U.S. NAVAL BASE, PEARL HARBOR, SHIPFITTER'S SHOP
(U.S. Naval Base, Pearl Harbor, Naval Shipyard, Facility Nos. 155 & 155A)
Seventh Street near Avenue C, Adjacent to Repair Basins
Pearl Harbor
Honolulu County
Hawaii

HABS HI-496
*HI-496*

HABS
HI-496

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN BUILDINGS SURVEY
PACIFIC GREAT BASIN SUPPORT OFFICE
National Park Service
U.S. Department of the Interior
1111 Jackson Street
Oakland, CA 94607

**HISTORIC AMERICAN BUILDINGS SURVEY**

**U.S. NAVAL BASE, PEARL HARBOR, SHIPFITTER'S SHOP**
**(U.S. Naval Base, Pearl Harbor, Naval Shipyard)**
**(Facility No. 155 & 155A)**

**HABS No. HI-496**

**Location:**

Seventh Street at Avenue C
Adjacent to Repair Basins
Pearl Harbor Naval Base
City and County of Honolulu, Hawaii

This building is at UTM coordinates 04.608490.2361480 and is within the boundaries of the Pearl Harbor, Naval Shipyard as defined in the location section of the overview report HI-483.

**Significance:**

Facility 155 and contiguous Facility 155A are located within the Pearl Harbor National Historic Landmark. Facility 155 was constructed as part of the major buildup of permanent shop facilities at the Shipyard in anticipation of World War II in the Pacific. The building was designed to house in one location, near the wharfs, the structural and boiler trades, with the possibility of expansion to house relocated forge facilities. Facility 155 is a large, prominent heavy-industrial structure designed by the firm of a noted industrial facility architect of the period, Albert Kahn, who also designed the still extant Facilities 67A(HABS HI-492), 167(HABS HI-497), and 3A(HABS HI-445), and the former 4A(HABS HI-360) at the Shipyard and Hangar 175 and 176 at Ford Island. The construction of Facility 155A, was an addition to Facility 155 to provide a furnace facility, and part of the further buildup following the December 7, 1941 attack.

**Description:**

Facility 155 is a large steel framed structure with three bridge-crane bays. The central bay, having a loft above, is two stories. This is flanked by an equal-width, equal-length one-story bay on the north and by a similar but half-length bay on the south. Narrower and lower two-story service structures adjoin the outer crane bays on either side and extend nearly their full lengths. The loft extends across the full width and length of the central crane bay below. The building faces and is oriented perpendicular to Seventh Street on its west end.

The three crane bays are arranged in a structural grid that is twenty-four, 23'-0" bays long by two, 100'-0" bays wide at the full-length bays, and twelve, 23'-0" bays long by one, 100'-0" bay wide at the half-length bay, for an overall size of about 556' x 304'. The service structures are in a 23'-0" x 25'-0" grid, adding 50'-0" to the overall width of the building. Total floor area is about 232,000 square feet. The approximate overall building height at the central bay loft is 82', 60' at the side bays, and 25' at the service structures.

The roof over the two side crane bays is a low slope (2.5:12) gable. The buildings central portion, above the loft, has a low slope gable roof and a unique roof monitor with a valley roof. Superimposed roof framing over the side bay rafters supports light monitors flanking the base of the loft, and the raked backsides of the outer wall parapets. The flanking monitors have steeper-pitched (7:12) roof planes replacing the lower halves of the inside planes of the side-bay roofs, and raked glazing across the opening. The parapet backsides are an upturn of the bottom of the side-bay roofs' outside planes to engage the top of the parapets. The flanking monitors provide natural light to the side crane bays and to the central bay as well. The function of the raked parapet backside is unclear but may be to facilitate control of roof runoff.

Continuation of the side-bay parapets around the corners at the west and east ends of the building hides the lower portion of the roof slopes of those bays and produces roof ends with the look of simple pediments rather than gables. The monitor over the central bay loft is stopped one transverse bay short of the west end of the building but extends all the way to the east end. The roof over the last bay on the west end of the mold loft slopes gently out to the building face and the monitor is not visible from that side of the building except at some distance. At the east end the monitor's inverted roof form extends to the building face. The side-bay flanking monitors either are held back from the building ends or hidden by elevator/stair towers. Low-slope shed roofs cover the service structures, extending out from the side bays.

The main structural floor is concrete slab-on-grade, with main structural columns supported by concrete pile caps over multiple concrete piles below each. The columns for the service structures are supported by spread footings. A continuous footing between the exterior columns supports a concrete wall of waist height capped by an integral sill. The structural slab is flat over the length of the building. The finish floor has many work areas where end-grain wood blocks are inset flush with the adjacent concrete finish floor. Other areas of the floor surface are overlaid with bending slab, essentially very thick plate steel with closely spaced square peg holes in an orthogonal grid array. In one area, the work floor consists of lengths of closely spaced parallel steel rails, solid-grouted and smoothed between. Limited remnants of narrow-gauge train tracks that once served Facility 155 and others in an interconnecting network are extant.

Columns, girders, beams, joists and purlins are standard flange-and-web structural steel sections. Connections of structural sections typically are riveted, with some bolted. In order to speed construction, some structural components of Kahn-designed facilities were partially pre-assembled and were then bolted together in the field. Many connections are augmented with triangular plates in various

configurations. There are no trusses as they generally are thought of, i.e. to bridge lateral expanses. The columns between the central and side bays, however, are vertically-oriented variants of the Warren truss type acting as columns and tapered at the lower end down to massive bolt pivots and cradles at the floor. Deep girders span the central bay, supporting the loft floor structure, with others supporting rails for the bridge cranes in each bay off the structural columns. The interior volume of the crane bays is unbroken across the length and width of the building other than by the main columns. The mold loft is divided transversely at the halfway point with several rooms and facilities clustered there and at the east end. It has wood strip flooring over heavy wood planks throughout. The service structures are divided into many rooms of various sizes determined by the functions within, which include administrative offices, lavatory and locker facilities and storage rooms.

The building presents a utilitarian but distinctive appearance in Moderne style. Above the base wall is a curtain wall of four horizontal bands of ganged, industrial-type steel sash window units alternating with four bands of corrugated asbestos-cement siding, and all supported by girts, brackets and clips to the structure. There is a fifth band of window units and further siding at the end walls of the loft over the central bay. In clear contrast to this dominant horizontality are three, projected elevator/stair towers. One is on the west-facing, principal façade of the building aligned with the right side of the central bay inside. Another stair tower is at the corner where the east end of the shorter side bay meets the continuing central bay. A later-added third tower is at the east end of the building in the corner where Facility 155A extends out from the central bay of Facility 155.

This arrangement of alternating window and siding bands is continuous essentially all the way around the building, including the service structures. It also prevails at the end of each bay on the face of the massive rolling doors, where window and siding bands align and match those in the adjacent curtain walls, an important characteristic feature in buildings designed by the architect. The exceptions are where Facility 155A joins Facility 155, and at the east end of the north side bay, where the fourth window band and third siding band have been removed to accommodate a later extension of bridge crane rails out in to a yard beyond and replaced with a large awning roof assembly.

Additional bands of window units occur along the long north and south faces of the monitors, vertically at the loft monitor, and raked inward from the bottom of the flanking monitors. At one outside corner of each stair tower, window units are arranged in a corner configuration. They extend back from the corner for a distance only about equal to their height, and their position vertically is staggered to correspond to the stair landings.

The window units typically have multiple fixed lights surrounding multi-light, pivot sash in several different configurations, mainly with rack and pinion operating hardware. The window units at the service structures wing have fixed lights above and to either side of a two-light-high hopper sash over a single-light-high hopper sash. The original window units appear substantially intact except for replaced individual lights. All sash at the east end of the center and north side bays were replaced with new sash to match the originals, except the glazing was translucent instead of transparent. All sash on the south side of the mold loft has been replaced with in-kind materials. Some translucent green corrugated shading devices have been added on the north-facing walls.

On the interior, window bands at the mold loft and service structures have a wainscot below them of vertically oriented, interlocking narrow metal panels concealing the backside of the corrugated siding. Original interior stairwell and similar doors are metal with two-over-two lights above the lock rail and a recessed flat metal panel below. The building's three industrial elevators have doors with interior gates that are split horizontally and operate up and down.

Roofed areas have close eaves and bituminous built up roofing over beveled-edge, wood tongue and groove planking which is exposed on the underside. The original roofing has been replaced at the flanking monitors with composition shingles.

Among other notable features is the cantilevered balcony at the west end of the loft. This is accessed by paired sliding doors that match the adjacent window unit band and are penetrated by a cantilevered chain hoist rail extending beyond the balcony.

Facility 155 appears to have been constructed substantially in accord with the original design drawings and later drawings for the loft extension and third elevator/stair tower added at the east end of the central bay. The design of the loft extension deviates only slightly from that of the original loft in details such as the substitution of plywood for the interlocking metal wainscoting used in the original. The third elevator/stair tower, while similar to the original two, lacks their refined detailing and integration, and their careful construction. The alterations to the east end of the north side bay to accommodate the later bridge crane extension were crudely realized. Those alterations and the north side shading devices detract from the building's original historic character, which otherwise remains substantially intact.

Facility 155A is a one-story, purely utilitarian steel-framed addition to Facility 155's east end, having four, 20'-0" transverse bays 40'-0" in length and an area of 3200 square feet. It has a slab-on-grade foundation; corrugated metal siding above formerly open lower sides now enclosed with chain-link fencing and other material; stacked Pratt roof and monitor trusses; and barely sloped gable roof planes. The

monitor extends for the full length of the building and has full-height louvers on its long sides.

**Historical Context:**

The specific need and location for a shipfitters' shop was defined in a letter dated 29 April 1940 and funded under an emergency appropriation that same year. With the rushed pace of the effort to prepare for World War II, the original design drawings were completed in less than two months by Albert Kahn, Inc. for the Bureau of Yards & Docks. They are dated June 22, 1940, the same date as Kahn's drawings for Facility 67A, an extension to the machine shop. Facility 155 was designed under contract no. 4173, which included a consortium of architects and engineers under Contractors Pacific Naval Air Bases. Kahn, whose office was in Detroit, designed major buildings for Ford as well as the Navy.

The original and by far dominant part of Facility 155 was constructed in 1941. Drawings for the extension of the loft are dated 9/10/41 when the original structure was near completion and still three months before the December 7th attack. Facility 155A's design drawings, by Fourteenth Naval District, Public Works, are dated 7/14/42 and 8/26/42, with that building completed in 1943. Drawings for the third elevator/stair tower are dated between 9/15/42 and 9/28/42 and work on that also was completed in 1943. Facility 155, along with many others, was camouflaged in 1942. Also in 1942, a series of splinter-proof personnel shelters were constructed around the perimeter of Facility 155. Except for Facility S1133(HABS HI-460) these shelters have been demolished. Although many small projects since have been undertaken on Facility 155 and 155A – typically foundations and services for major pieces of machinery, or electrical upgrades – neither building has significantly changed since 1943.

For an overview of the Naval Shipyard see HABS No. HI-483.

**Sources:**

Almy, Capt. E.D., Cmdr. J.J. Manning, and Lt. Cmdr. Philip Lemler

1940 Letter Report dated 29 April 1940 to the Secretary of the Navy on Development of Fourteenth Naval District. In National Archives, San Bruno, RG 181, 14th ND, District Staff Hdqtrs., General Correspondence [Formerly Classified] 1936-1944, Box 1, Folder 1-1(1) Developments.

Contractors Pacific Naval Air Bases

n.d. *Technical Report and Project History, Contracts NOy-3550 and NOy 4173:* On microfilm at Pacific Division Naval Facilities Engineering Command Library.

Fogel, Frederick F.

1980 Historic Resources Inventory Form for Bldg #155. Prepared by Pearl Harbor Naval Shipyard, Facilities

Planning & Programming for State Historic Preservation Office.

Kidder-Smith
Naval Facilities Engineering Command Library. Photos N-186-12, N-188-9, N-191-9, N-192-3, N-195-5. Port Hueneme, CA.

National Archives II, Still Photo Collection
Photos in group RG71CA.

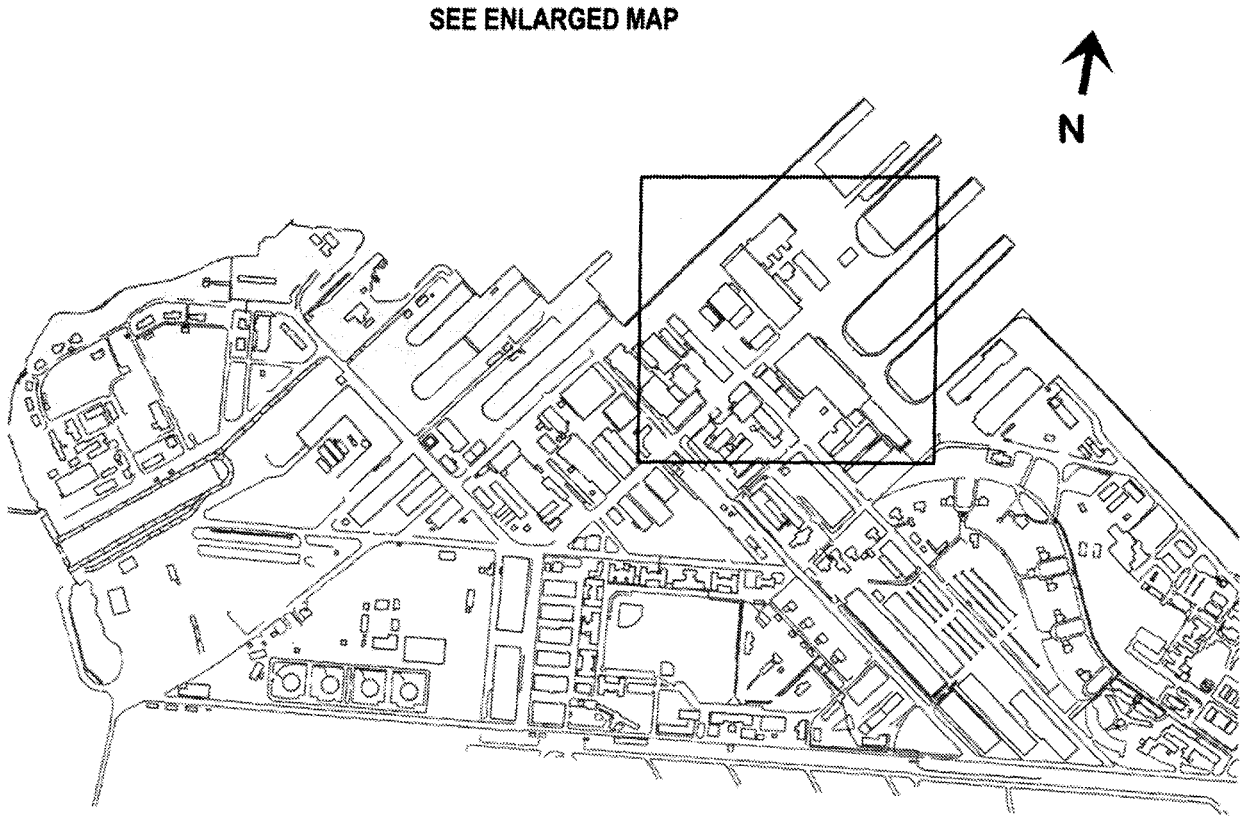
NAVFACPAC: Plan Files.
Drawings for Facility 155/ 155A.

U.S. Navy, Bureau of Yards and Docks
1947 *Building the Navy's Bases in World War II: History of the Bureau of Yards and Docks and the Civil Engineer Corps 1940-1946.* Volume I. United States Government Printing Office: Washington, D.C.

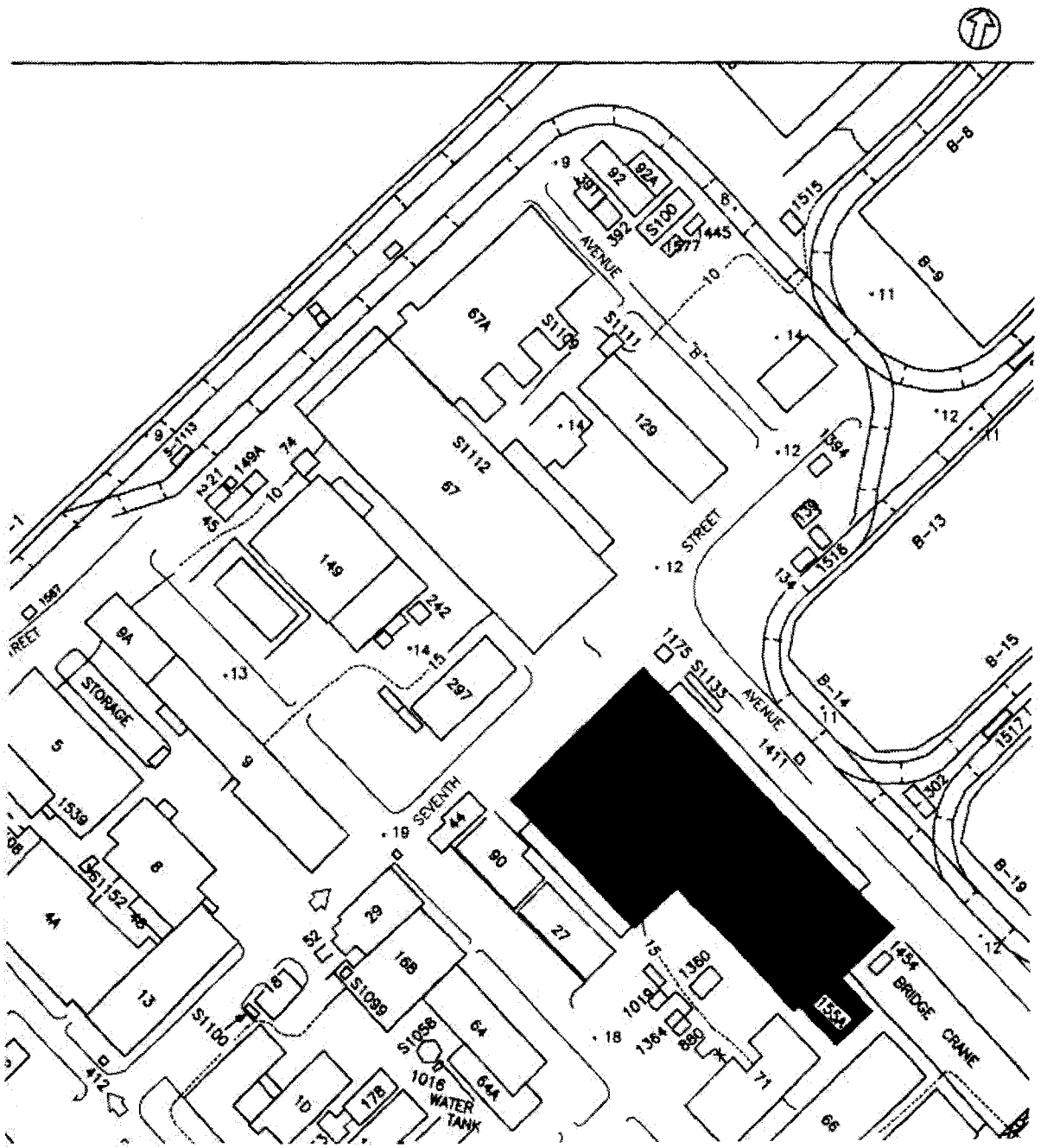
*USS Arizona* Memorial Association
Fourteenth Naval District Photo Collection.

**Project Information**: Photo documentation and recordation of this facility by the Navy has been done in anticipation of future alterations of the structure. Photo documentation of historic facilities by the Navy assists in expediting planned undertakings by having the documentation prepared prior to taking actions. Also, photo documentation assists the Navy in gaining more information about its historic facilities to assist in making proactive management decisions. This project is being supervised by Jeffrey Dodge A.I.A., Historical Architect NAVFAC Hawaii. The photographic documentation was undertaken by David Franzen, photographer. Douglas P. Luna, AIA/Architect, consultant to Mason Architects, Inc. prepared the written documentation. The field work and research was conducted for this report between July 2001 and December 2001.

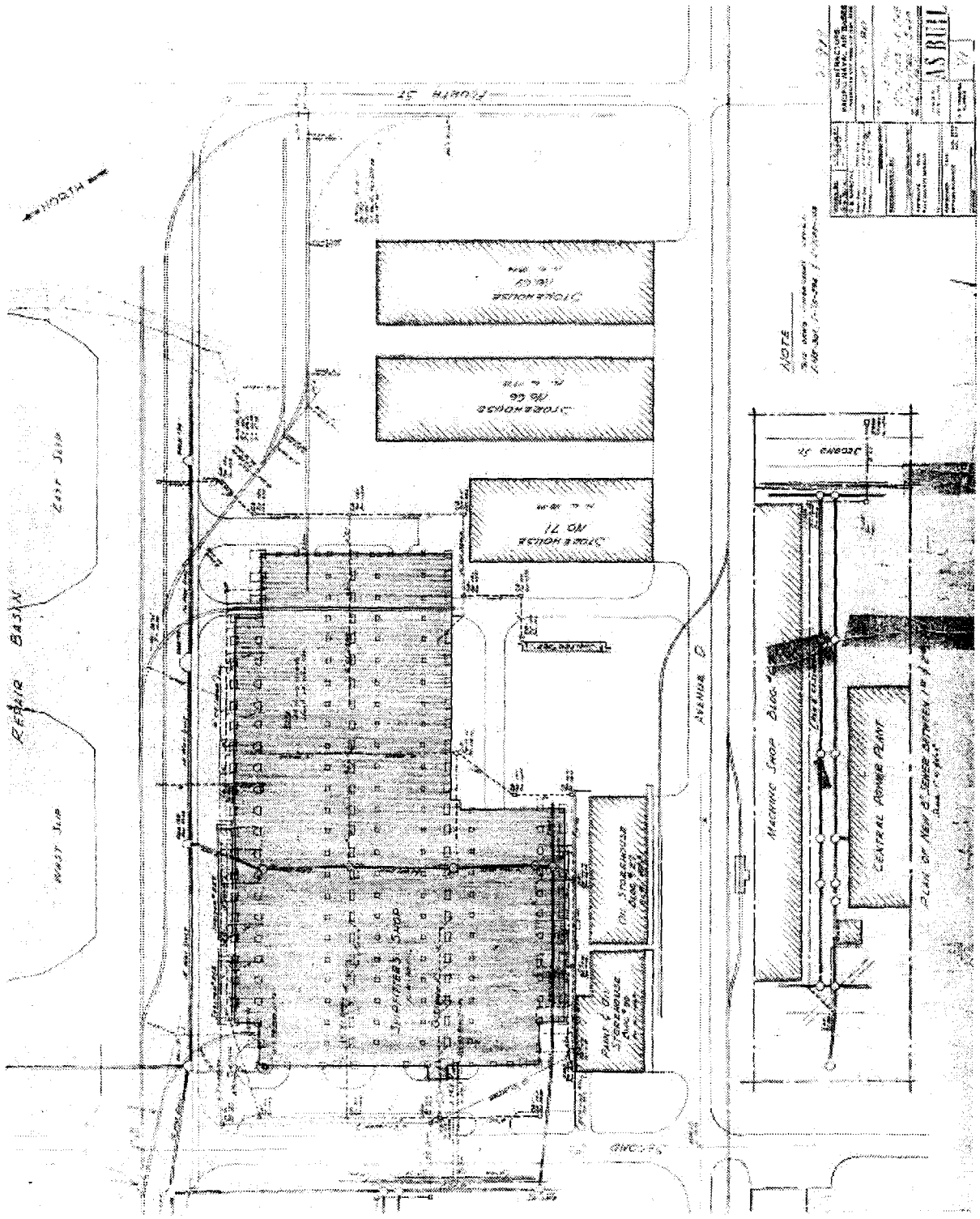
**Shipyard Map**



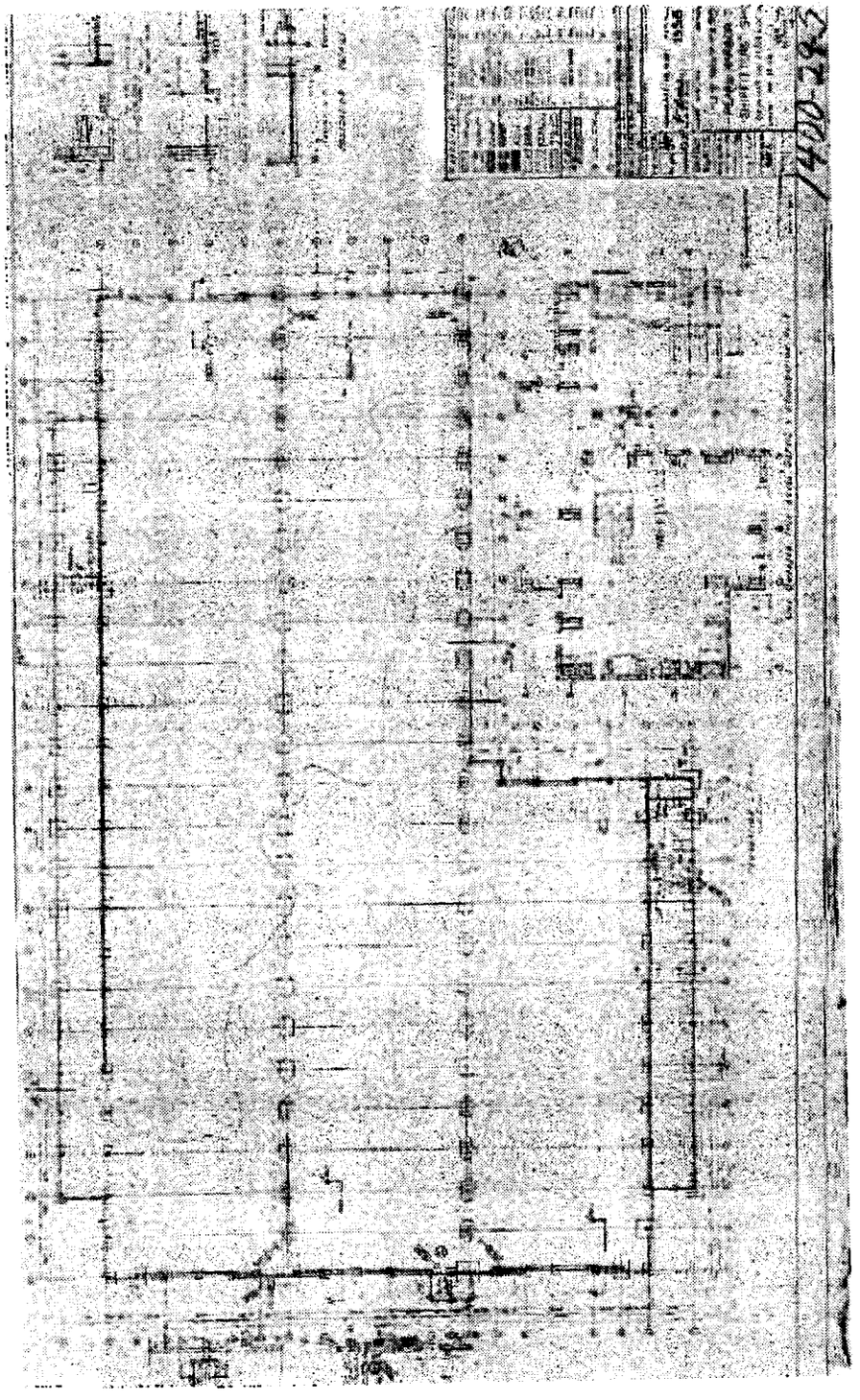
**Enlarged Area Map (reduced, not to scale)**



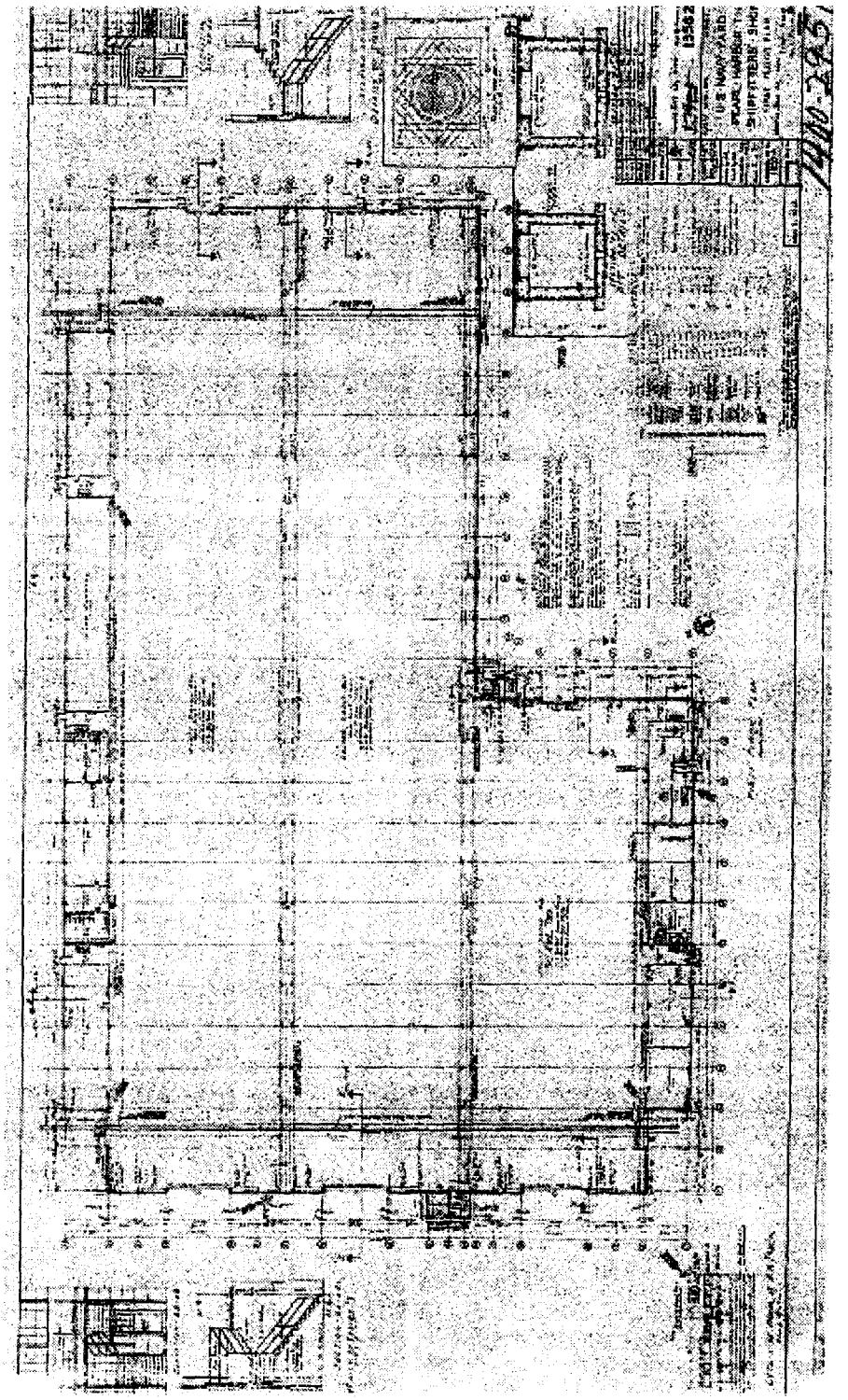
**As Built Utilities at the Shipfitters Shop (Drawing No. 919, dated 10/23/1941) (reduced, not to scale)**



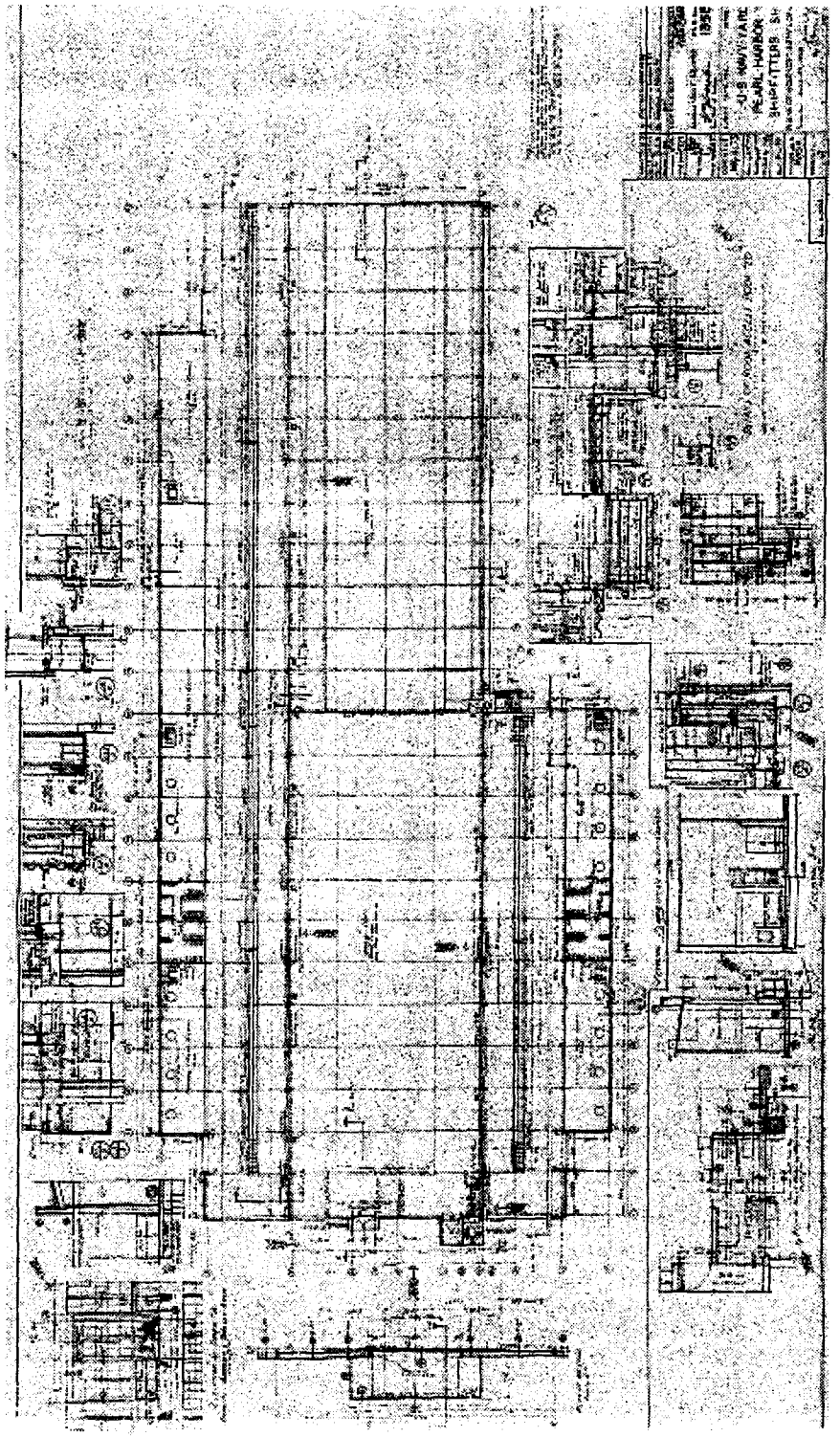
Facility 155 – Foundation Plan and Details (Drawing No. 135819, dated 9/17/1940)
(reduced, not to scale)



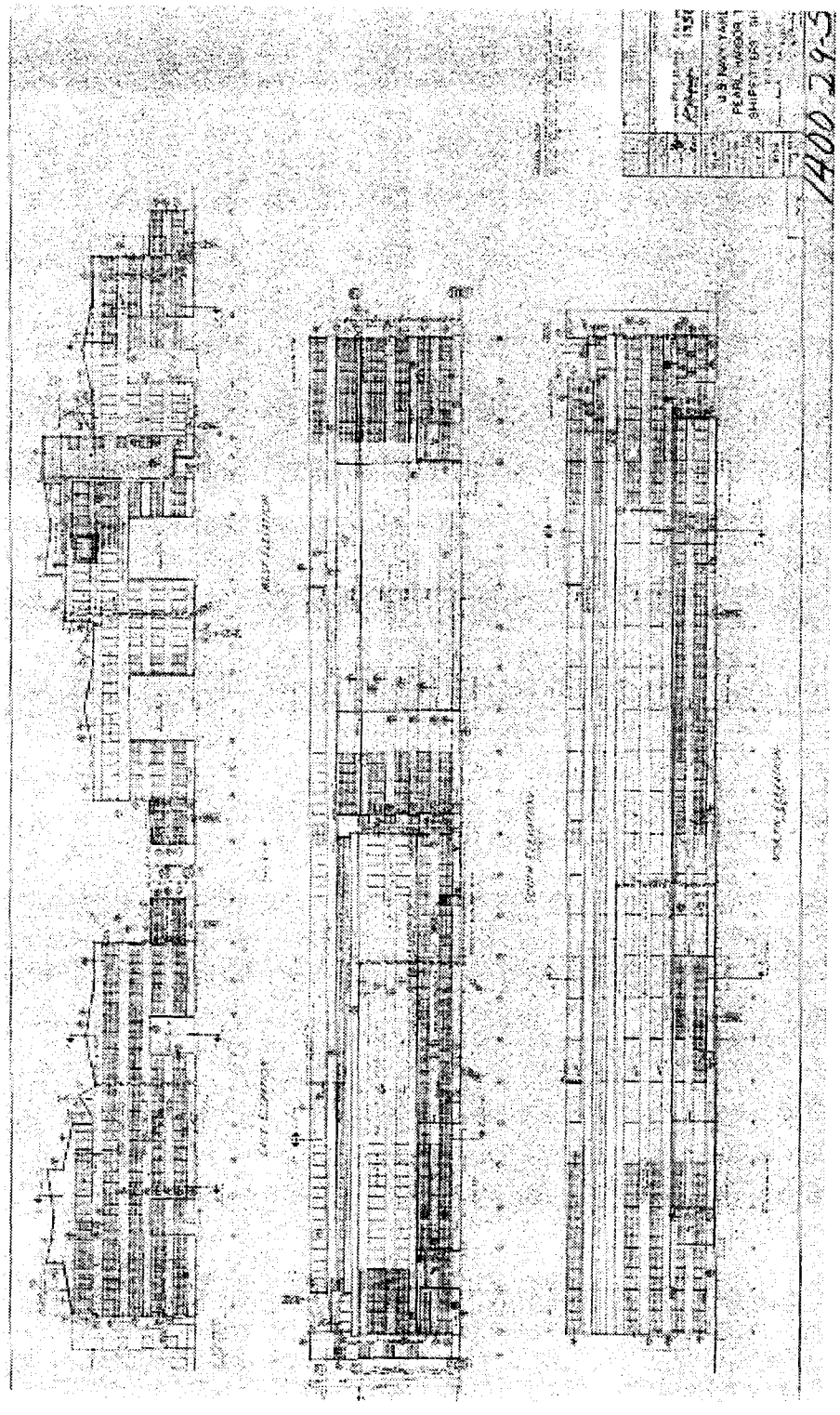
**Facility 155 – First Floor Plan (Drawing No. 135820, dated 12/17/1940) (reduced, not to scale)**



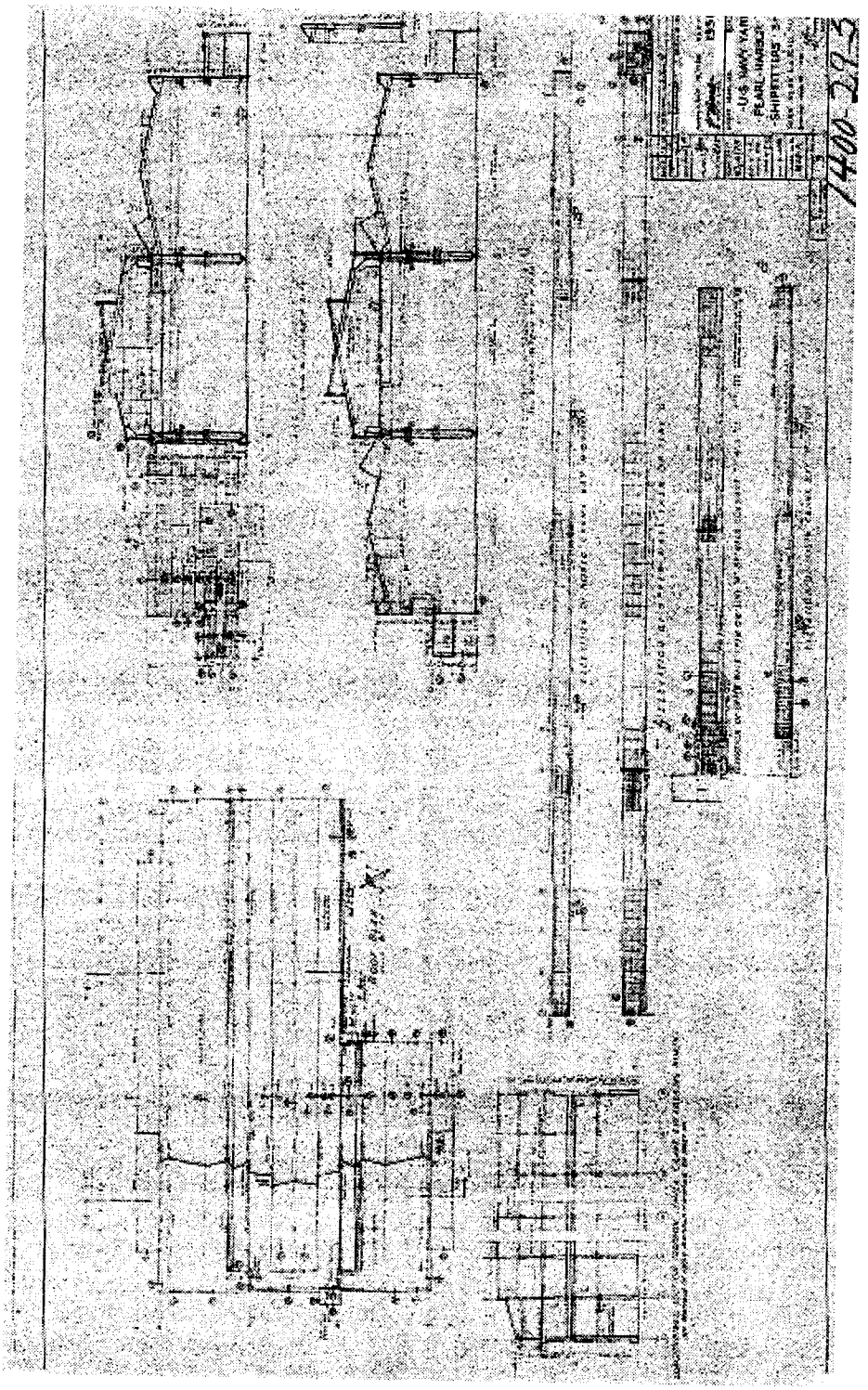
**Facility 155 – Plans of Mold Loft and Second Floor of Lean-To**
**(Drawing No. 135821, dated 11/22/1940) (reduced, not to scale)**



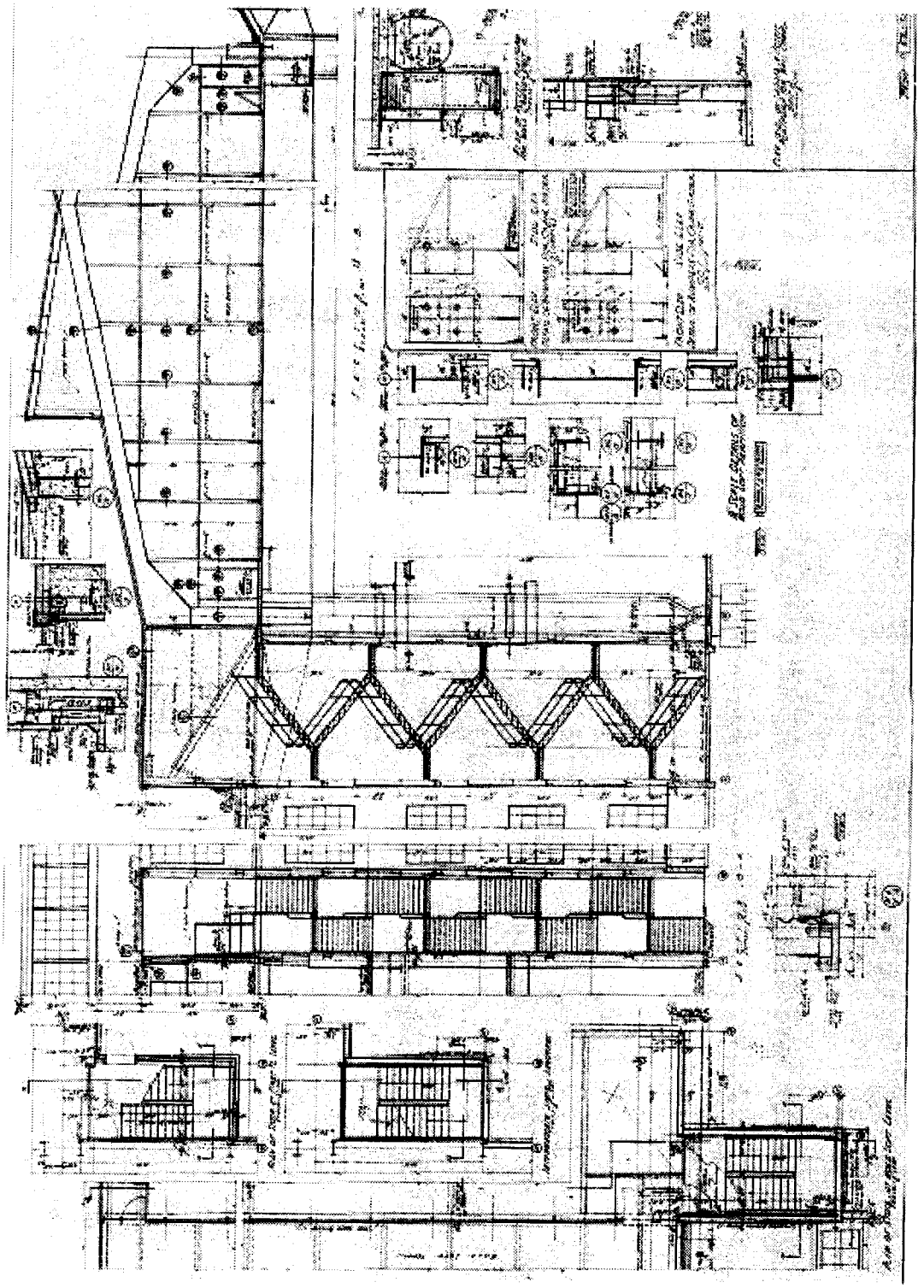
**Facility 155 – Exterior Elevations (Drawing No. 135822, dated 10/17/1940)
(reduced, not to scale)**



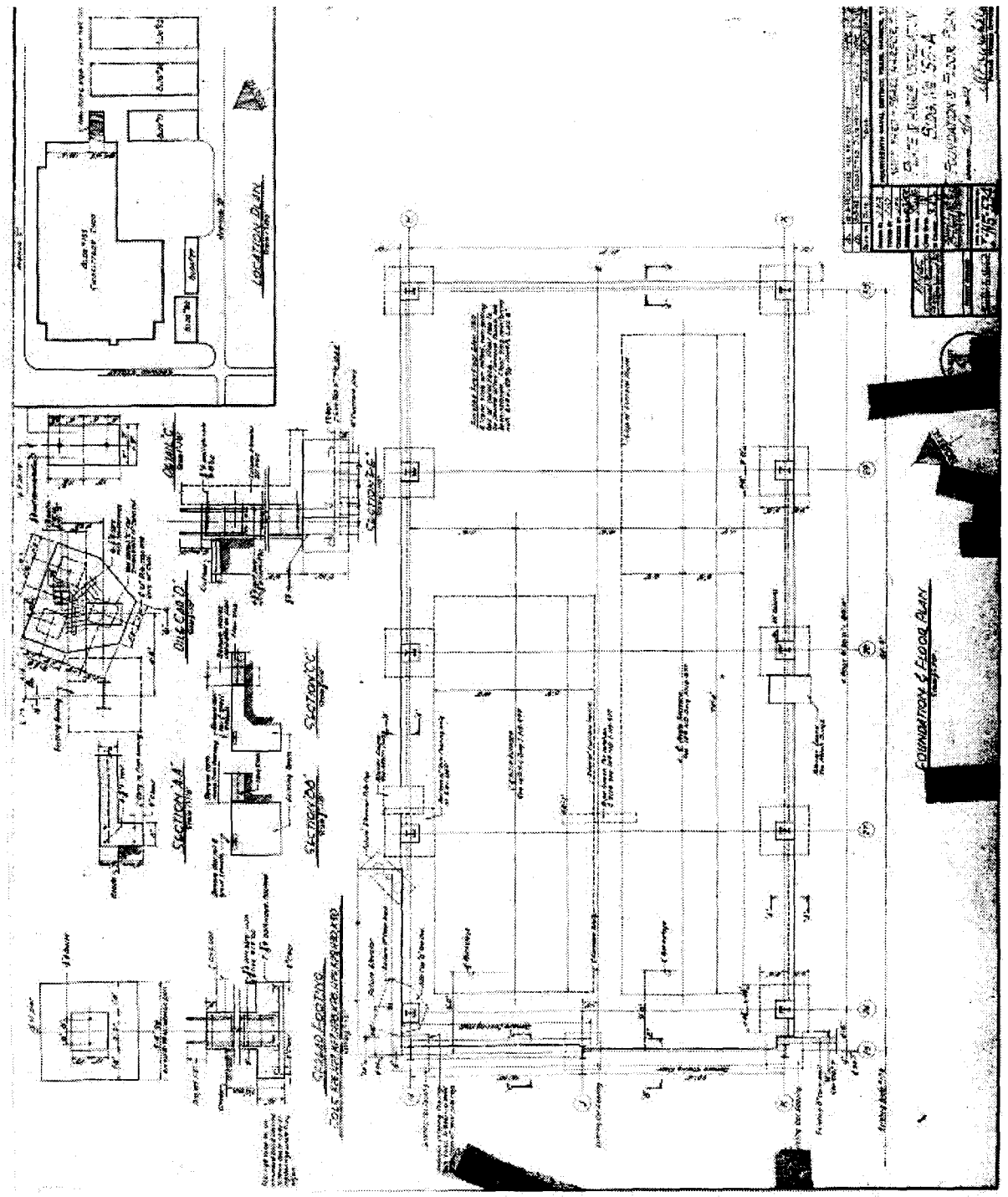
Facility 155 – Roof Plan, Sections, and Elevations of Upper Wall Sash and Monitor
(Drawing No. 135823, dated 7/8/1940) (reduced, not to scale)



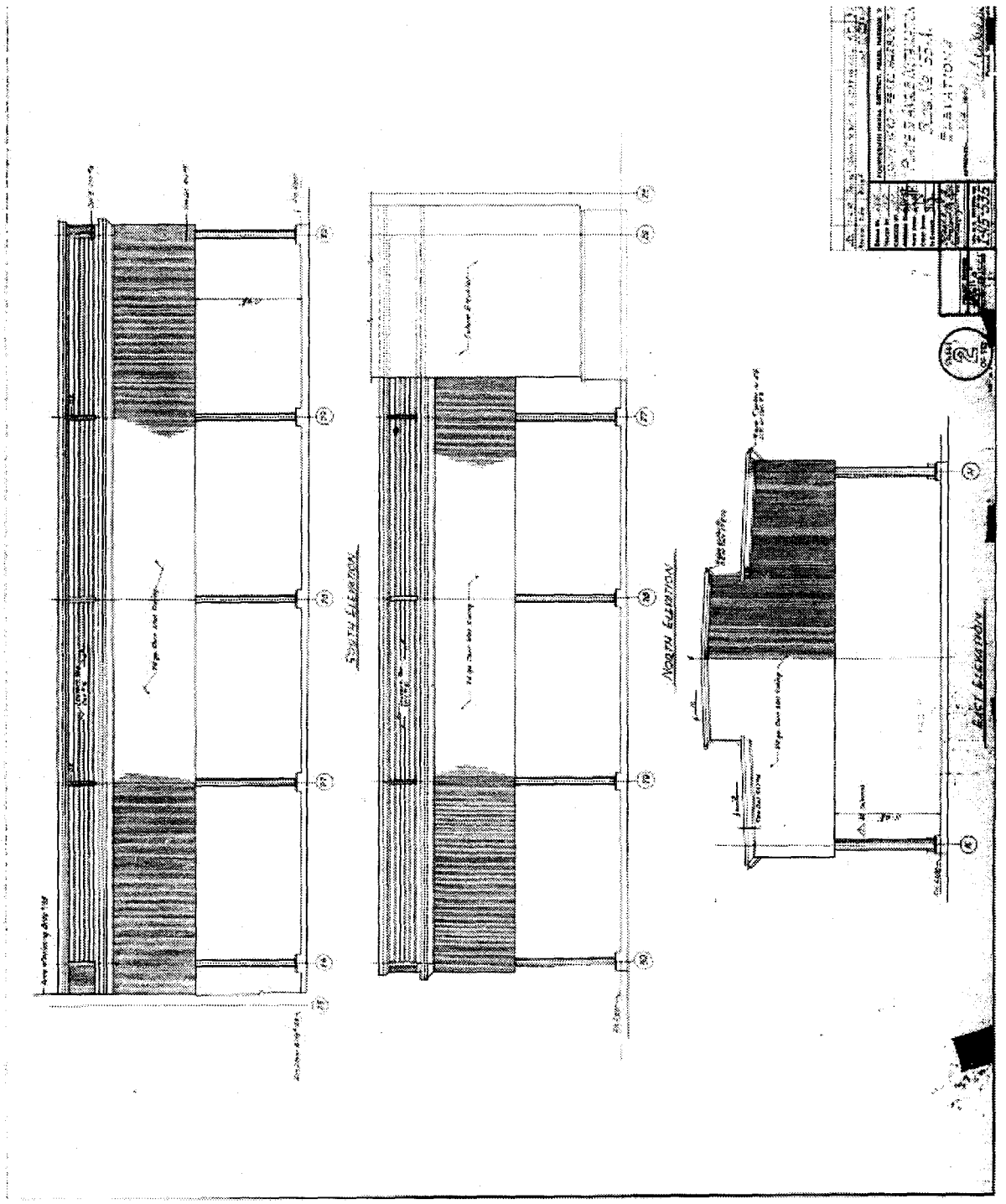
**Facility 155 – Plans and Sections of Stair with Miscellaneous Details**
**(portion of Drawing No. 135831, dated 7/3/1940) (reduced, not to scale)**



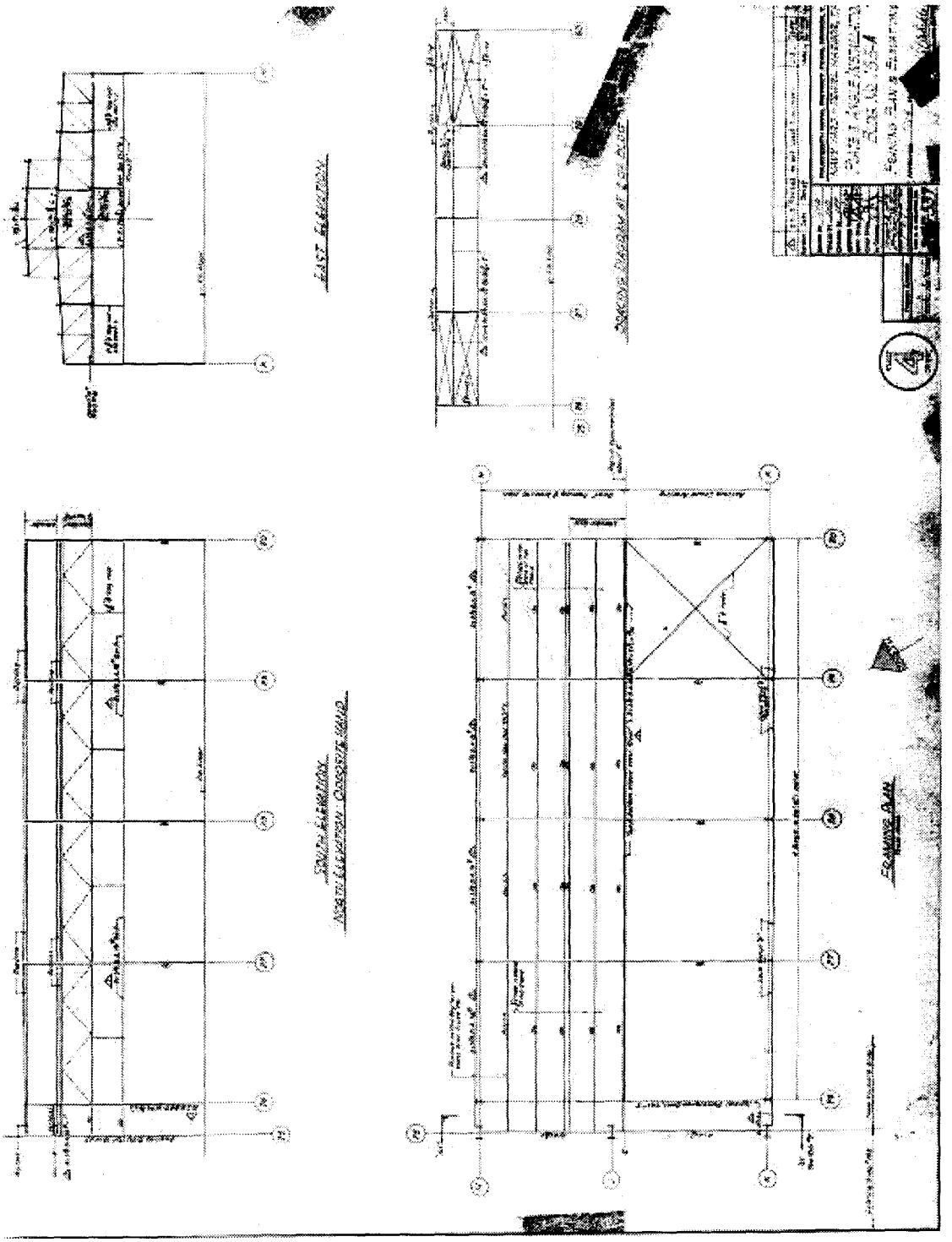
**Facility 155A – Foundation and Floor Plan (Drawing No. I-N5-534, dated 7/14/1942) (reduced, not to scale)**



**Facility 155A – Elevations (Drawing No. I-N5-535, dated 7/14/1942) (reduced, not to scale)**



**Facility 155A – Framing Plan and Elevations (Drawing No. I-N5-537, dated 7/14/1942) (reduced, not to scale)**



ADDENDUM TO:
U.S. NAVAL BASE, PEARL HARBOR, SHIPFITTER'S SHOP
(U.S. Naval Base, Pearl Harbor, Naval Shipyard, Facility Nos. 155 & 155A)
Seventh Street near Avenue C, Adjacent to Repair Basins
Pearl Harbor
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HABS HI-496
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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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PACIFIC GREAT BASIN SUPPORT OFFICE
National Park Service
U.S. Department of the Interior
1111 Jackson Street
Oakland, CA 94607

**HISTORIC AMERICAN BUILDINGS SURVEY**

**Addendum to**
**U.S. NAVAL BASE, PEARL HARBOR, SHIPFITTER'S SHOP**
**(U.S. Naval Base, Pearl Harbor, Naval Shipyard)**
**(Facility Nos. 155 & 155A)**

HABS
HI-496

**HABS No. HI-496**
(page 19)

**Location:**

Seventh Street at Avenue C
Adjacent to Repair Basins
Pearl Harbor Naval Base
City and County of Honolulu, Hawai'i

U.S.G.S. Pearl Harbor, HI Quadrangle 1999 (7.5 minute series) NAD83.
Universal Transverse Mercator Coordinates: 4.608490.2361480

Data pages 1-18 have been previously transmitted to the Library of Congress.

**Significance:**

Facility No. 155 and contiguous Facility No. 155A are located within the Pearl Harbor National Historic Landmark and are contributing buildings. They are significant for their association with the history of the development of the shipyard during the buildup of Pearl Harbor in the months leading up to World War II, and following the December 7, 1945 attack. Building 155 is one of seven extant buildings at Pearl Harbor designed by Albert Kahn, the nationally known industrial facility architect. Additional historic context for Albert Kahn is included in this addendum.

**Description:**

Facility 155 and 155A are large steel-framed structures in a utilitarian Moderne style. The focus of this addendum is to document the wood block flooring. The wood block flooring in Facility No. 155 is found in various areas of the building (see floor plan), with the areas ranging in size from 32 square feet to large areas of over 3,500 square feet. They are made of 3" W x 6" L x 2" D wood blocks which were laid with their end grain up. Each block had two v-notches on one of the long sides and one v-notch on one of the short sides. The grooves were added to the blocks in order to give the filler, or bonding adhesive, more bite in the wood blocks, allowing the binding between the blocks to be more firm.

Fine, even-grained wood define the character of these blocks which remain unstained and unvarnished laid in a brick pattern. This gives a non-slip finish to the floor which was meant to absorb the impact of falling tools and equipment. In the area that has remained relatively untouched, the overall smooth level of this flooring material is apparent, indicating an almost perfect cut to each block of wood, unlike the almost cobblestone feature of the woodblocks found in the current Gentry Design Center, the former American Can Company building in Iwilei, Honolulu, O'ahu.

As was typical of the period, the blocks were treated with creosote (a water free oil based product) as a preservative. The creosote was applied under pressure with approximately sixteen pounds of creosote used per cubic foot of wood. Creosote was also added to the tar base for the wood blocks. The dark color of the original wood blocks is indicative of a generous use of creosote.

**Historical Context:** Facility No. 155 and 155A are located in the Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility, adjacent to the repair basins. Building 155 was designed by the architectural firm of Albert Kahn, who *Time* magazine labeled the "father of modern factory design."[1] It is one of eight extant buildings at Pearl Harbor known to have been designed by this nationally known architect. Kahn (1869-1942) was born in Rhauen, Westphalia, Germany, and was raised in Echternach, Luxembourg until the age of eleven, when his parents migrated to the United States, settling in Detroit. With his family confronted by economic difficulties, Kahn forsook his secondary education and went to work for with the Detroit architectural firm of John Scott and Associates as an errand boy. In 1884 he entered the architectural office of Mason & Rice. Within twelve years he attained the position of chief draftsman in that firm, remaining there until 1896 when he went into partnership with George W. Nettleton and Alexander B. Trowbridge. By 1902 he was sole proprietor of the office.

Between 1903 and 1905 he designed and oversaw the construction of nine factories for Packard Motor Car Company. The last of these was a reinforced concrete framed factory, which drew the interest of Henry Ford. He designed Ford's Highland Park plant in 1909, where Ford consolidated production of the Model T and perfected assembly line production. In 1917 he designed the massive, half mile long, Ford River Rouge Plant, which eventually grew into the largest manufacturing complex in the United States, with Kahn responsible for additions up through 1939. During the 1930s Kahn designed over six hundred factories, including 521 for Joseph Stalin in the Soviet Union during 1930-1932. In 1936 he designed Chrysler Corporation's Detroit plant using large glass curtain walls, and by 1941 he was responsible for twenty percent of all architect-designed factories in the United States, having worked as Packard's architect for thirty nine years, Ford's for thirty four, and Chrysler's for seventeen. For Ford he designed over one thousand buildings, and for General Motors over hundred fifty major plants. During the first four decades of the twentieth century Kahn was responsible for approximately two billion dollars worth of industrial building construction. Kahn's factories were known for their maximum use of natural ventilation and light, using continuous strip windows, roof monitors, or skylights. He pioneered the use of long-span steel trusses which resulted in large, open floor areas free of columns. His automobile plants made extensive use of wood block floors in areas where heavy machines were placed.

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[1] "Industry's Architect," *Time Magazine*, 29 June 1942: 40-41.

In addition to his industrial buildings, Kahn also designed banks, office buildings, mausoleums, hospitals and private residences, as well as a number of buildings at the University of Michigan. During World War I Kahn designed a large number of army airfields and navy bases, and by World War II his six hundred person office designed the Detroit Arsenal Tank Plant, Wright Aeronautical Corporation's factory in Cincinnati, and Ford's Willow Run Bomber Plant. During 1941, as America prepared to enter World War II, his firm churned out plans for an unprecedented 20,000,000 square feet of industrial construction for the national defense effort. The latter included numerous military projects. In addition to Facility 155, other Kahn designed buildings at Pearl Harbor include: Facilities 3A, 4A, 5, and 167 in the shipyard, and Facilities 86, 175 and 176 on Ford Island. His office was also responsible for laying out much of the Naval Air Station at Kaneohe, designing over twenty seven buildings there, including the hangars, administration building, theater, mess hall, barracks, warehouses, and shop buildings.

Building155 and 155A are one of five buildings at Pearl Harbor to employ wood block flooring. Others include: Facilities 67, 92, 214 and 215. The former American Can Company building in Iwilei is the only structure outside of Pearl Harbor known to utilize this flooring material in Hawaii (see field photographs on page 36). The construction of the latter, started in November 1930 and completed in 1931, was superintended by the New York architect, Mr. J.F. Abbey. The facility was utilized to can Dole Pineapples.

The use of wood block as a paving material in modern times dates back at least to the 1830s, when it was applied to several London streets. Over the years its use spread to other parts of Europe, remaining a popular material to pave urban streets from the 1870s up through the 1920s. In an age dominated by carts and carriages with iron wheels drawn by horses with iron shoes the use of wood block pavers was justified by its being sanitary, cost-effective, durable, and sound absorbent when compared to stone, brick, or macadam. The earliest known mention of the material's use in America can be found in *Engineering News* for January 10, 1878, which noted its use on Chicago streets[2], and twenty years after the fact J.W. Byrnes in a letter to *Municipal Engineering*, reported that Galveston, Texas had embraced creosoted wood block paving in 1875, and it was still "perfectly intact and free from decay" in 1895.[3] However, it was not until the late nineteenth and early twentieth centuries that several other American cities started to pave certain streets with wood block, with the material usually employed on roads bearing moderate traffic or running past locations such as hospitals and court houses where reduced noise was desired. The November 3, 1906 issue of *Scientific American Supplement* reported,

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2 Fox, E.A., "Wood Paving in Chicago --- Durability," *Engineering News*, 10 January 1878: 14-15.

3 Byrnes, J.W., "Creosoted Wood Pavement in Galveston, Texas," *Municipal Engineering*, 1895:206-207.

> Wood has long been used for street pavements. Only within the past few years, however, has it been satisfactorily adopted in the cities of the United States. Previous failures can be traced almost entirely to improper construction or methods of preparation. In most cases round blocks of cedar or other woods were used, without precautions against decay and without adequate foundation for the pavement. The consequence was that as a paving material wood fell into disfavor. Recent use of rectangular wooden blocks for street pavements has given excellent results.[4]

The article went on to note a revival in the use of wood blocks, and found that the cities of New York, Boston, Indianapolis, Minneapolis, and Toledo, Ohio had installed wood block paving over the past ten years. These five cities accounted for more creosoted block pavers than all the other cities in America combined. By the end of 1905, approximately 1,400,000 square yards of wood block had been laid across the nation, the equivalent of nearly eighty miles of thirty foot wide streets. [4]

During the opening decades of the twentieth century the material gained favor around the world, appearing in the streets of such places as Tokyo, Australia, and Argentina. It remained a common paving material into the early 1920s. After that time it disappeared from roadway use, made obsolete by motorized vehicles with rubber tires, and their heavy traffic demands.

The application of wood blocks for a paved surface easily transferred to architectural situations during the last half of the nineteenth century. When placed inside buildings as flooring, the wood blocks had the added advantage of being protected from the elements, contributing further to their life span. British author Edward Robert Robson in his 1877 book, *School Architecture*, noted the already common use of wood block floors in schools, a direct result of their reputation for durability. He recommended the use of 4" thick blocks set in asphalt on top of concrete.

The Queens Club at Kensington in England, which was named after its first patron, Queen Victoria, and reputed to be the world's first multipurpose sports complex when it opened in 1886, paved its tennis courts with wood blocks in April 1889, indicating further on-going explorations into possible applications for the material. As early as 1889 J. Davis Barnett in a presentation on shop buildings to the Canadian Society of Engineers noted that while stone and tile floors were used in industrial settings, wood block floors were being employed in the areas where men stood at machines. As a flooring, the material sufficiently acquired an industrial or institutional association, that by 1906 British author Arthur Martin advised against its use in a residential setting as, "wood block flooring is rather unsympathetic, and suggestive of schools

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[4] "Experiments in Wood Paving," *Scientific American Supplement*, 3 November 1906: 25774-25775.

and hob-nail boots, although there is no warmer or harder wearing floor, although rather costly." [5]

During the opening decade of the twentieth century interest in the use of wood block floors increased in the United States. The International Library of Technology in its 1903 textbook for the Engineering Professions and Trades noted several approaches to laying wood block floors. The floors they described used either oak or cedar for the blocks laid on a concrete bed and secured by being dipped in liquid asphalt with a mortar of one part Portland cement to two parts sand used as a filler. The blocks ranged in size from 6" x 4" x 4" to 3" x 12" x 5".

Henry Grattan Tyrrell in his 1911 book on mills and industrial buildings, noted the use of wood block flooring in these settings and pointed to the American Bridge Company's factory in Ambridge, Pennsylvania and the Illinois Central Railroad's freight car repair shop in Burnside, Illinois as two examples of such floors. The former used maple or beech blocks and the latter oak. [6]

During the second decade of the twentieth century wood block flooring began to develop a track record. Used for over ten years by the railroads in freight stations, there was considerable curiosity about the utilization of wood blocks as flooring in industrial settings, and a variety of approaches were tried. At its twenty-sixth annual convention in 1916 the American Bridge and Building Association reported that either a sand or concrete foundation worked well for a wood block floor, with the Baltimore & Ohio Railroad using both.[7] However, sand soon fell into disfavor, and a concrete foundation covered by a pitch base with bituminous used as filler soon became a recognized norm.

The railroads found the material to be cost efficient, especially if second hand bridge timbers or railroad ties were utilized, resulting in a cost of ninety cents to a dollar for a square yard. They recommended using 4" x 3" or 4" x 6" creosoted blocks that were 4" to 8" deep with a sand base and filler. The blocks with greater depths appeared to hold better, but cost approximately $1.25-$2.50 a square yard. Southern Longleaf Yellow Pine with an asphalt filler provided a more even surface.

The growing use of wood blocks as a flooring material led *Scientific American* in its July 22, 1916 issue to address the new trend,

> Creosoted wood blocks, already extensively used as paving material in city streets, have been coming into use as flooring for the last four or five years, according to the Forest Service. The durability of this paving, its noiselessness under heavy traffic, and its sanitary properties are the chief advantages for paving and also

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[5] Martin, Arthur, "The Small House," (London: Alston Rivers, Ltd., 1906): 78.

[6] Tyrrell, Henry Grattan, "A Treatise on Design and Construction of Mill Buildings and Other Industrial Plans," (Chicago: Myron C. Clark Publishing Company, 1911): 229-230.

[7] American Railway Bridge and Building Association, *Twenty-Sixth Conversion*, (Elgin, Illinois: Brethern Printing House, 1916): 133.

> give it particular value for making floors, especially for use where heavy trucking, the moving of heavy machinery, or other severe uses make the maintenance of floors a serious problem. Its rather high cost is its chief disadvantage.
>
> Wood block is now widely used for flooring in factories, warehouses, machine shops, foundries, various types of platforms, wharves, and docks, and for such miscellaneous purposes as hotel kitchens, hospitals, laundries, and slaughter houses. Possibly one of the oldest of these uses is for the floors of wild animal cages and runways. . . . These floors are well liked by the workmen because they are easy on the feet.[8]

Similarly C.H. Teesdale, in a presentation to the American Wood Preservers' Association at their 1916 annual meeting, observed,

> Since 1900 there has been a steady and rapid increase in the use of creosoted wood blocks for paving the streets of our cities. A more recent development and one that promises to become an important source of business to the manufacturers of these blocks, has been their adoption for a variety of uses other than street paving.[9]

He then went on to enumerate the presence of wood block floors in a wide variety of factories and plants.

Although not specifically mentioned by Teesdale, by the beginning of the twentieth century the U.S. Department of Defense was familiar with the use of wood block flooring and was employing such floors in various buildings. The Chief Engineer's report for 1903 mentioned the use of such floors in the Government Printing Office, which was constructed under the supervision of Captain John Sewell of the Army Corps of Engineers, and the Department of Navy report for 1909 mentioned the use of such a floor at the Ship Fitters' Shop at the Navy Yard in Charleston, South Carolina. The following year mention was made of the installation of a wood block floor in the Reserve Torpedo Flotilla Building Number 9 at the Naval Station at Cavite in the Philippine Islands.

By the 1920s wood block flooring was also used in such farm buildings as horse stables, dairy barns, hog houses, calf pens, and bull pens. In addition to the warmth of wood and its being soft for animals to walk on, stockmen found these floors with their smoothness and minimal joint size, were easily cleaned. Furthermore, creosote acted as an anti-bacterial agent further providing for the well being of the animals.

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[8] "Increasing Popularity of Creosoted Wood Blocks for Flooring," Scientific *American*, 22 July 1916: 83.

[9] Teesdale, C.H., "Treated Wood Block for Factory Flooring and Miscellaneous Uses," *Proceedings of the Twelfth Annual Meeting of the American Wood Preservers' Association*, (Baltimore: Peters Publishing & Printing Company, 1916): 202-209.

By 1920 the Safety Institute of America could safely note that wood block floors were "coming into more general use."[10] With the growing acceptance of wood blocks as both a paving and flooring material there rose within the users a concern for proper installation and quality control. In 1915 a meeting was convened in Brooklyn, New York to develop standard specifications for wood block paving in roads, which were equally applicable to its use in floors. Six associations attended: the American Wood-Preservers' Association, American Society of Municipal Improvements, American Society for Testing Materials, American Society of Civil Engineers, American Railway Engineering Association, and the Southern Pine Association. Items discussed included the types of timber to be used in manufacturing the wood blocks, the treating of the wood, the size of the blocks, the handling of the blocks after treatment, and inspection.

Wood blocks were primarily manufactured from Longleaf Yellow Pine in the east, and Douglas Fir in the west; however other woods, such as Birch, Maple, Tamarack, Norwegian Pine, Hemlock, Black Gum and White Pine were also used for this purpose. The group made no recommendation as to which timber source was the best; however, the city of Minneapolis undertook a study by paving one of its streets with seven different woods. After twelve years, both the Longleaf Yellow Pine and White Birch were determined to be the best in terms of durability. However, it was difficult to find Birch blocks free of decay, leading to its infrequent use. Next in durability came Norway Pine, then Tamarack, Eastern Pine and Western Larch. The latter deteriorated quickly under constant traffic, and was deemed unsuitable. Douglas Fir was also used in the experiment, but the blocks were not in good condition when they were installed, and after five years had to be replaced. The second set of Douglas Fir blocks proved durable over the next seven years, but were still out performed by the Longleaf Yellow Pine and White Birch. The study also indicated the length of the block was not a significant factor in its performance, nor were any differences detected between blocks made from heart and sap wood.

The committee recommended that the blocks be seasoned, square butted and square edged, and run between five to ten inches in length, with the length averaging approximately two times the block's depth.

The participants did not address the laying, cushion, foundation, or filler materials. However, in 1917 the American Wood Preservers' Association recommended that the blocks be laid on concrete and in a mortar cushion of Portland cement to four parts sand. Coal tar or asphalt were recommended as a filler, although they noted on many occasions the blocks were laid in sand with sand as a filler. Sand offered lower construction costs, but many more instances of failure were reported with this material. In addition, coal tar and asphalt were considered

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[10] Safety Institute of America, *Safety Fundamentals*, (New York: Safety Institute of America, 1920): 99.

waterproof and a means to prevent water from seeping into the blocks, which resulted in swelling and an uneven surface.

The expansion and buckling of wood block roads and floors was considered the major problem with the use of this paver. As early as 1903 the War Department's Chief Engineer reported that the contractor for the wood block floors in the new building constructed for the Government Printing Office had to execute considerable repairs to the new floor as he had put some of the floors down too dry and they swelled and came up in places.[11]

By 1918, the American Wood-Preservers Association was giving strong consideration to endorsing bituminous paint as the standard material for securing the wood blocks to the concrete foundation, and by 1922 the organization advocated such paint replace their previously recommended Portland cement and sand cushion between the concrete and blocks. This paint sealed the bottoms of the blocks and supposedly eliminated the possibility of pockets to form under the blocks where water might gather. The paint also allowed for the use of only a two and a half inch deep block. A bituminous filler was used as a base and filler between the blocks at Building 155. However, it did not live up to its waterproof reputation, and when heavy rains flooded the floors of the building, blocks would pop out, and less senior staff were assigned to repair the floors.[12]

Although wood block floors were more expensive than concrete floors, many factory owners found the positive qualities of the floor justified its cost. With blocks ranging from two to four inches in depth, the floors were highly durable affording almost indefinite wear, especially when properly installed and treated with creosote against rot. In addition, the wood, when compared to stone, brick or concrete floors, was much more resilient and therefore easier on the feet of the workers and less likely to damage falling tools. It was also deemed to not be as slippery as other materials, and cleats, braces, etc could be readily attached to the floor. Its smoothness, coupled with the narrowness of its joints also made it easy to clean. The material was also warmer and quieter, especially in factories where equipment with metal wheels was employed, and most importantly the expense of repair was slight. The repair of a wood block floor required less preparation, less expertise on the part of the crew, and resulted in less interruption of operations as the repaired areas were immediately usable.

Another perceived benefit was the floor's ability to withstand fires. In 1914, Philadelphia's Pier 35, which was paved in 1910 with wood blocks, survived a major fire with minimum damage, and streets in the area of Baltimore's 1904 fire, although charred, were reinstalled upside down when they repaved the roads.

End grain wood blocks for flooring continue to be manufactured.

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[11] Annual Reports of the War Department for F.Y. Ended June 30, 1903, v.1, (Washington D.C.: Government Printing Office, 1903):673.

[12] Howard Miwa, interview by Tonia Moy and Julie Lam, 11 December 2008.

**Sources:**

A. Architectural Drawings:

1. 1941, Drawing No. I-N5-361A, Fourteenth Naval District, Pearl Harbor, New Ship Fitters Shop Stream and Water Access Pit Area.
2. November 4, 1942, Drawing No. I-N5-650, Fourteenth Naval District, Pearl Harbor T.H., Navy Yard Pearl Harbor T.H., Ship Fitters Shop.
3. Unknown date, Drawing No. I-N5-1762, Public Works Department Pearl Harbor Naval Shipyard Pearl Harbor, Oahu, HI, BLDG 155-Ship Fitters Shop, Machine Foundations

B. Early Views:

Aerial photos are available at the National Archives and Records Administration, and the Admiral Furlong Collection at the Hawaii State Archives (HSA). (See Appendix) The photos of the Admiral Furlong Collection were taken under the direction of Admiral William R. Furlong, Commandant of the Pearl Harbor Navy Yard. Photos in both archives were created by a U.S. federal agency (U.S. Navy) and are considered in the public domain.

Additional photos are found in the U.S. Navy Seabee Museum Archives at Port Hueneme, CA.

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Oral Interviews

Interview with Howard Miwa by Tonia Moy and Julie Lam, December 11, 2008.

Interview with Robbert McKay, architectural historian in the Michigan State Historic Preservation Office by Don Hibbard, May 4, 2009.

**Project Information**: The Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility (PHNSY&IMF) propose to renovate the third bay of Building 155, which will include the removal of large portions of its historic woodblock flooring. In accordance with 36 CFR Part 800, implementing regulations of Section 106, National Historic Preservation Act, Commander Navy Region (COMNAVREG) Hawaii has consulted with the Hawaii State Historic Preservation Officer (SHPO) and other parties, and has agreed to document the woodblock flooring in accordance with HABS standards prior to undertaking the proposed renovations. This photo documentation and recordation fulfills that agreement.

This report was prepared under a Historic Preservation Services contract (N62742-06-D-1869) awarded to Wil Chee Planning, Inc., the prime contractor, by the U.S. Navy, Pacific Division, Naval Facilities Engineering Command. This project is being supervised by James Furuhashi, Environmental Planner, NAVFAC Hawaii. The photographic documentation was undertaken by David Franzen, photographer. Don Hibbard and Tonia Moy, Architectural Historians at Fung Associates, Inc. prepared the written documentation. The field work and research was conducted for this report by Julie Lam and Tonia Moy in February 2009.

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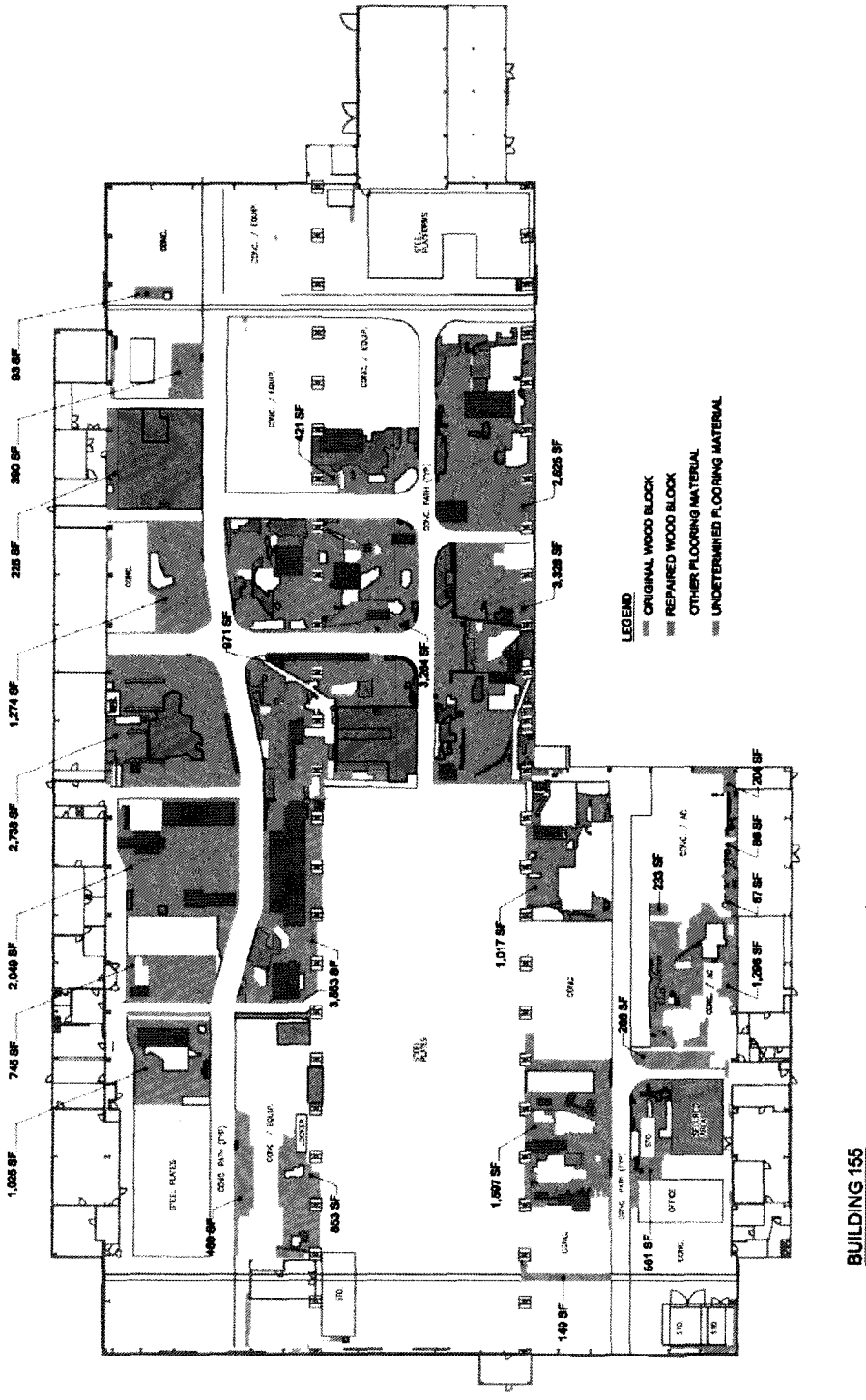
Date of Report: May 2009

**Facility 155, floor plan with location of end grain wood block flooring. (not to scale)**



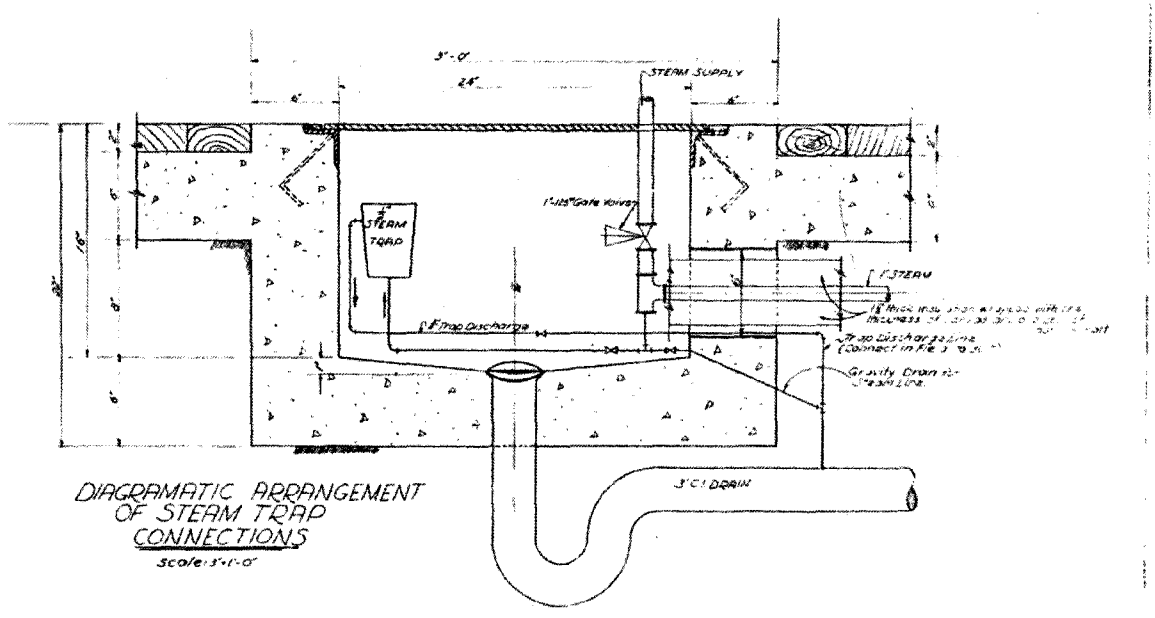
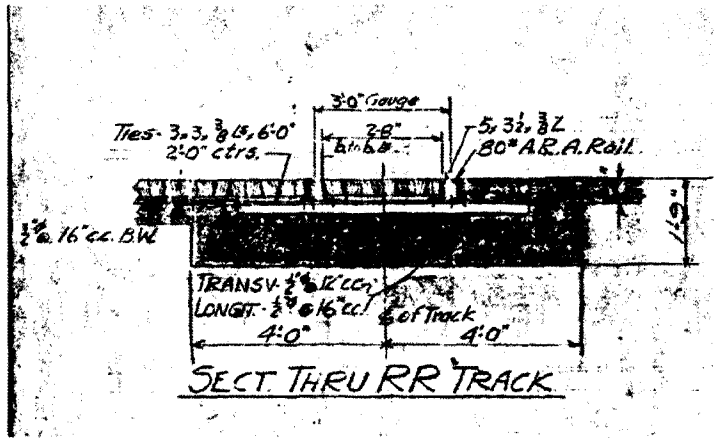



**Fig. 1:** Diagrammatic Arrangement of Stream Trap Connections, Not to Scale (1941, Drawing No. I-N5-361A, Fourteenth Naval District, Pearl Harbor, New Ship Fitters Shop Stream and Water Access Pit Area)



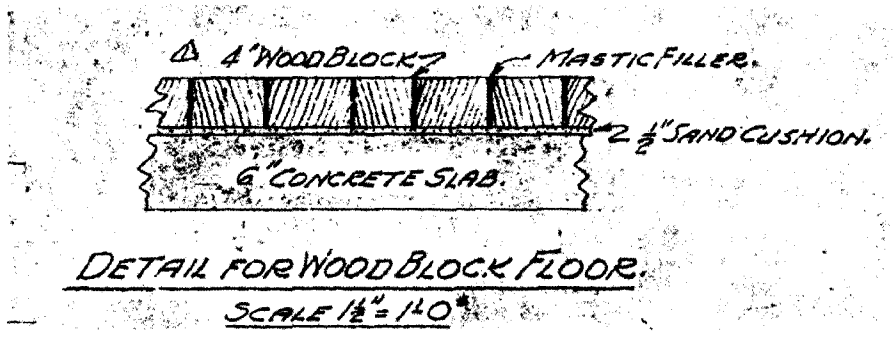




**Fig. 2:** Ship Fitters Shop Building 155, Foundation Plan, Section Through R-R Track, Detail for Wood Blocking Floor, Not to Scale
(November 4, 1942, Drawing No. I-N5-650, Fourteenth Naval District, Pearl Harbor T.H., Navy Yard Pearl Harbor T.H., Ship Fitters Shop)

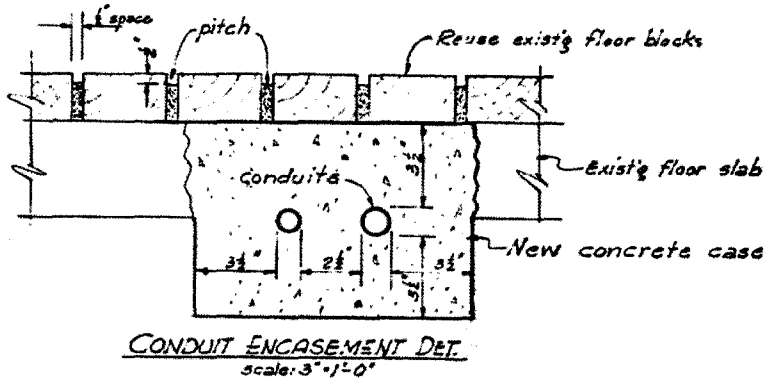
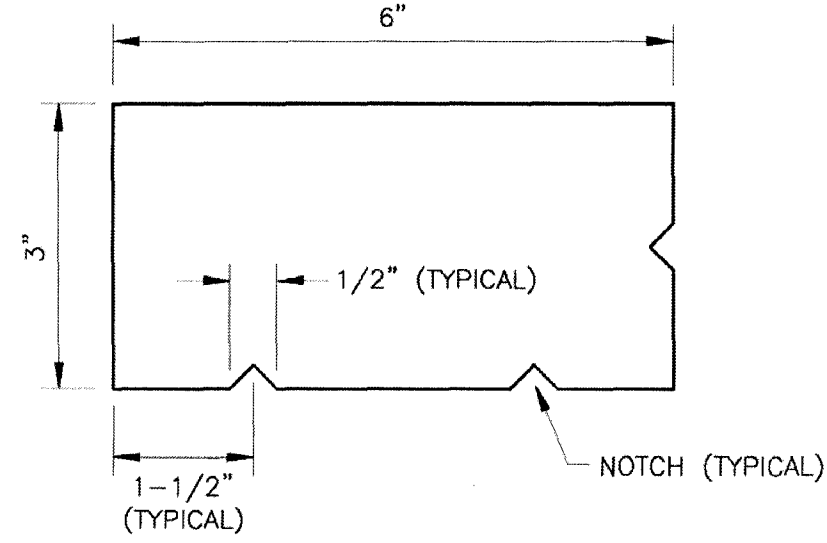
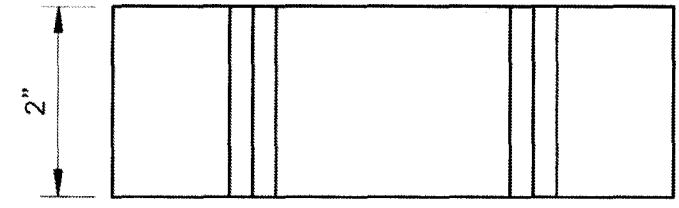


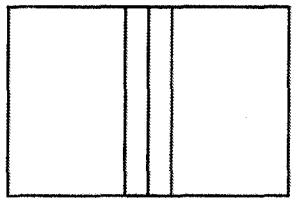

**Fig. 3:** Conduit Enhancement Detail, Not to Scale
(Unknown date, Drawing No. I-N5-1762, Public Works Department Pearl Harbor Naval Shipyard Pearl Harbor, Oahu, HI, BLDG 155-Ship Fitters Shop, Machine Foundations)




TOP VIEW

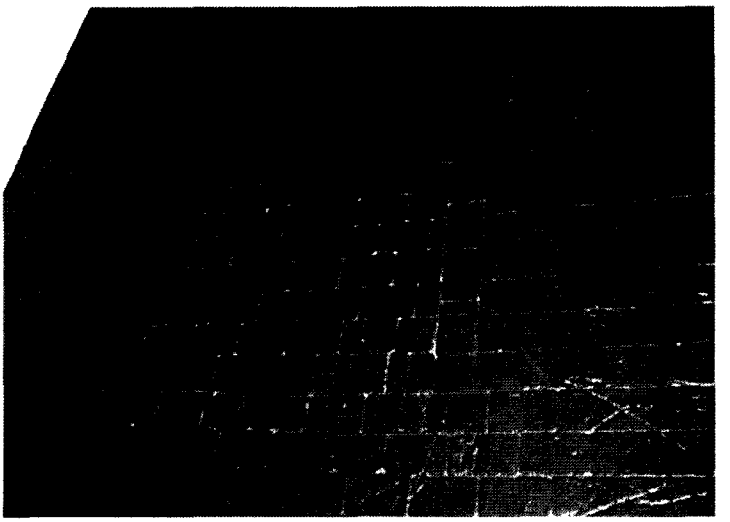


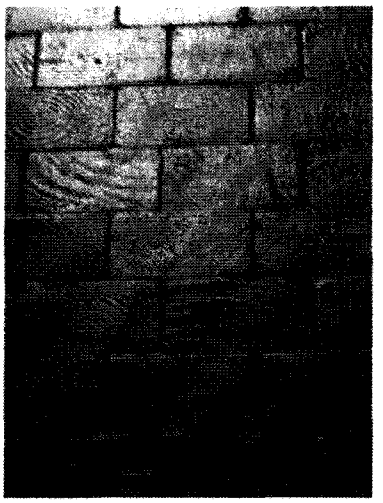

LONG SIDE VIEW



SHORT SIDE VIEW

**Fig. 4:** Wood Block Detail, Not to Scale
(May, 2009, Naval Facilities Engineering Command)





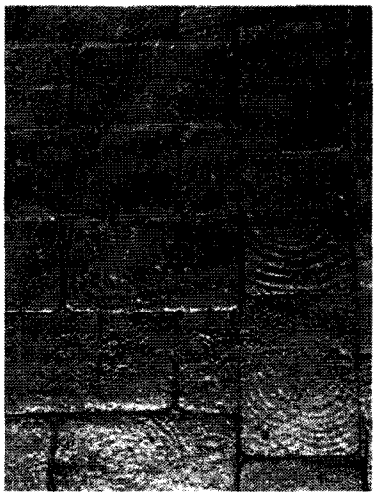


**Fig. 5:** Iwilei Floor (Wood blocking used in a former American Can Company Building)
(December, 2008, Taken by Don Hibbard)