U.S. NAVAL BASE, PEARL HARBOR, LANDPLANE HANGAR TYPE
(U.S. Naval Base, Pearl Harbor, Naval Station Ford Island, General Warehouses)
(Facility No. 175 and 176)
Wasp Boulevard and Gambier Bay Street
Pearl Harbor
Honolulu County
Hawaii

HABS HI-400
HI-400

HABS
HI-400

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN BUILDINGS SURVEY
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
1111 Jackson Street, Suite 700
Oakland, CA 94607

HISTORIC AMERICAN BUILDINGS SURVEY

U.S. NAVAL BASE, PEARL HARBOR, LANDPLANE HANGAR TYPE
(U.S. Naval Base, Pearl Harbor, Naval Station Ford Island)
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(Facility Nos. 175 and 176)

HABS No. HI-400

Location:

Wasp Boulevard and Gambier Bay Street
Ford Island
Pearl Harbor Naval Base
City and County of Honolulu, Hawaii

U.S.G.S. Pearl Harbor Quadrangle, Hawaii, 1999
7.5 Minute Series (Topographic) (Scale - 1:24,000)
Universal Transverse Mercator Coordinates:

Facility No. 175 4.607570.2363040
Facility No. 176 4.607490.2362960

Significance:

Facility Nos. 175 and 176 are associated with the history of the Navy's transition from seaplanes to landplanes. The hangars were critical components of the aircraft carrier support facilities on the northwest side of Ford Island, and contributed to the U.S. victory in World War II. These two are the only known World War II hangars of this type in Hawaii. Facility Nos. 175 and 176 were designed by the office of Albert Kahn, a prominent architectural firm noted for their industrial buildings. They are contributing elements to the Pearl Harbor National Historic Landmark.

Description:

Facility Nos. 175 and 176 are at the northeast end of the row of hangars on the northwest side of the central Ford Island runway. They are surrounded by concrete paving of the hangar and airfield aprons on three sides. On the Wasp Boulevard side of the hangars there are grass strips between the buildings and the asphalt pavement of the road, interrupted by the concrete sidewalks along the road and leading to the shop or office doors. Across Wasp Boulevard, between these hangars and the harbor waters, is an open grassy area. The grouping of other aircraft carrier support buildings is also across Wasp Boulevard, but further southwest. Gambier Bay Street intersects Wasp Boulevard between the hangars and leads to Facility No. S383, one of the three aircraft carrier wharfs at Ford Island. Just to the northeast of these hangars is a bombproof shelter, Facility No. S181, and the landscaped neighborhood of Luke Field houses.

Both of these hangars were completed at the same time from the same design, but have had somewhat different alterations over the years. The following description will largely focus on the common design elements in both hangars, but differences between them will be noted.

Each hangar is a generally boxy shape, except for the angled roof monitors. The grids of the glazed hangar doors and window bands are part of the rectangular emphasis of the design. The basic volumes of each hangar consist of a high-ceilinged open space for working on planes flanked by lower two-story sections with offices and shops, called lean-tos. The lean-to sections have low-slope shed roofs, and the main hangar roofs are low-slope gables. Perpendicular to the gable axis on each hangar roof there are roof monitors with triangular cross-sections facing in opposite directions. The windows of the monitors face towards the north and south hangar doors. These angled monitors give the buildings their distinctive profile.

Each hangar's footprint measures 255'-3" x 211'-11"; this includes the main hangar space approximately 200' square, a row of offices and shops on each side, measuring about 26' x 200', and door pockets in each corner. There are various roof heights. The roofs on the lean-tos are approximately 28' above grade. The lower edges of the main roof are about 38' from grade. The height to the gable roof's ridge line is approximately 40'. The height to the top of the roof monitors is about 50'.

The drawings for the hangars show that two types of reinforced concrete foundations were designed, both piles and spread footings. It is not known what type was used under these two Ford Island hangars, but since the land they were built on is not fill, spread footings are likely. The perimeter footings around the main hangar space are all spaced about 20' apart. The footings along the exterior length of the lean-tos have the same 20' spacing, but these lean-to footings are 26'-0" from the footings under the main hangar walls, measured from their centerlines. Under each corner door pocket there is an intermediate footing. There are large footings under the five columns along the centerline of the hangar space. The footings are all connected with grade beams, except the three interior columns along the centerline. The reinforced concrete floor is at least 5" thick, and it slopes slightly towards the doors.

The steel structural framing of Facility Nos. 175 and 176 includes bolted, riveted and welded connections. The roof over each main hangar space is supported by a riveted steel truss system which includes a large truss spanning the center posts, plus eleven other trusses, running perpendicular to this center truss, supported on their ends by the columns at the inner planes of the lean-tos. The top chords of these cross trusses are pitched to achieve a low-slope gable roof. All the trusses are connected with bottom chord cross-bracing, incorporating extensive bracing around the perimeter. The structural framing of the office/shop portions of the buildings is simpler. The lower portions of the lean-to walls are concrete, adding to the structural stability of the hangars.

The roofs of the hangars have built-up roofing over wood tongue-and-groove sheathing. There are numerous floodlights mounted on the edge of the hangar roofs on their airfield side. Facility No. 176 has several antennae on its roof.

The shed roofs over the lean-tos have wide eaves that shade the second-floor windows, while the main gable roof has close eaves that do not overhang the clerestory windows. There are gutters along the eaves of the gable and shed roofs; downspouts are spaced at every other bay. The gutters and downspouts are copper, and they empty rain water into cast-iron pipes that start just below the concrete walls of the lean-tos and run underground to other drain pipes. There are roof access ladders on both buildings, typically two on each side, that is, one ladder to each roof level. These are usually located at the center of each side, but the lower ladder is missing on the airfield side of Facility No. 175. These ladders have safety cages and parapet extensions. There are four additional ladders on the harbor (west) side of Facility No. 176, apparently installed as fire escape ladders; they do not reach the roof level, and do not have safety cages. They are located between the downspouts, and so the ten bays on this side of Facility No. 176 are clearly demarcated.

Corrugated transite is the primary sheathing material for these hangars. There are concrete base walls around the hangar perimeters, except at the location of doors, and concrete bands between the first- and second-floor windows of the lean-tos. The transite is most prominently used on the large flanking hangar door pockets in the corners of the buildings and in the gable ends. The concrete base walls are approximately 5' in height with either corrugated panels (at the door pockets) or windows (at the lean-tos) above. The concrete bands between the first- and second-floor windows are about 7' in height.

Each gable end has eight large sliding hangar doors, each measuring about 25' wide by 28' tall. These steel-framed doors are glazed on the upper three-quarters and have 1/8"-thick steel plate on the lower fourth. The steel framework of the doors is braced around the perimeter. Within each door's steel framework are eighteen steel-sash windows; and each window has twelve lights. In the doors alone, these hangars have almost 7,000 lights. Wired glass was originally installed but some have been replaced with other types of glass. All the lights in Facility No. 175's hangar doors have been painted. The door design includes steel wheels, and they run on four steel tracks and overhead between steel door guides. The doors can be stacked in the door pockets to fully open the main hangar space. A shed roof of corrugated transite covers the door guides. Some of the large hangar doors, typically two in each set of eight, contain small hinged metal doors. On the original drawings such an opening is labeled "pilot door." These entrances, for pilots and others, are about 3' x 5' and have two lights in the upper section. Additional

small doors have been installed, often near an original pilot door. These are typically narrower metal doors, without lights.

In addition to the hangar doors there are exterior metal doors into each of the door pockets and into many of the first-floor rooms of the lean-tos. Each hangar door pocket has two hinged doors, a single door at the bottom on the narrow end, and a double door at the level of the lean-to roof. The single door in each door pocket measures 3'-0" x 7'-0" and in the original design has three lights in the portion projecting above the concrete base wall. The original drawings show the double doors at the roof level with six lights and louvers in each leaf, and 6'-0" x 8'-6" dimensions. The exterior doors into the shops or stair halls have various dimensions, and include double as well as single doors. They all originally had lights in the portions of the doors that are above the concrete base wall. Many of the lights in the doors have been covered up or painted. The doors to the transformer rooms also have louvers in their lower sections.

Above every door on the east and west sides of the hangars are nautical-style metal-cage light fixtures. In each band of concrete between the first- and second-floor windows there are also about three fire alarm fixtures. These decorative pie-plate-shaped metal alarm covers have a rim pattern of voids consisting of diamonds alternating with three vertical lines around the bottom edge, with a ray motif in the upper half of the flat portion, above the words "Rockwood Worcester."

Bands of clerestory windows, each about 200' in length, run above the lean-tos, providing light and ventilation to the main hangar space, as do the windows in the monitors, which are approximately 120' long. Each of the multi-light windows in the monitors has a projected section in the center, above and below fixed lights. Hardware interconnects these ventilating sections and operates them via a rack-and-pinion assembly. The clerestories have similar windows, but some are entirely fixed with no operable section. The second-floor windows, on both sides of both hangars, are also continuous bands of windows, either twelve-light or eight-light. All of the eight-light and some of the twelve-light ones are fixed windows. There are central six-light projected sections in two or three of the twelve-light windows in each bay on the second floor. These projected sash are like awning windows but not hinged at the top; instead pins near the top of the sash move in tracks along their sides. The first-floor windows are similar, except doors make the pattern of projected sash less regular than on the second-floor. Above the doors, there is typically a six-light transom window (or twelve-light transom above double doors). Since construction, many of the original lights on both structures have been broken, boarded up, replaced with other material, or painted over. The toilet rooms appear to have had a textured glass originally, while the shops and offices had clear glass lights. On Facility No. 175, all the monitor windows facing the housing area, all the clerestory windows

on the airfield side, and many of the first-floor windows on that side have been entirely covered up.

The interior of each hangar is a large open space, about 200' square, with five support columns down the centerline between the doors. There is cross-bracing in the 20'-0" spans between each pair of columns closest to the doors. The central column is the only free-standing one. There is a clear span of 28'-0" to the underside of the trusses. There are no interior finishes; the same exterior and structural materials are seen here. The floor is concrete, with various types of expansion joints dividing it into a 20' square grid. The steel trusses are exposed, but some vertical planes are faced with corrugated metal panels. The tongue-and-groove boards of the roof underlayment are visible as the ceiling surface. There are numerous circular light fixtures, suspended on long rods, to illuminate this large space.

The interior spaces in the lean-tos on the airfield and Wasp Boulevard sides of the hangars are 26'-0" wide on the first floor and about 20' wide on the second with a corridor along most of the length of each upper story, open to the main hangar space above the steel plate railing. The floor-to-ceiling height on the first floor is about 15', while the second-floor rooms are approximately 13' high (varies due to sloping roof). The partitions for the rooms in the lean-tos are usually made of metal and glass, and most of the glass has been painted. These floor-to-ceiling partitions are like fixed windows, usually with twenty-four lights per "sash." The commanding or flight officer's rooms at the second-floor corners of the lean-tos have two six-light vent sections that project into the hangar space. The toilet rooms and stairs have concrete partition walls. A variety of doors and light fixtures are seen in the rooms of the lean-tos.

Historical Context: Refer to HABS No. HI-394 for more information on the aircraft carrier support activities on Ford Island and HABS No. HI-382 for an overall history of Ford Island. There are also several reports on other Ford Island hangars, including HABS No. HI-365 (which has a list of the other hangars or hangar-like buildings)

Facility Nos. 175 and 176 were built from plans by Albert Kahn, Inc. of Detroit, Michigan. This firm designed many of the buildings at naval installations throughout the Pacific (Contractors Pacific Naval Air Bases n.d.: A-388). "Kahn was one of the country's foremost industrial building designers, and had been chosen to prepare plans for the barracks, mess halls, and hangars that could be standardized for the various bases" (Woodbury 1946: 75-76). Kahn's firm specialized in factory design and their buildings were noted for their simplicity, efficiency, and use of natural light.

These hangars were built in 1941 as part of the expansion of the Naval Air Station at Ford Island prior to the U.S. entry into World War II. The buildings on this side of Ford Island were intended to support the Navy's carrier planes. These support buildings were mostly constructed after 1940, following the move of the Army aviation functions from the northwest side of Ford Island to either Hickam or Wheeler Army Air Fields. Construction of these two hangars required demolition of several buildings that the Army had not moved. A June 1940 map shows that a dispensary, seven houses and a duplex for enlisted men, two officers' duplexes, and some unnumbered buildings were removed before building Facility Nos. 175 and 176 (Fourteenth Naval District 1940).

Historic photos show the hangar frame was erected by August 1941, with siding up by September 1941 (National Archives II). A November 1941 view of the hangars is labeled a completion photo, although the contractor's report lists their final completion date as March 1942 (Contractors Pacific Naval Air Bases n.d.: A-562). The component design of the hangars allowed for rapid construction. Speed of both design and construction was definitely a goal for the architectural firm, in response to the needs of the Department of Defense. In the 1940s Kahn wrote that "simplicity of design and construction is imperative. Every day counts and minutes must be saved. It is not only a matter of dollars and cents, but, today, it is a matter of life and death" (Bucci 1993: 108). The need for speed was also understood by the builders -- Contractors Pacific Naval Air Bases (CPNAB), a consortium of construction companies that was responsible for building innumerable facilities at air bases and other naval stations in the Pacific, between 1939 and 1943.

These hangars are significant because they are associated with the transition of Navy aviation from seaplanes to carrier-based planes. Naval aviation's role also expanded from a patrol emphasis to become the Navy's main combat arm during World War II (WWII). The aircraft carriers became more important than the battleships, the traditional capital ships.

Kahn's firm developed standard designs for both landplane and seaplane hangars, although the latter were sometimes used for carrier-based planes. The first new Navy Air Station (NAS) developed under the Hepburn Program (which funded Naval expansion, especially of aviation shore establishments) was in Jacksonville, Florida in 1940 (Pedrotty et al. 2001: 4-25). The architectural drawings for the Ford Island hangars are identical to the landplane hangars built in Florida, and "Jacksonville, FLA." is simply crossed out in the title blocks, and "Ford Island, Pearl Harbor" written in. It is not known if landplane hangars of this type were built at other Navy airfields in the Pacific, but perhaps none were, since the Navy's outer island air installations were not major aircraft repair bases. The completion reports for Kahului NAS and Hilo airfield only list nose hangars in their respective lists of drawings (Holmes & Narver 1943).

The standard seaplane hangar design by Kahn's firm was larger and seems to have been used more often than the landplane design. In the Pacific it was termed "Midway type" (Contractors Pacific Naval Air Bases n.d.: A-352). Two hangars at NAS Barbers Point and five at NAS Kaneohe are the seaplane hangar type, although both the Barbers Point hangars and at least one at Kaneohe were used solely by carrier planes.

Facility Nos. 175 and 176 were not damaged during the December 7, 1941 attack. There were no planes on the tarmac just in front of them, since the carriers were out at sea with their squadrons. The patrol planes on the ground, especially those based in the hangars on the other side of the Ford Island airfield, were targets for the Japanese bombers, as well as the ships on both sides of the island. A photo taken just after the December 7, 1941 attack shows Facility No. 175 with billowing smoke from Battleship Row in the far background (National Archives 1941). Unlike the other buildings in the area, these hangars were not painted in camouflage patterns after the attack.

Some carrier planes did have tragic associations with the attack on Pearl Harbor, as outlined in more detail in HABS No. HI-394. Eighteen dive bombers from the USS *Enterprise* were on scouting patrol at dawn on December 7, and afterwards directed to land on Ford Island, instead of returning to the carrier. They arrived about 8 am, during the first wave of the Japanese attack. Five of the eighteen made crash landings or were shot down, either by Japanese planes or by anti-aircraft fire (Lundstrom 1984: 15). The remaining planes and others from the carrier looked for the Japanese attack fleet, and at the end of a day of unsuccessful searching, six of the *Enterprise* fighter planes were directed to land at Pearl Harbor. Distraught gunners shot at them, believing the Japanese were returning, and only one of the six landed safely with his plane through the hail of bullets (Daniels 1999).

In response to the December 7, 1941 attack "ready ammunition lockers" were built near the two hangars. Historic maps show these were erected sometime between June 1942 and October 1943. They were simple structures built of concrete masonry units, with flat roofs, flush metal doors, and metal mesh over small ventilation openings just under the eaves. Two were built near each hangar. Facility Nos. 229 through 231 were built close to Wasp Boulevard, but Facility No. 232 was erected on the airfield side of Facility No. 176. These small ammunition storage buildings were demolished about 1998.

It is not known when the fire alarms were placed on the building. This might have been done after the December 7, 1941 attack. The alarms, whose metal covers are described in the section above, were a product of Rockwood Sprinkler Company in Worcester, Massachusetts. An employee of that company, who like the founder was an alumnae of the Worcester Polytechnic Institute, "invented the Watermist spray nozzle for

fighting shipboard fires, an invention that saved thousands of lives on Navy ships during World War II" (Worcester Polytechnic Institute 2006).

Throughout WWII, Facility Nos. 175 and 176 were of vital importance as repair and overhaul facilities for the Pacific-based aircraft carriers. In the early years of the war the carriers tied up at the moorings on the northwest side of the island (F9 to F13) and a floating crane was used to load or unload materials, including planes that could not fly. The mooring pairs, except F11 -- where the sunken USS *Utah* lies, were converted into wharfs (Facility Nos. S382 through S384) by 1943. This made loading operations much easier.

Facility Nos. 175 and 176 were the main carrier hangars. Each of these had two identical sets of shops and offices, and so one hangar could handle two 18-plane squadrons. Typically there were four squadrons per aircraft carrier, and usually only one aircraft carrier was at Pearl Harbor at any given time during the war. Repairs as well as upgrades to the planes or their equipment, such as guns or radar, were done in these hangars (Daniels 1999).

The original plans show the first-floor rooms in the lean-tos included shop and storage spaces, with rooms for radio repair, carpenter shop, metal shop, engineering shop, gunnery workshop and storage, and squadron stores with a separate space for parachutes. There were also locker, toilet, and wash rooms at one end. In each first-floor lean-to there are also two stairs and small equipment rooms for heaters, transformers, and switchboard. The second level mostly contained offices for the commanding officer, communications officer and navigation officer, yeomen (petty officers performing chiefly clerical duties), executive officer, gunnery officer, engineering officer, and flight officer. A locker room and two toilet rooms were also on this level. Each level had a small room with a deep sink, labeled "cleaning gear."

The renovations to the hangars over the decades since their construction have been minor. In 1956 "draft curtains" of galvanized corrugated iron were installed up in the roof structure. Two were attached to the central trusses (along the length and width of the main hangar space), and two additional "longitudinal draft curtains" were installed. All three of the longitudinal ones extended up into the angled monitors, apparently to deflect the draft from those windows. Sprinklers were installed in the hangars in about 1959. Minor changes to some of the lean-to spaces were made in 1962.

After the closure of the air station on Ford Island in 1962 the facilities' hangar function was unnecessary. In 1962 several drawings, under four different project numbers, were prepared to change Facility No. 175 to a communications center. One drawing (no. 956181) shows that 36 office cubicles of plywood were built on the hangar floor. In 1965 Facility No.

176 was slightly altered to become a heavy maintenance shop. The 1965 work simply added a new wire cage tool shed and two monorails with electric hoists in the large hangar space. Some original partition walls were removed and mezzanines were added in some of the first-floor shop spaces at this time. A plumbing drawing (no. 22082) shows that the shop functions also changed and new sinks were installed. Despite the change in uses after these renovations, the 1966 Navy facilities inventory still lists both buildings as hangars. In 1978 the uses listed were "hangar – storage" (Naval Facilities Engineering Command, Pacific Division 1978: A-21). Since then these hangars have been used mostly for storage.

Sources:

The drawings for these buildings are on microfiche cards at the Plan Files of the Naval Facilities Engineering Command, Pacific. The original drawings are under numbers 135741 through 135755 and 2675 through 2679. Repair and renovation drawings are under numbers 11080 through 11083, 872912 through 872915, 956166, 956181, and 956265 through 956268.

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National Archives II
1940s Historic photos showing Facility Nos. 175 and/or 176, dated Aug. 11, Sept. 1, and Nov. 5, 1941, in RG 71 CA; dated Dec. 7, 1941 under no. 80-G-266629; and dated July 19, 1942 in RG 71 CB at Still Photo section of National Archives II, College Park, Maryland.

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2001 *Historical and Architectural Overview of Military Aircraft Hangars: A General History, Thematic Typology, and Inventory of Aircraft Hangars Constructed on Department of Defense Installations.* Prepared for United States Air Force Headquarters, Air Combat Command. United States Army Construction Engineering Research Laboratory: Champaign, Illinois.

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Project Information: Commander Navy Region (COMNAVREG) Hawaii has embarked on a program of documentation of historic properties within its area of responsibility, with the goal of recording historic information about each property and establishing its context of significance. This information will assist COMNAVREG Hawaii in the appropriate management of these properties, be it routine repair and maintenance for continuing use, rehabilitation for continuing use / adaptive reuse, or demolition. At this time, specific action that may affect these facilities has not been determined. This report was prepared under a Historic Preservation Services contract (N62742-97-D-3502) awarded to AMEC Earth and Environmental, the prime contractor, by the U.S. Navy, Naval Facilities Engineering Command. The contract was funded through the Cultural Resources Program of COMNAVREG Hawaii. The photographic documentation was undertaken by David Franzen, of Franzen Photography. Location maps were made by Nestor Beltran of NAB Graphics. Between 1999 and 2001, the field work was done and the draft

of this report was written by Dot Dye, AMEC Earth & Environmental, Inc. The report was rewritten in 2006 by Mason Architects, Inc.

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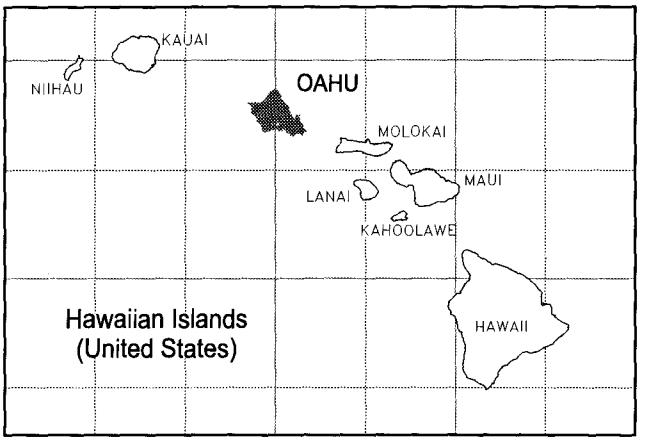
Date of Final Report: March 2006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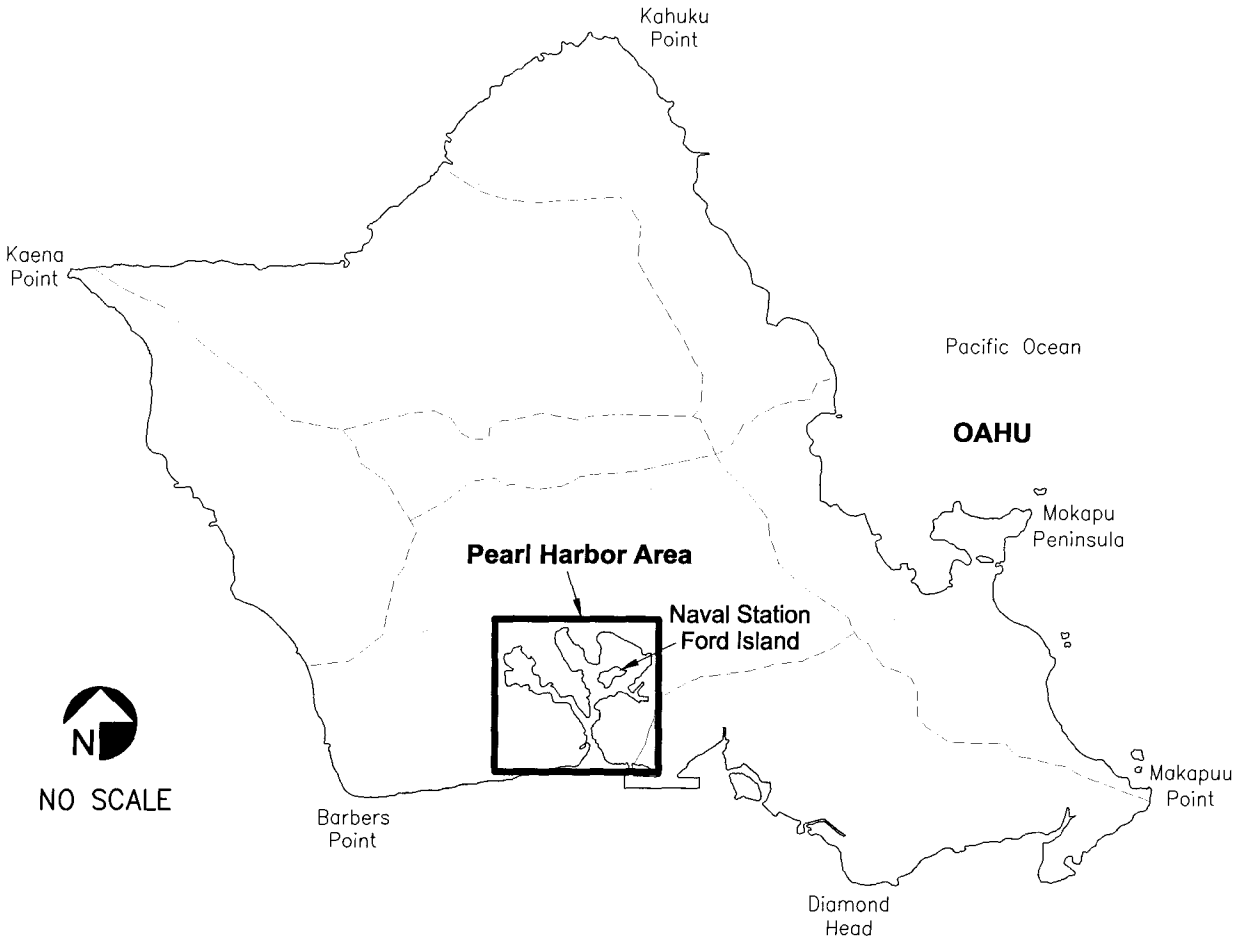
Hawaiian Islands
(United States)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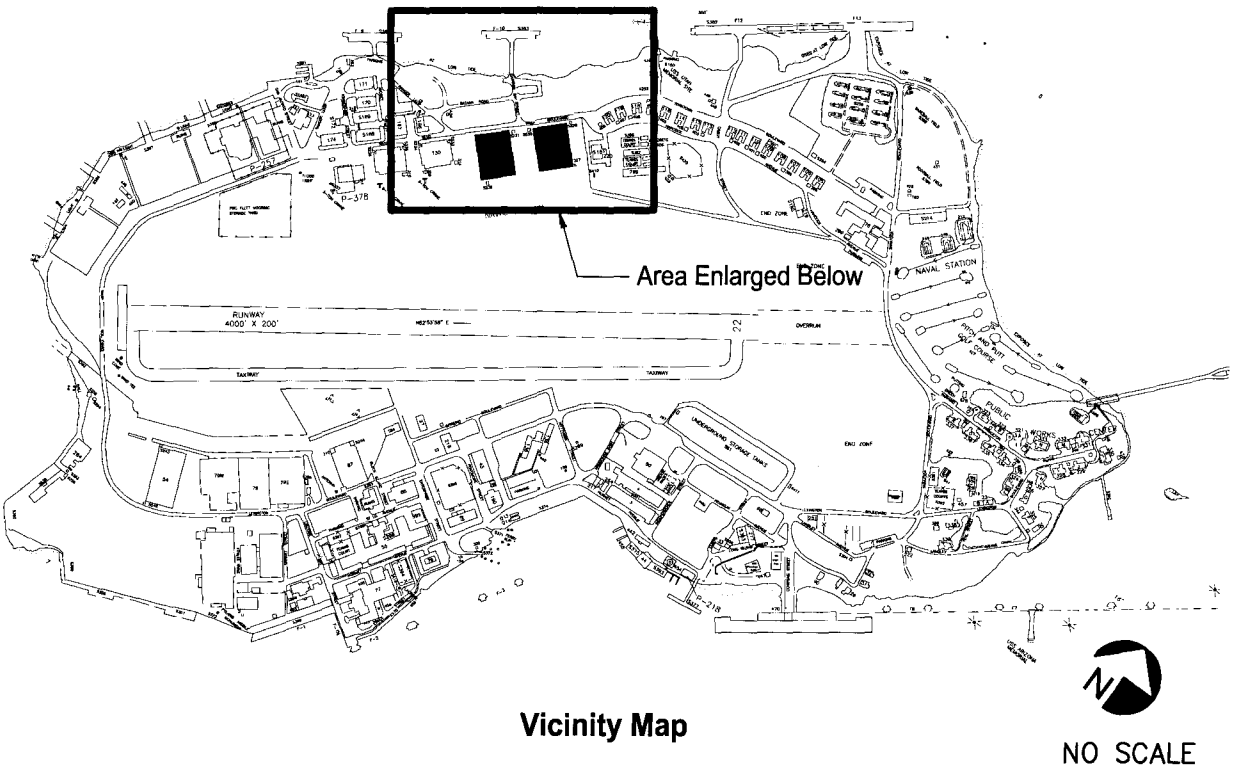
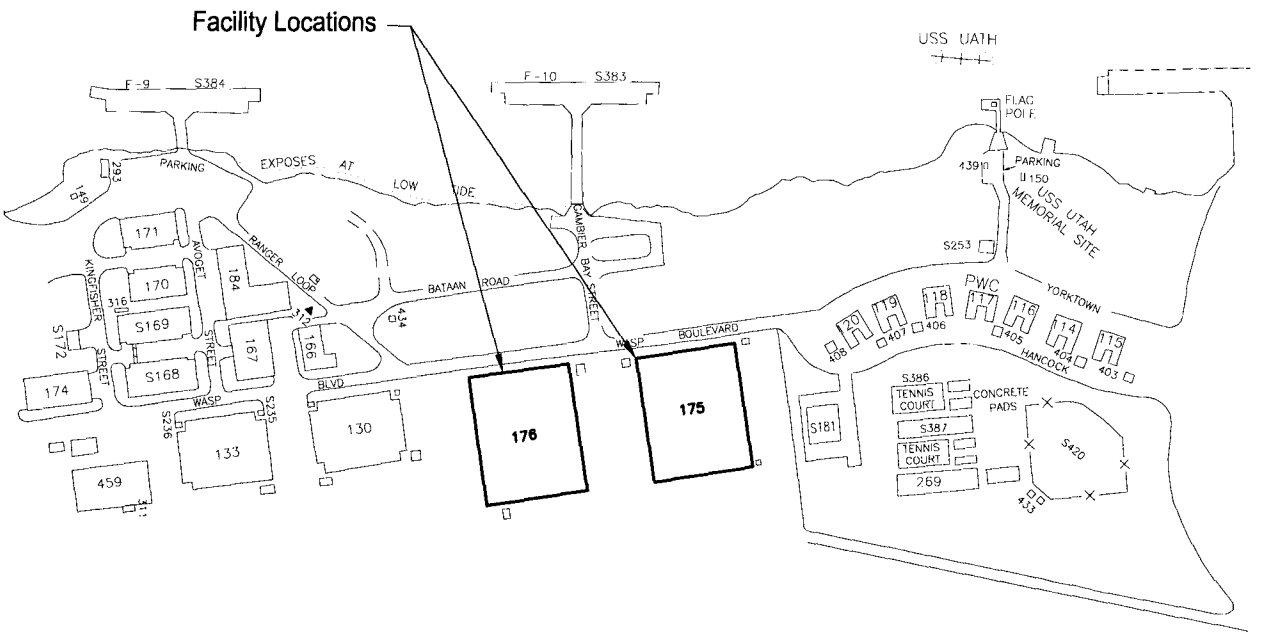
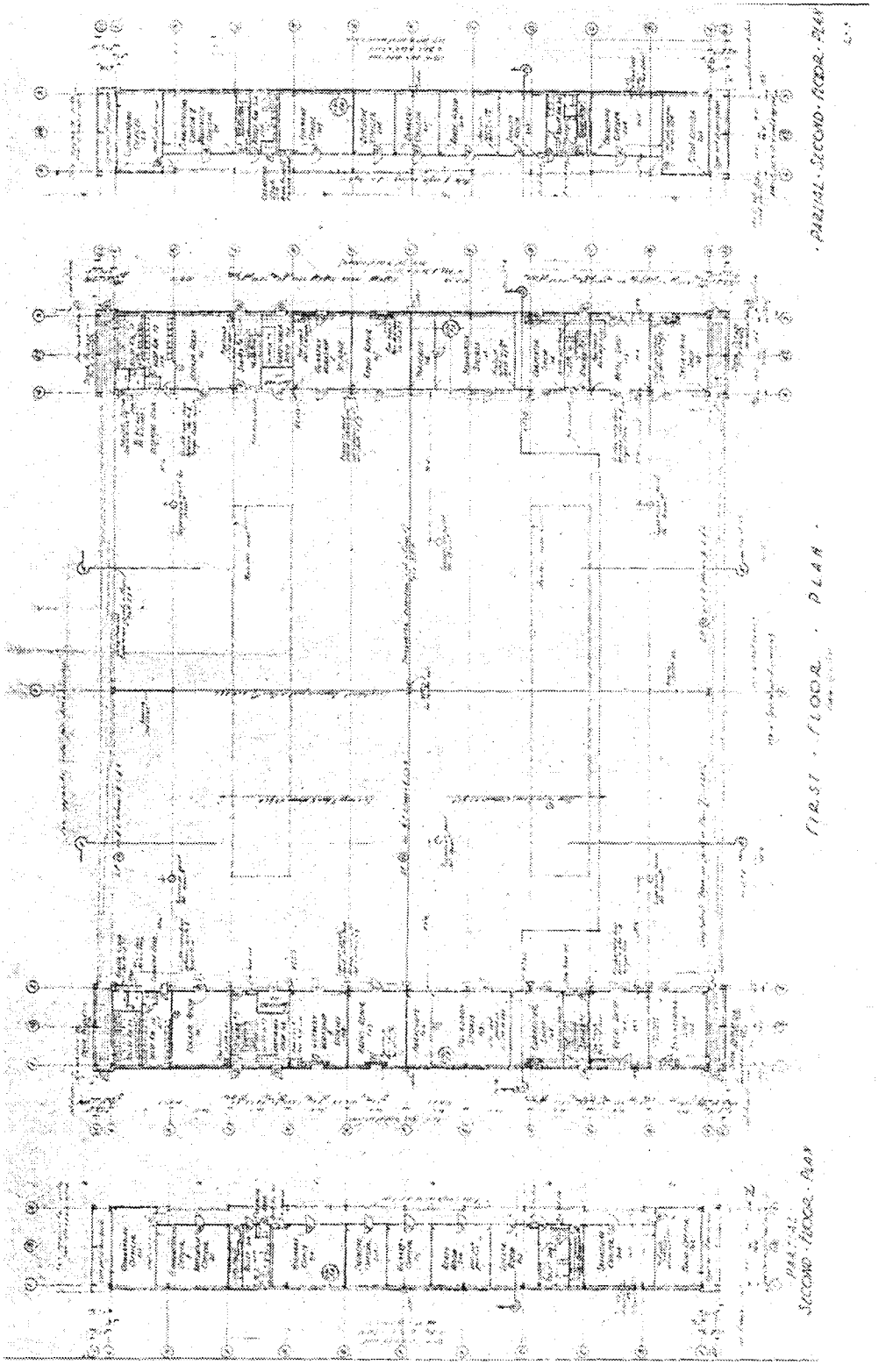


Vicinity Map

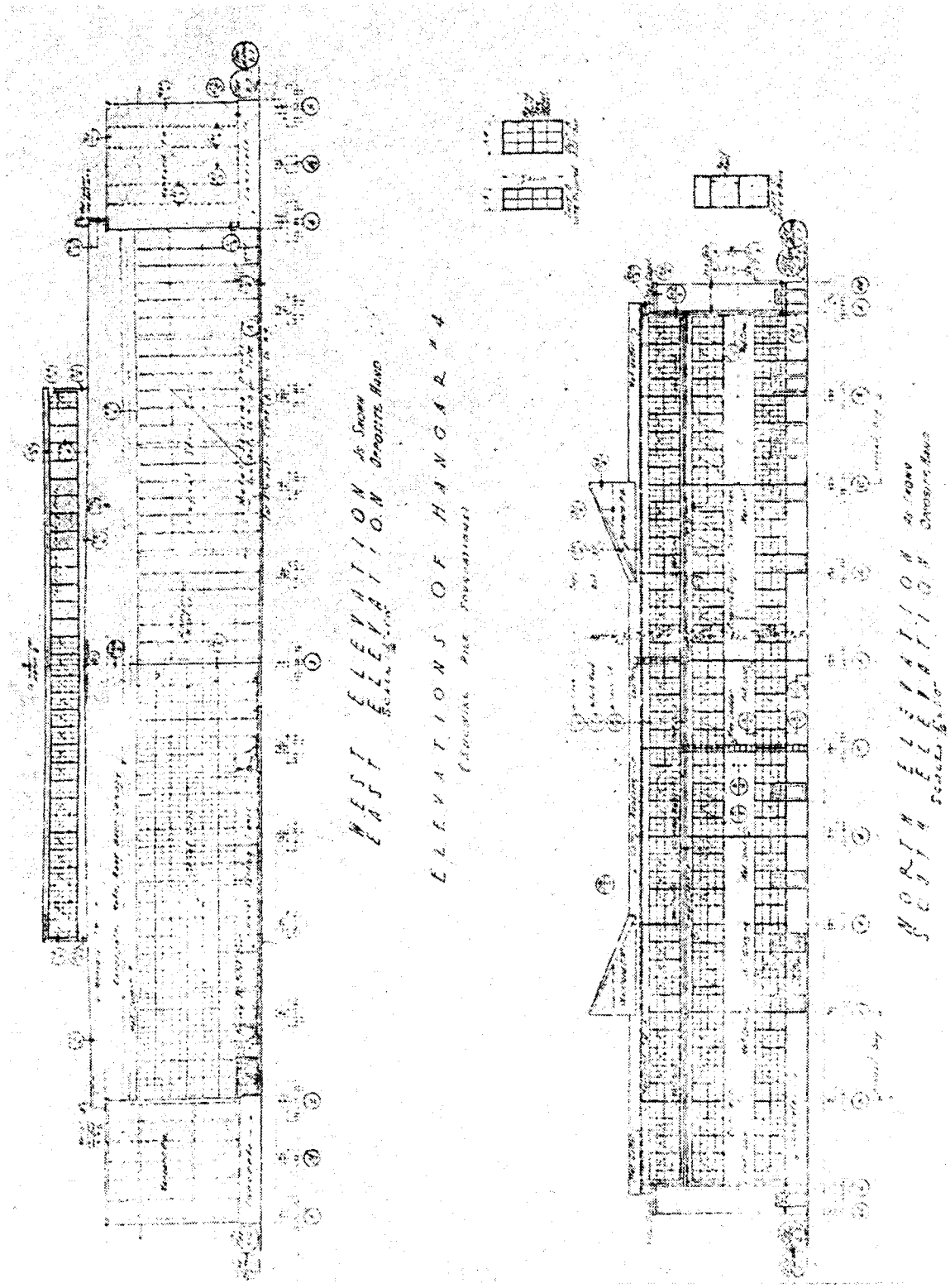


Site Map

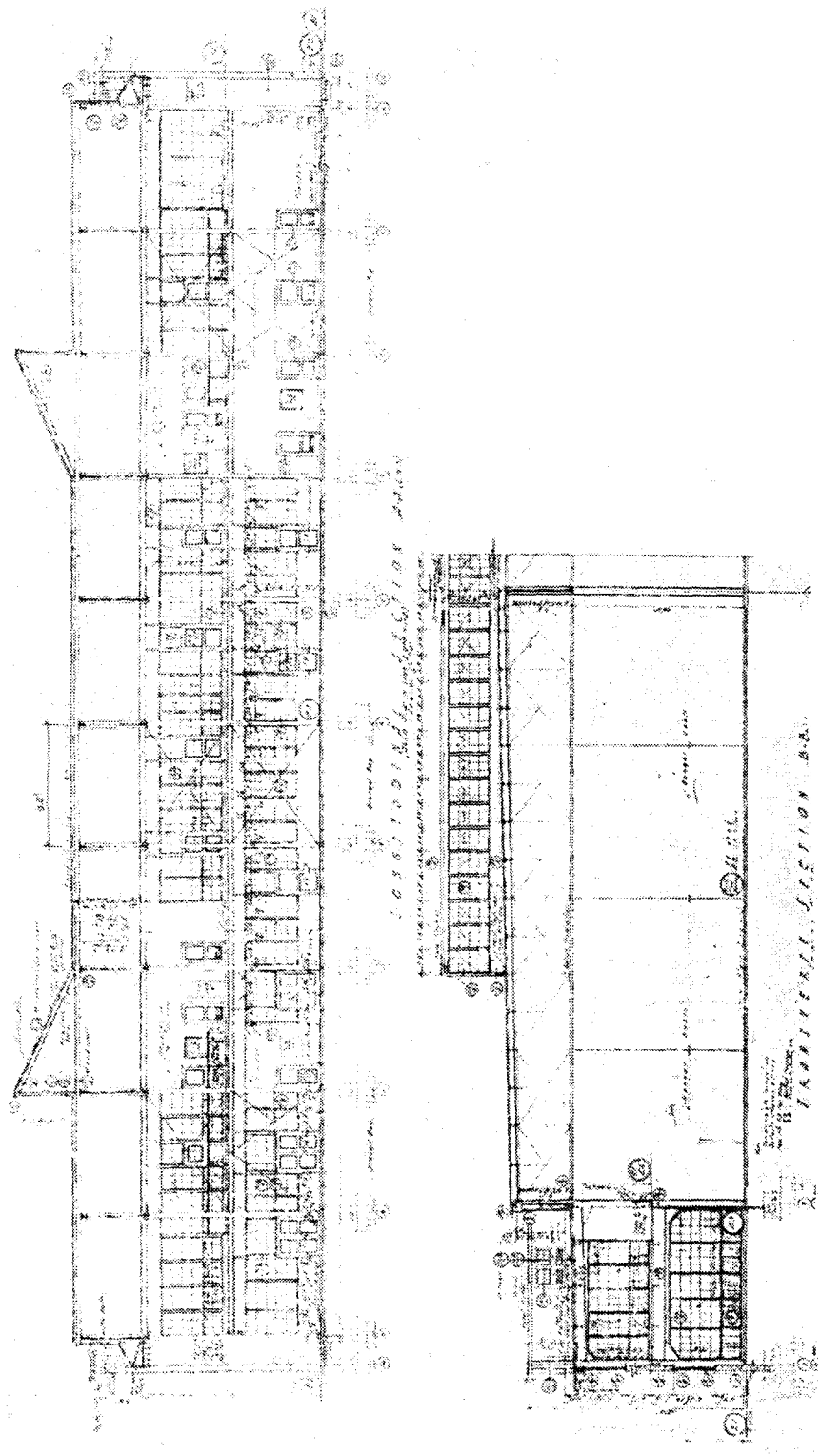
Portion of drawing No.135741, dated May 23, 1940 (First-Floor & Partial Second-Floor Plans)



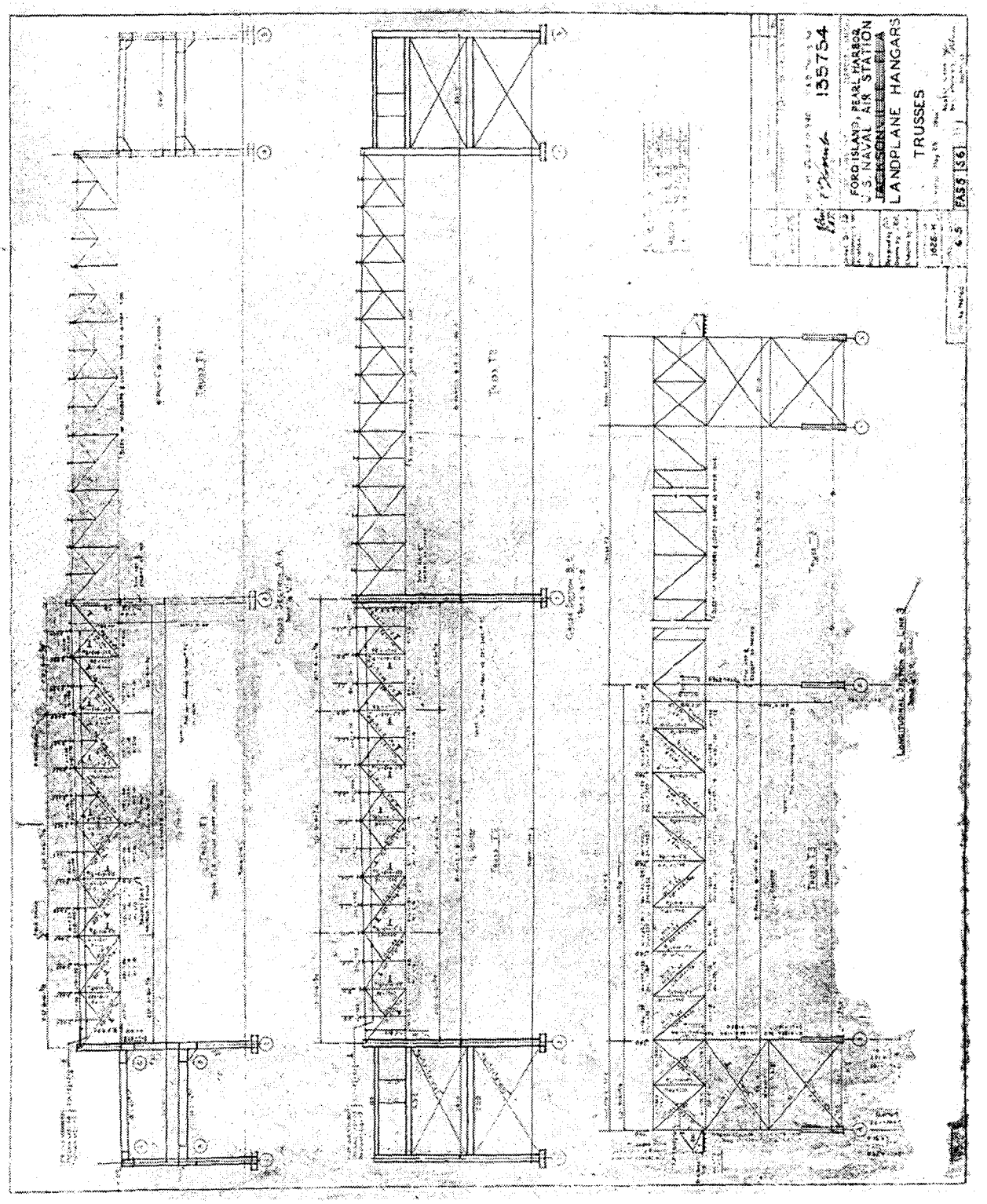
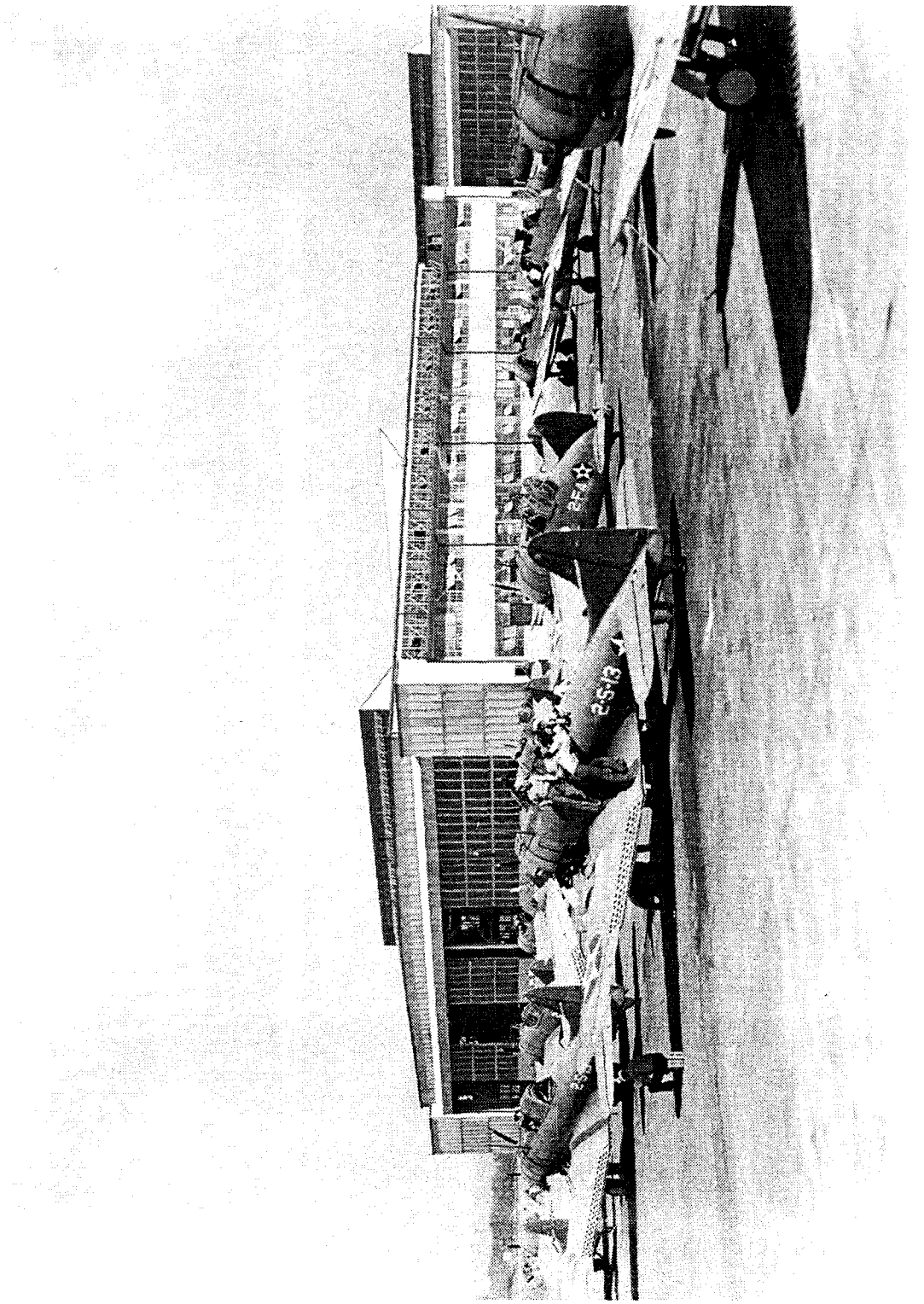
Portion of drawing No.135742, dated May 23, 1940 (Exterior Elevations)



Portion of drawing No. 135743, dated June 10, 1940 (Cross Sections)



Drawing No. 135754, dated May 23, 1940 (Cross Sections of Trusses)



Facility No. 176 at completion (Facility No. 175 in background), dated 5 November 1941
(Source: National Archives II, order no. 71 CA-178-HH-1)