge and Cooper islands, the two principal land masses. Following the recommendations of the Hepburn Board, a larger dredge began operations on an 11,000-foot seaplane runway and deepened the existing ship channel.

Later, a revision in plans caused an increase of Palmyra's facilities to support land-based planes. As no single islet provided the necessary length for an airstrip, spoil from the dredging operations was pumped between Menge and Cooper islands and on the lagoon side of Cooper Island. After this coral fill was rolled, no further treatment was necessary, and the ultimate result was a runway, 5000 feet long and 300 feet wide. A smaller runway, 3700 feet by 200 feet, also of compacted coral, was constructed on Menge Island, and a concrete seaplane ramp was added.

In April 1941, a second expansion of plans necessitated additional quarters for a detachment of Marines who were to garrison the island. Four 60-men barracks were built, and extensions were added to a previously completed galley and messhall. Eight tanks with a total capacity of 200,000 gallons were built on Cooper Island, and 43 buildings, largely of frame and corrugated-iron construction on concrete foundations, was erected. These were used for shops, storehouses, and offices.

A second tank-farm was built on Menge Island.

When news of the attack on Pearl Harbor reached Palmyra, civilian labor forces were diverted to the construction of defense installations in preparation for an expected attack, which occurred on December 24, 1941. The only damage was minor: a shell from an enemy surface craft passed through the dredge.

Inter-island transportation, non-existent except by water, became of prime importance in the proposed defense of Palmyra against an enemy landing. Work was immediately begun on the placing of fill between the islets to form a continuous horseshoe-shaped causeway extending from Strawn Island, on the northwest, around to Home Island on the southwest tip of the atoll. Twelve miles of coral highway were constructed on Palmyra.

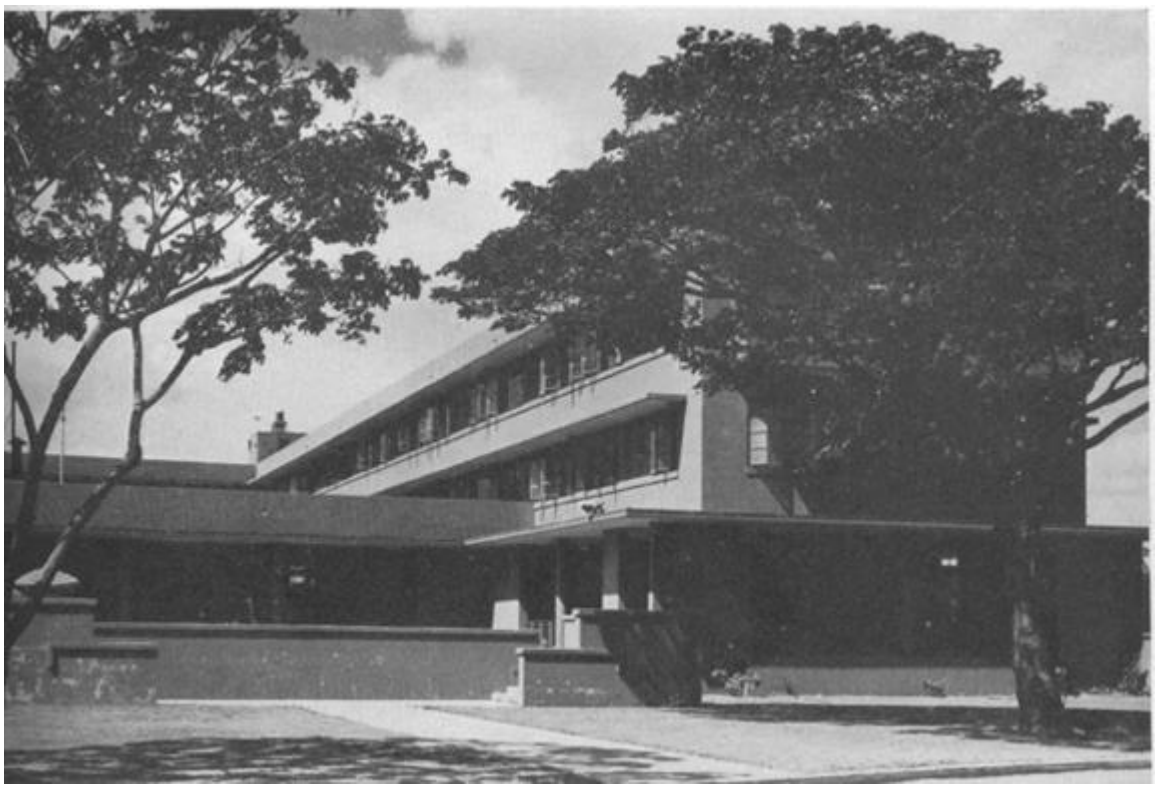
Due to an increase in air traffic through Palmyra, the detachment from the 5th Construction Battalion, which arrived in the summer of 1942, engaged principally in enlarging fuel and ammunition facilities, and building additional quarters and messhalls, until the arrival of half of the 76th Battalion in April 1943.

Work completed by the Seabees on Cooper Island included a 100-room hotel for transient personnel, two 200,000-gallon tank-farms for aviation gasoline, two 13,500-barrel fuel-oil tanks, two 17,500-barrel diesel tanks, and additional dredging operations for fueling wharves. On Menge Island, they built two aviation-gasoline tank farms, one of 125,000-gallon and the other of 175,000-gallon capacity a 633-foot sheet-steel bulkhead, a boathouse with five 20-foot slips, and a fuel-oil tank-farm. A small emergency landplane runway, 2400 feet long and 200 feet wide, was built on Sand Island, and a hospital on Engineer Island.

In January 1944 the 76th Battalion was replaced by CBMU 527, which, in turn, was replaced by CBMU 564 in November 1944.

Canton

Canton Island, one of the Phoenix group, was developed as a naval air station to support a squadron of patrol seaplanes and to provide a minor fleet refueling point. In addition to these naval missions, the Army developed three airstrips to support Army Air Force base units and the staging



Bachelor Officers' Quarters, NAS Pearl Harbor

of itinerant aircraft. Canton also served as a principal stop on the air-transport route to Australia.

Canton, a coral atoll, lies about 800 miles southwest of Palmyra. A hotel and some seaplane installations, previously built by Pan-American Airways, were taken over by the Navy.

When a detachment of the 10th Construction Battalion arrived on March 7, 1943, the Army was operating an air base with all supporting installations. The island was under the command of the Army, and maintained by Army forces. After establishing a tent camp, the Seabees started work on a 17-hut quonset village, complete

Army forces. After establishing a tent camp, the Seabees started work on a 17-hut quonset village, complete with a sewerage system, power and light, and a water-distribution system. Extensive blasting operations were also begun in the channel and lagoon.
The seaplane runways were sounded, their depths charted, and tide and current observations made, with the intention of reworking them to suitability for naval patrol-plane operations.
While dredging work was in progress, a construction crew started work on an officers' quarters, an overflow hotel building, which was an expansion of the existing hotel, and several magazines. Other men of the detachment were occupied in maintenance and repair work on the original Army facilities. A seaplane ramp and four prefabricated steel warehouses were also built.
In November, shortage of dynamite made it necessary to halt blasting operations. In April, all projects on Canton were turned over to a detachment of the 99th Battalion. The 10th had by this time succeeded in blasting the lagoon to the required depth and had performed 70 per cent of the required work on an aviation-gasoline system. The 99th continued work at Canton until June 1944, when CBMU 588 relieved it to carry out maintenance and minor construction until inactivated in July 1945.

French Frigate Shoals

French Frigate Shoals, a crescent-shaped reef formed on a circular platform about 18 miles in diameter, 500 miles northwest of Honolulu, was

Barracks at Pearl Harbor Separation Center

developed as a minor naval air facility to support the staging of aircraft and to serve as an emergency fueling stop and as a link in the radio-detection chain centered in the Hawaiian Islands.
The reef forms a barrier against winds and currents around the north and east sides of the platform. The south and west sides are open and are covered by water that averages a hundred feet in depth.
Construction was started during July 1942 by a detachment from the 5th Battalion and was accomplished by March 1943.
The major development centered about Tern Island in the northwest corner of the reef. A ship channel, 200 feet wide, was dredged through the barrier reef, and a seaplane runway, 8000 feet long and 1000 feet wide, was cleared in adjacent waters. Ships entering the lagoon were moored to three wood-pile dolphins.
By use of coral dredged from the channel and seaplane runway, Tern Island was increased in area to permit the construction of a coral-surfaced landing field, 3100 feet long and 250 feet wide. A parking area to accommodate 24 small planes was also provided. Housing in quonset huts was provided for 360 men; four temporary wooden buildings served as storehouses. Fresh water and electric power were provided by stills and generators; 20 steel tanks with a capacity of 100,000 gallons were provided for aviation gasoline.
In addition to the seaplane operating area developed adjacent to Tern Island, an auxiliary water area, 5700 feet long, for landing and take-off was also cleared. This runway was also provided with an adjacent mooring area, 4000 feet square.

area, 4000 feet square.

Source:*Building the Navy's Bases in World War II: History of the Bureau of Yards and Docks and the Civil Engineer Corps, 1940-1946,* Vol. 2, Chapter 22, pp. 121-162.