U.S. NAVAL BASE, PEARL HARBOR, FORD ISLAND POLARIS MISSILE LAB & U.S. FLEET BALLISTIC MISSILE SUBMARINE TRAINING CENTER
(U.S. Naval Base, Pearl Harbor, Ford Island)
(Facility No. 39)
Between Lexington Boulevard and the sea plane ramps on the southwest side of Ford Island
Pearl Harbor
Honolulu County
Hawaii

HAER No. HI-86

BLACK & WHITE PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Department of the Interior
National Park Service
Oakland, California

HISTORIC AMERICAN ENGINEERING RECORD

U.S. NAVAL BASE, PEARL HARBOR, FORD ISLAND POLARIS MISSILE LAB & U.S. FLEET BALLISTIC MISSILE SUBMARINE TRAINING CENTER
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Location:	Located near the southwest tip of Ford Island Pearl Harbor Naval Base City and County of Honolulu, Hawaii
UTM:	The UTM coordinates for Facility 39 are: 04.607540.2361940. Map: Pearl Harbor, HI. 1999. 7.5 minute series, North American Datum of 1983 (NAD 83).
Dates of Construction:	1933
Builder:	Initial construction: Navy Department Bureau of Yards and Docks. World War II extension and modifications: Contractors Pacific Naval Air Bases. Cold War-era additions: Public Works Office, Fourteenth Naval District.
Present Owner:	United States Navy
Present Use:	Submarine Training Facility
Significance:	Facility 39 is located within the Pearl Harbor National Historic Landmark. Its construction and ensuing modifications reflect the evolution of Navy activity at Ford Island, with periods of significance in the pre-war, World War II, and Cold War eras. Its pre-war significance is tied to its function as a Navy aircraft servicing facility in the newly established Naval Air Station. It is also significant as a distinctive building type erected in this era. During World War II, its expansion reflected the increased demand for aircraft repair activities at the Naval Air Station, and contributed to the readiness for Pacific air battles which made the final victory possible. Its Cold War significance derives from its association with training, as the training devices within Facility 39 served as the center of training for missile submarines in the Pacific. These specific training activities, from servicing and launching a missile, to plugging leaks, to making a submarine hover, were absolutely crucial to the conduct of the Cold War because they enabled the Navy to maintain the most survivable of all the nuclear deterrent weapons in this period. Further, it appears that the missile and dive training performed in Facility 39 on Ford Island were initially unique to the Navy nationwide and the missile training lab is the only survivor of its type.
Historian:	Steven Bedford, Ph.D. Architectural Historian, of Fitzgerald & Halliday, Inc., and Polly Cosson, Architectural Historian, of Mason Architects, Inc.

Project Information: Photo documentation and recordation of this facility by the Navy has been done in anticipation of scheduled demolition of the exterior steel superstructure, or crane, atop the missile training lab located on the southwest corner of Building 39. 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 Historical Architect, NAVFAC Hawaii. The photographic documentation was undertaken by David Franzen, photographer. Steven Bedford, Ph.D. Architectural Historian, of Fitzgerald & Halliday, Inc., and Polly Cosson, Architectural Historian, of Mason Architects, Inc. prepared the written documentation and history of this structure. The field work and research was conducted for this report between March and May of 2005.

This report is an addendum to an earlier HABS report completed on the structure, HABS No. HI-305. This HAER report focuses on the technical training facilities added to Facility 39 during the Cold War, particularly the Polaris missile training lab and crane, and in part the submarine training facilities, such as the damage control wet trainer and a dive trainer. The report is focused in this manner because the crane atop the Polaris missile training lab is presently scheduled for demolition. The report provides only a general architectural description and historic context of the pre-Cold War era components of Facility 39 and is not intended to mitigate any renovations which may be planned for these portions of the building which are not documented in this report.

Description: Engine and aircraft overhaul shop, Facility 39, is a two-story concrete, steel-framed structure. The building has a slab-on-grade foundation, with a concrete masonry unit (CMU) superstructure. The wood roof is supported by steel trusses, and the roof's form is dominated by a central raised double-gable clerestory monitor component. The raised component is surrounded by flat roof to the northwest, northeast, and southeast sides. The roof is finished with built-up roofing material.

Facility 39 is nearly rectangular in plan, approximately 320' long by 210' wide. It is approximately 36' high. In some locations, various lean-to or other type additions extend these dimensions further, and make the rectangular plan somewhat irregular. The additions are primarily of concrete construction, although at least one lean-to is finished with corrugated metal panels.

The original layout of the building, which consisted of a large double-height hangar space with mezzanine areas on the northwest, northeast, and southeast sides, has been greatly modified over time. Drawings dated 1942 show that the mezzanines were extended

across the space, and the double-height interior hangar was divided into two separate floors at this time. The new floor was built of reinforced concrete and supported by concrete columns. Also added at this time was a 17'-3" wide interior stair near the south side of the building, from the first floor to the new second floor.

Both levels of the building now consist of various training areas, conference rooms, class rooms, hallways, and small-scale rooms. The interior finishes of most of these areas are modern, and include vinyl composition tile on the floor and gypsum board on the walls.

The southwest façade of the structure was originally defined by eight double-height rolling hangar doors. Above the doors are twenty-four openings filled with steel-frame multi-light windows which were part of the original fenestration design. In 1942, the hangar doors were removed and the opening was filled with an 8" concrete hollow tile wall (CMU) with multi-light windows at first and second floors. Large scale sliding doors were also added at various locations on both levels; on the second level, one set of doors with four panels was added (still extant) and on the ground level, two sets of double doors were added (still extant) and one single sliding door was added (still extant).

Also added to the front façade in 1942 where the hangar doors were removed was a "Drop Hammer Shed" at the ground floor level. This structure, still extant but extensively modified, was built approximately halfway in and halfway out of Facility 39 and likely housed an industrial drop hammer, a large tool commonly used in the aircraft industry which employs male and female dies to form sheet metal parts. This shed was finished with corrugated metal panels on the roof and walls, which are still largely intact. Some of the original metal mesh paneled window openings remain.

The original northwest, northeast, and southeast facades have been drastically modified, largely with lean-tos, extensions, and other additions. These facades were originally defined by bays of steel-frame multi-light windows (16 bays at the rear and 8 bays at the sides) containing eight-light pivot panels. Most of these original windows on the ground floor have since been in-filled with CMU. Many on the rear extension have been in-filled on the second level in the same manner. The original northwest façade was completely altered and is now devoid of fenestration.

Facility 39's numerous additions and alterations occurred throughout the 1930s, World War II, as well as in the Cold War era. In addition to the modifications already discussed, other notable alterations include the addition of several transformers. Two similar extant transformer substations, Transformer Station No. 1 (Facility S257), and

Transformer Station No. 2 (Facility S72), were added onto the northwest and southeast sides, respectively. These are both one-story concrete lean-to structures with flat roofs and basic rectangular plans, and blast wall-type entrances. The Navy database lists the construction date of Facility S72 at 1942 and the date of Facility S257 at 1944 (although drawings show that it was planned earlier).

Another transformer station, Facility 250, was also constructed close to (but not touching) the northwest façade. This structure is rectangular in plan, with a flat roof and was also built of CMU. The Navy database lists its construction date as 1942.

In 1943, a second-story extension was added to the northeast side of the building. This extension, framed in steel and built of CMU, has a low-slope shed roof, and a raised clerestory monitor. Most of its steel-frame multi-light windows remain on the second floor.

Other additions, to be discussed below, include the Ca. 1965-66 addition of the missile lab and dive trainer, and the 1967 addition of the damage control wet trainer. A Polaris missile monument was built in front of the southeast façade of the building which incorporated an inert Polaris missile, probably an A3. It was removed sometime post-1982.

The Damage Control Wet Trainer:
Since its creation in 1967, the damage control wet trainer has undergone several alterations and has been partially dismantled. It was last altered in 1985 in the designs of Shigemura, Yamamoto and Lau. As it exists today, it is located on the southeastern side of the ground floor of Facility 39, adjacent to the south exterior wall. The primary element of the wet trainer is a concrete-block pool approximately 15' square in plan. Inside this pool a training compartment formed of curved steel panels which simulated the sides of a ship was installed using a steel frame that fit the square sides of the seven-foot deep pool. Access to the pool is by ladder at the northern end. The bottom of the trainer pool is topped by a steel deck, separated from the steel floor by 3" steel angles. The sides of the pool are lined with remnants of sloping pipe racks that allowed different configurations of piping to be used in training. The southern end of the pool contains piping that floods the pool and can be used to simulate various flooding situations. A metal catwalk cantilevers approximately three feet over the northern, eastern, and southern sides of the pool, while a metal railing and 12" curb surround the pool. The southern end of the pool is flanked by the control area, a six-foot wide concrete deck that extends the width of the trainer. At the eastern end of the control deck is a single unmarked control box and a telephone.

The Missile Lab:

Located on the west corner of Facility 39, the missile lab, as it was named in early drawings, rises 85' to the top of its crane tower. It is 31' deep and 24' wide. The top 34' comprise the open trusses of the crane structure. The lower 51' are divided into four uneven levels that wrap around the missile launch tube. There are two original exterior openings—one double door at the center of the ground floor of the southern elevation and a sliding double corrugated door at the top of the structure for missile loading access. Practice missiles were loaded into the launch tube using a winch through a section of the roof at the southwest side that opened in conjunction with these double upper doors. Other openings were added to the north side in 1967 to provide access to an exterior stair that connects the levels. The exterior of the reinforced concrete structure is buttressed at four points. This was a 1967 modification to provide more support and stability for the crane. (This modification that may also indicate that the crane was being used to lift larger loads than originally intended, such as the 30,000 pound Poseidon, which was a replacement for the lighter Polaris.) The 16" thick buttresses taper from 9' deep at the ground to 6' deep at the base of the crane trusses. The buttresses are cross-braced with steel for the top 25'-- up to the base of the crane trusses.

The Crane

Three vertical crane trusses rise 39' to support the crane rail. They are unevenly spaced. The central truss line is 13' from the southerly truss and 17' from the rear truss. The front (southerly) and rear (northerly) truss lines are doubled around a central column. Cross bracing between the truss lines creates a space frame. The two truss lines are further stabilized by cross bracing on the northern side of the structure. At the uppermost level—the level of the crane rail—horizontal trusses provide lateral stability for the crane rail. The crane rails project 18' beyond the face of the building and these projections are supported by 19' trussed brackets. A 30-ton rolling crane is still attached to the crane rails.

Interior

The missile laboratory is essentially an enclosure for a 36' tall, 7' diameter steel alloy missile launch tube. The floors are inserted at access and service areas for the tube and are named relative to the tube. Each floor is constructed of a 4" concrete deck supported by 8" steel beams. The first, or lower level, floor is at 0' datum, the intermediate floor is 14' above the ground. The upper level is located 21'- 8" above the ground, while the "fairwater"[1] floor rises 35' above the base of the missile. The fairwater level is covered with a roof structure that rolls back to permit missile loading and removal. A

[1] The bridge and conning tower on a submarine.

scissor stair in the southwest corner of the building provides vertical access to these floors, while a door on the northeastern side at the upper level provides access into the rest of Fac. 39. Each floor was built with an octagonal opening for insertion of the missile tube and the area between the floors. The intervening space between the tube and floor deck is spanned by metal grates that are bolted to a flange on the tube.

The ground floor opening provides access to the generator and compressor room, which is approximately 8' wide x 12' long, and on the southeastern side of the floor. A door on the western wall of this room also provides access to the base of the missile launcher. At this level the launcher tube is bolted to the floor and the lower level of the tube is reinforced with gusset plates and additional ribbing. A bronze hatch provides access to the interior of the launcher tube and was intended to allow for servicing of the lower stage of the missile. Inside, one can see the supporting hydraulic alignment system for the missile. One can also see the inlet point for the air launching system. A curved piece of steel at the base seems to indicate that there are missing pieces that used to support the missile. On the exterior of the tube, a mechanical arm permits closure of all level hatches from the base of the tube. A large diameter pipe on the southern side of the tube was used to drain water from the tube after the missile was launched. A metal gangway provides access to what appears to be the gas charging system for the tube, decommissioned hydraulic lines, large electrical and data connectors, and other test equipment.

The intermediate floor of the tube has two access hatches that permitted access to the second stage rocket motors. Along the eastern wall of this level is the metal carcass of a 16-tube launch computer. At the edge of the southern grating is a console that once contained the fault insertion system. Other small hydraulic lines and the large drain line continue up the side of the tube. Along the western wall is a missile temperature monitoring device.

The upper level provides access to the missile guidance system and optical alignment hatches. The inertial guidance system[2] was brought in by an overhead monorail from the adjacent navigation laboratory where it had been calibrated. The optical alignment guide system ensured that the missile was properly aligned in the tube. Other electrical and monitoring system cables penetrate the tube. The

[2] An inertial guidance system consists of an inertial navigation system (definition to follow) combined with control mechanisms, allowing the path of a vehicle to be controlled according to the position determined by the inertial navigation system. These systems are also referred to as an inertial platform.
An inertial navigation system measures the position and altitude of a vehicle by measuring the accelerations and rotations applied to the system's inertial frame. It is widely used because it refers to no real-world item beyond itself. It is therefore immune to jamming and deception.

upper level provides access to the tube hatch and fairwater covering. One can see that the hydraulic motors and controls have all been removed from the tube assembly.

From the fairwater level one can see the hatch locking mechanism for the tube as well as the fairwater tube covering. The interior of the hatch is decorated with a cartoon showing the Charles Schulz character Snoopy as a World War I aviator, about to drop a torpedo with the words, "I'll get you, Red Baron." Ballistic missile tube hatches onboard submarines were frequently decorated with unit insignia, logos, or mottos painted by the missile crew as a symbol of their unit pride and tradition. At the fairwater level the remnants of the crane controls are located in the southeastern corner of the room.

The Dive Trainer:
The dive trainer is enclosed in a double height space that is 29'high, 40' long and 25' deep. The lower level of the trainer facility contains the foundation and support for the device as well as small computer control room located at the northern end of the facility. The upper level, about 16' above the base of the facility, includes a 9' wide walkway on the northern side of the facility. A railing lines the walkway. The entrance to the trainer is on the eastern end of the southern side of the walkway. The western end of the walkway provides access to a stainless steel ladder that descends to the lower level.

The foundation is centered in the lower section. U-shaped in section, the reinforced concrete descends 2'-6" below the lower level grade. It is 19'-6" long, 18'-2" deep. The 4'-7" x 8'-2" piers rise 4'-6" above grade. Anchor-bolted T-shaped anchor plates connect the dive trainer support tripods to the foundation. The hydraulic system for the trainer is located on the western side of the foundation piers, connecting to hydraulic reservoirs and controls through a metal-covered channel that runs north-south through the floor.

The trainer support tripods are located about 17' apart, atop concrete foundations. Tubular in shape and about 6" in diameter, each tripod converges on each pivot point approximately 12' above the foundation. Stops are located about one third of the way up each exterior leg of the tripods to prevent the trainer from over rotating. A cable tray for the controls runs perpendicular to the northern pivot.

The base or floor of the trainer itself is made up of a 17'x 22' metal deck over steel pipe sections. The trainer cab, approximately 7' high, is made of sheet metal. The cab is partially open on the northern side and roof. Only the skeletons of the rear (eastern) training consoles and the forward diving consoles survive. It is designed for a

maximum pitch of 50 degrees and a maximum roll of 35 degrees. One can reach the access passage via a series of steps.

Historical Context:

Pre-War through World War II:
An overview of Ford Island's aviation history from 1919 through World War II is provided in HABS No. HI-361.

Facility 39 was built in 1933 as an aviation shop called the "Engine and Aircraft Overhaul Shop". The construction of this facility was a significant component of the development of Naval Air Station Ford Island, as it provided aviation repair facilities for the developing aviation installation. The aircraft maintenance function of Facility 39 was augmented in 1940 with the nearby construction of Facility 79, another aircraft shop which, along with its 1943 additions, became Ford Island's main repair and assembly facility for airframes.

The building was built by the Bureau of Yards and Docks, Fourteenth Naval District. Historical records indicate that it was constructed at a cost of $196,000. However, once completed, the structure was modified numerous times, and these changes added significantly to its cost.

Approximately one year after its completion, President Roosevelt visited Ford Island. An historic photograph of his visit shows him touring in a car in front of a hangar facility. It is possible that as part of his tour that the Commander in Chief also visited Facility 39, as the shop building was a new and important component of the Air Base.

Although some hangars on Ford Island were devastated by the Japanese attack on Pearl Harbor on December 7, 1941 (in particular Hangar No. 6), Facility 39 survived intact. The closest building in its vicinity to be damaged was Hangar No. 38 (no longer extant), which was located directly to the west. This facility's windows were blown out from nearby exploding bombs.[3]

After the December 7th attack, the building was expanded to keep up with the growing demand for aviation repair and engine overhauls during the war. The newly constructed second floor was filled with various uses, some which were arranged in assembly-line fashion; a large minor overhaul area, a final assembly area, an engine overhaul storeroom and office, and an engine cleaning area. Other smaller rooms were built for radio testing, instruments, inspection surveys, and a planning office. Three electrical transformers/substations were also added on to the extension of the building at this time to keep up with the increased power requirements.

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[3] Ford Island Dad's Club, *Ford Island, Past and Present: a picture story of the United States Navy on Ford Island from 1923 up to the present day,* (Pearl Harbor, HI: N.d.), 53.

An extension was added approximately one year after the second floor was built along Facility 39's northeast side. On the first floor it had a parachute repair room, a fabric room, and a heat treating room, and on the second floor it contained an instrument room. Included in this extension was a 260'-0" long monitor that was oriented southeast to northwest along the length of the extension. This monitor had a low slope shed roof and its walls were filled with windows to allow natural light into the second floor.

The consortium of contractors responsible for the World War II extension, additions, and various modifications to Facility 39 was Contractors Pacific Naval Air Bases (CPNAB). The work they did was under Contracts NOy-3550 and NOy-4173. CPNAB reported that the facility's modifications were extremely protracted and expensive:

> Aircraft overhaul building (known as A. and R. Shop No. 39): This structure is referred to locally as the "headache of Pearl Harbor" -- because of the unprecedented number of changes, revisions, and experimental installations made in and to this building. Upon orders originating with the Assembly and Repair Shop Officer, the overhead cranes, the machine shop appointments, the furnaces, the paint and dope shop tanks, and other appurtenances were rearranged to conform to the particular requirements of this station. As actual servicing of planes began, many other changes were made – in the interests of more efficient operation, but with ever-accumulating over-expenditures; the electric installations alone exceeded the funds originally allotted by more than 300 per cent.[4]

Cold War:

The forward location of Pearl Harbor in the eastern Pacific, especially in relation to the rest of the homeports of the Third Fleet, made it an ideal locus for focusing submarine activities. The Navy clearly recognized this by establishing a submarine training center and prospective officer's school at SUBASE in 1947. In 1948, the Navy's latest submarines - the GUPPYs (Greater Underwater Propulsion Power Program) - began to be deployed to Pearl Harbor. In 1950, the USS *Pickerel* demonstrated the potential of GUPPY-class snorkel submarines when she submerged off Hong Kong and did not resurface until she reached Pearl Harbor. Also, in 1951, as part of the Korean War effort, Submarine Squadron (SUBRON) 7 joined SUBRON 1 at Pearl Harbor.

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[4] Contractors Pacific Naval Air Bases (CPNAB), *Technical report and Project History, Contracts NOy 3550 and NOy 4173,* (Pearl Harbor. N.d.), microfilm of ca. 1947 report at NAVFAC Library, A-600.

From a submarine operations standpoint however, Pearl Harbor began to grow in importance. The primary mission of SUBRON 1 and 7 at Pearl Harbor was to conduct anti-submarine warfare, and most of the boats attached to the squadrons were the latest Hunter-Killer submarines. SUBRON 7's specific role was to help develop hunter-killer tactics and "advance work in the field of sonar classification," (Command History, 1951-58). Evidence of the use of Pearl Harbor as a center for submarine warfare is also demonstrated by SUBRON 1's *USS Gudgeon* (SS 567) becoming the first U.S. submarine to circumnavigate the globe.

Throughout the 1950s, SUBASE continued as the center for all submarine activities in the Pacific. The submarine nuclear age came to Pearl Harbor with the visits of the *USS Nautilus* (SSN-571) and the *USS Sargo* (SSN-583) in 1958. On July 22, the *USS Nautilus* left Sierra 18 dock headed for its passage under the icepack at the North Pole. Only two months after the visit of the *Nautilus,* the SUBASE began its conversion to nuclear. In October 1958, the *Sargo* (SSN-583) became the first nuclear submarine assigned to Pearl Harbor. The next month the Pearl Harbor submarine force was further strengthened with the assignment of the *USS Grayback* (SSG-574), equipped with *Regulus* II missiles. Four more *Regulus*-equipped submarines followed and Guided Missile Unit 90 was established to provide missile support. In 1959, the *USS Swordfish* (SSN-579) was also home ported at Pearl Harbor.

With an ever-increasing number of nuclear submarines arriving at Pearl Harbor, the maintenance workload increased. In 1960, the base commander noted that the arrival of the nuclear submarines caused a 60 percent increase in workload on shore.

By the early 1960s, SUBASE was one of the key installations for the conduct of the Cold War. In 1960, the base was homeport for two of the first five nuclear submarines, along with 20 diesel-powered submarines. Over the next decade, this ratio would reverse and a third squadron would be home ported at Pearl Harbor.

Onshore construction began to reflect this importance with the completion of the Naval Submarine Training Center, Pacific, completed in 1960. This three-story concrete structure (Facility 1262) is painted a light blue, and is known as the "Blue Building". One of two in the nation, it is devoted to training for attack submarines, containing diving simulators, training devices and classrooms. Despite huge technological changes in the submarine forces, few infrastructure changes have occurred at Pearl Harbor's Submarine Base. As long as the technology and mission could be

accommodated within the existing infrastructure, no additional buildings were built.

Major changes occurred at the base with the arrival of the seven Polaris submarines of the re-formed Submarine Squadron (SUBRON) 15 from 1964 to 1967. Although home ported in Hawai'i, these boats were usually forward deployed to Apra, Guam. The first to arrive was the *Daniel Boone* (SSBN 629), followed by the *Tecumseh* (SSBN 628), the *U.S. Grant* (SSN 631), and the *Stonewall Jackson* (SSN 634). The *Benjamin Franklin* (SSBN 640) and *Kamehameha* (SSBN 642) arrived in 1966, while the final boat in the compliment, the *Mariano Vallejo* (SSBN 658), arrived in 1967.[5] (Command History SUBRON 15, 1967).

As a result of refits, overhauls and reassignments, submarines rotated in and out of the squadron with some regularity. In addition to those listed above, the following submarines served with SUBRON 15 prior to its disestablishment in the early 1980s:

- *George Washington* (SSBN 598)
- *John Adams* (SSBN 620)
- *Woodrow Wilson* (SSBN 624)
- *Henry Clay* (SSBN 625)
- *Daniel Webster* (SSBN 626)
- *Robert E. Lee* (SSBN 601)
- *Theodore Roosevelt* (SSBN 600)
- *Abraham Lincoln* (SSBN 602)
- *Ethan Allen* (SSBN 608)
- *Thomas Edison* (SSBN 610)
- *John Marshall* (SSBN 611)
- *Thomas Jefferson* (SSBN 618)
- *Sam Houston* (SSBN 609)

Fleet Submarine Training Center

The arrival of the first ballistic missile submarines in 1963-4 also coincided with the completion of the Fleet Submarine Training Center, (located within Facilities 26, 26a, and 39) on Ford Island. At that time, Facility 39 was the Navy's primary training facility for all operational aspects for the Polaris Missile submarine.[6] The adaptation of Facility 39 for use by Fleet Submarine Training Center was designed by Wilson Associates, a local architectural firm, who would continue to provide plans for alterations of the building into the 1970s.

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[5] Commanding Officer, Submarine Squadron 15, *Command Histories*, (Washington D.C.: Naval Historical Center, 1967).

[6] Commanding Officer, Fleet Submarine Training Facility, *Command Histories,* (Washington D.C.: Naval Historical Center, 1963-1964).

All aspects of submarine training were offered in the three buildings on Ford Island. Their equipment lists contained almost all equipment found on a typical Pacific fleet ballistic missile submarine. In 1964, these included classrooms, laboratories, a complete engineering plant, a torpedo tube and a Polaris missile and launching tube. In 1965, weapons training focused on two areas; missile launching and torpedo firing. In the missile area, the subject of this study, the Command History described the courses as Weapons Control Sub-Systems (WCSS) training. The courses included instruction and training on the Polaris A-3 missile, the Missile Test and Readiness Equipment (MTRE), the Underwater Launch Control and Energy Recorder (ULCER), and the MK 84 Missile Fire Control System. Named the Fleet Submarine Training Facility (FLESUBTRAFAC), it opened in 1965 to provide training to the crews (526 in all) of the *Tecumseh, Daniel Boone*, and *U.S. Grant*. The 1966 FLESUBTRAFAC Command History indicated that there were 44,773 graduates of its 151 courses, which meant that almost 300 naval personnel had attended each course.

Missile Training Tube

In the missile training area inside Facility 39, which included the now-empty rooms to the northwest of the tube facility, missile technicians were trained how to load and maintain the missile; align the missile in its tube; insert the guidance system; maintain correct temperature control; prepare the missile for firing; and conduct a simulated launch.

Although the missile was developed by Lockheed, in 1956 the Special Projects Office of the U.S. Navy awarded the Westinghouse's Sunnyvale Division the prime contract to design, manufacture, test, and install the launching and handling equipment for the Polaris Ballistic Missiles. The tube may have been altered to accommodate the Poseidon missile as well. Tests between 1960 and 1962 determined that glass-fiber liners and locating rings, which surrounded the Polaris missiles as they sat in their launch tubes, could be safely removed without adversely affecting a missile's operation. As a result, missiles with a larger width could be safely housed in the same launch tubes used for the narrower Polaris. This allowed the U.S. Navy to deploy a larger, improved Fleet Ballistic Missile (FBM), without having to make major modifications to existing launch tubes. This would have extended the useful life of the tube. A check of Navy Bureau of Personnel (BUPERS) records indicates that the tube was used for training into the 1980s.

The design date of the missile launch tube, its size and internal configuration indicate that it was used for training Polaris, Poseidon, and possibly Trident missile crews. Drawings dated March 28, 1963 show the designs for the conversion of Building 39 to accommodate

the Fleet Ballistic Missile (FBM) Submarine Training Center, including the installation of the missile launch tube.[7] This date corresponds to the time when the Polaris A2 missile was deployed (operational on June 26, 1962) and the Polaris A3 was in development (first test flight on August 7, 1962). Although the Polaris A3 missile was considered a new missile design, rather than an evolution of an existing missile, which was the case of the transition from Polaris A1 to A2, it was fired from the same missile tubes as the earlier A2. Diameters of all these missiles were the same, 4'-6" and the A3 was only one foot longer (32' versus 31') than the A2. The Polaris A3 missile became operational on September 28, 1964 around the time that the FBM Building 39 conversion was completed. So, the tube could have been used for training on both of these missiles. It is unlikely that training was carried out here for Polaris A1 missiles. Although this missile (28'-6" long, 4'-6" in diameter and first deployed on November 15, 1960) was fired from the same sized tube, it was retired on October 14, 1965. The internal configuration of the tube points to its additional use in training Poseidon C3 missile crews, the replacement missile for the Polaris A3. The Poseidon, under development in 1966 and becoming operational on March 31, 1971, at 34' in length (2' longer that the Polaris A3), was designed to be launched from the same missile tube as the Polaris A3. Although the Poseidon was 6'-2" in diameter, which is 1'-8" wider than the Polaris, this was accomplished by removing the locating rings and fiberglass liners from the inside of the Polaris-configured tubes to give a larger useable diameter to the existing tube. Earlier tests had shown that the Polaris could be launched effectively without them, and the designers of the Poseidon capitalized on the additional space that resulted in the tube. The interior of the missile launch tube at Building 39 has no locating rings or fiberglass liner, indicating that it might have been used for Poseidon training. The Polaris A2 was operational until November 1974, the Polaris A3 until February 1982, and the Poseidon C3 until September 1992.

The next submarine-launched ballistic missile (SLBM) deployed by the United States was the Trident I C4. The Trident was designed to be used on existing Poseidon-capable submarines and had the same dimensions as the Poseidon missle. The Trident's design was first test fired in January 1977 and deployed on October 1979 in a former Poseidon-fitted submarine, the USS *Francis Scott Key*. The Trident I C4 was retired in September 2005, it was the last SLBM to be able to utilize a missile launch tube of the size found in Building 39. The George Washington Class SSBN had 16 tubes for Polaris missiles. These submarines were fitted with Polaris A1 and A3 missiles. The Ethan Allen Class SSBN also had 16 tubes for Polaris missiles. This class of submarine was also fitted with Polaris A2 and A3 missiles.

[7] Naval Facilities Pacific (NAVFAC PAC), Plan Files drawing number 998282.

The Layfayette Class SSBN also had 16 tubes and were fitted with Polaris A2, Polaris A3, and Poseidon C3 missiles. The James Madison Class SSBN and the Benjamin Franklin Class each also had 16 tubes and were fitted with Polaris A3, Poseidon C3, and Trident I C4 missiles. Ohio Class SSBN had 24 tubes and the eight earliest vessels were originally fitted with Trident I C4 missiles.

Submarine crews operate on a rotation system. There are two full crews for each submarine, including commander, officers, and enlisted men. One crew is designated "Blue" and the other "Gold." While one crew has the submarine out on patrol, the other crew is on shore training, orienting new crew members, and taking leave. Generally this cycle repeats about every 2 months when the crew aboard the submarine is returned to home port and the other crew goes on patrol.

The guidance system, which the missile technicians trained on and would install in the missile, was designed by the Charles Stark Draper Laboratory at MIT. It was a special purpose digital computer that was designed to solve the specific equations required for the guidance and control system. The first version of this system, called the Mark 1, was the first use of onboard digital computers to provide guidance and control computations for a ballistic missile. The computer occupied about four-tenths of a cubic foot, weighed 26 pounds, and consumed 80 watts. A new design, eventually designated Mark 2, repeated the architecture and logic design with improvements in circuits and packaging. The missile launch computer controls, the remnants of which are found on the second level of the missile training tube in Facility 39, were designed and built by Burroughs and Sperry. In 1967, in order to better approximate operational conditions, a fault simulator was installed.

This missile trainer and tube are the last surviving examples in the U.S. Navy. Building 586, the Polaris Missile Training Facility in Dam Neck Virginia, has three concrete tower areas that once contained Polaris missile tubes. In the early 1990s, the START 1 arms reduction treaty required that the Navy remove all of the Polaris equipment and tubes from Building 586 and place them in the adjacent parking lot for a Soviet reconnaissance satellite to verify deactivation. About 1 year after the dismantling and flyover, a Soviet arms reduction inspection team inspected the three missile towers to insure the equipment was destroyed.

The Damage Control Wet Trainer

The engineering training at FLESUBTRAFAC on Ford Island covered all aspects of the 616-class (*Lafayette*) submarine except for the nuclear reactor, but all actual operational conditions could not be fully simulated until November 1967, when the wet trainer was installed on

the ground floor of Facility 39. As described by the Command Historian:

> Engineering personnel acquired a knack for getting all wet as the first "Get Wet Trainer" in the Pacific was installed to simulate actual flooding conditions aboard a submarine. The device, specially designed and built by FLESUBTRAFAC Engineering personnel, provides practical—though uncomfortable—experience in the recognition, control and repair of flooding casualties. Piping and communications systems duplicate actual conditions found on board submarines.[8]

The trainer was so enthusiastically received that the facilities were immediately expanded in order to double course enrollment. The trainer was unique in submarine damage control training and became a prototype for other installations within the submarine force. Approximately 350 students received training each year. The designer of the trainer, Senior Chief Electrician's Mate Robert H. Stenstream, was awarded a letter of Commendation by the Commander in Chief, U. S. Pacific Fleet for his efforts in the development of the trainer and the training techniques involved.[9]

Dive Trainer

Little information on the dive trainer located in Facility 39 is publicly available. Drawings dated 1966 indicate it was added to the building at this time as part of the conversion of the facility for the FBM Submarine Training Center, and occurred in conjunction with the addition of the missile lab. As a trainer used as part of the tactical department's course work, the trainer was meant to simulate the dive station of a SSBN 627 (*James Madison*) type submarine. Two crewmen in training would sit side-by-side at the forward controls while being tested and supervised by a trainer sitting at a console located aft. The southern and eastern sides of the trainer contained panels that simulated the interior of a submarine. The simulator was designed so that the operators could practice all aspects of steering, diving and surfacing a submarine, but they also learned an essential, but complicated, maneuver required of all missile submarines of the era—hovering in place while firing missiles.[10] Lighting in the dive trainer utilized red filters to allow training in the red-light environment used to illuminate some submarine compartments at night.

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[8] Commanding Officer, Fleet Submarine Training Facility, *Command Histories,* (Washington D.C.: Naval Historical Center, 1967), 20.

[9] Commanding Officer, Fleet Submarine Training Facility, *Command Histories,* (Washington D.C.: Naval Historical Center, 1968), 5.

[10] [10] Commanding Officer, Fleet Submarine Training Facility, *Command Histories.* (Washington D.C.: Naval Historical Center, 1965), and Norman Freidman, *U.S. Submarines Since 1945,* (Annapolis M.D.: Naval Institute Press, 1994), 197.

Selected notes from an instruction sheet found within the training cab state:

- Safety – Do not enter or exit the trainer while it is in the "Operate" mode. Max. allowable number of people in the trainer is ten. Do not sit on railings. Use seatbelts or brace yourself at all times.
- In all situations formal communications will be adhered to as per the Submarine I.C. Manual.
- Prior to each exercise, the instructor will introduce initial conditions such as: speed, depth, course, trim, sea state, sonar contacts, what is streamed.

The drawings for the dive trainer's construction indicate that it was installed by excavating adjacent to the building, removing the foundation wall, inserting the trainer, resealing the wall and backfilling the excavation.

Sources:

Drawings

Original Navy drawings are on file in microfilm at Pearl Harbor in the Naval Facilities Pacific (NAVFAC PAC) Plan Files.

Shigemura, Yamamoto, Lau and Associates. "Modify Damage Control Wet Trainer ," 1985. Y&D drawing numbers 7060408.

Wilson and Associates "FBM submarine training center conversion of Bldg 39," 1963. Y&D drawing numbers 998280, 998281, 998290, 998291, 998292, 998293, 998328,

Wilson, Okamoto and Associates. "Alterations to Missile Tower, Bldg 39." 1967. Y&D drawing number 119040.

U.S. Navy Bureau of Yards and Docks. "Engine & Aircraft Overhaul Shop" Y&D drawing numbers 112614 thru 112617, 112619 thru 112624, 114346 thru 114351, and 114715 thru 114717. Also, V-N10-116, V-N10-118, V-N10-133, V-N10-159, V-N10-161, V-N10-163, V-N10-167, V-N10-169 thru 170, V-N10-177, V-N10-204, V-N10-231, V-N10-244, V-N10-266, V-N10-282 thru 83, V-N10-294 thru 295, V-N10-380, V-N10-421, V-N10-476, V-N10-594 thru 597, V-N10-599 thru 601, V-N10-610, V-N10-619, V-N10-649 thru 650, and V-N10-666 thru 668.

Manuscript sources

Commanding Officer, Fleet Submarine Training Facility. "Command Histories." 1965-1969. (Operational Archives, Naval Historical Center, Washington, D.C.)

Commanding Officer, Submarine Squadron 15. "Command Histories." 1964-1968. (Operational Archives, Naval Historical Center, Washington, D.C)

Contractors Pacific Naval Air Bases (CPNAB). Technical Report and Project History, Contracts NOy 3550 and NOy 4173. Microfilm of ca. 1947 report from NAVFAC library, Pearl Harbor. N.d.

Newsletters
"The Patrol." 1963-1980. (Naval Submarine Base, Pearl Harbor)

Personal Interviews
John P. Craven, Former Chief Scientist of Navy Special Projects Office. Personal interview by Steven Bedford, Honolulu, HI. January 20, 2005.

Claude Coleman, Retired Navy Master Chief, now in charge of Fac.39. Personal interview by Steven Bedford, Honolulu, HI. April 12, 2005

Capt. Jerry Hofwolt USN (Ret,), Former Commanding Officer, Naval Submarine Base, Hawaii. Personal interview by Steven Bedford, April 13, 2005.

Sudhir, Bansal, Navy Special Projects Office. Telephone interview by Steven Bedford May 5, 2005.

Personal Correspondence
Glen B. Hammit, Electric Boat Division, General Dynamic Corporation. E-mail correspondence. May 5, 2005 to May 11, 2005.

Secondary Sources
Chang, Sherwin. *Historic American Buildings Survey, U.S. Naval Base, Pearl Harbor, Engine and Aircraft Overhaul Shop, Submarine Training Center, Building 39*, HABS No. HI-305. August, 1996.

Commander, Navy Region Hawaii. *Pearl Harbor Naval Complex, Cultural Resources Management Plan*, Pearl Harbor, HI, 2000.

De Yarmin, Ray. *The History of the Naval Submarine Base Pearl Harbor Hawaii*. Pacific Submarine Museum, Pearl Harbor, HI. 1984.

Dictionary of American Naval Fighting Ships accessed on May 13, 2005 at http://www.history.navy.mil/danfs/index.html.

Ford Island Dad's Club. *Ford Island, Past and Present; a picture story of the United States Navy on Ford Island from 1923 up to the present day,* n.d. Compiled, edited and produced by the Ford Island Dad's Club.

Freidman, Norman. *U. S. Submarines Since 1945*. Annapolis, MD: Naval Institute Press. 1994.

Jennings, G.P. Letter to Peter Young, Chairperson & State Historic Preservation Officer, Department of Land and Natural Resources, State Historic Preservation Division, regarding Section 106 responsibilities pursuant to demolition of the missile-training tower on Facility 39, dated May 24, 2004.

Merrill, J. and Wyld, L. *Meeting the Submarine Challenge*. Washington, D.C.: GPO. 1997.

Navy Office of Manpower and Personnel Classifications. accessed on May 6, 2005 at http://buperscd.technology.navy.mil/bup_updt/508/OfficerClassification/ii/C_11_2.htm.

Parsch, Andreas. "Lockheed UGM-27 Polaris Lockheed UGM-73 Poseidon." *in Directory of U.S. Military Rockets and Missiles* accessed on 5/6/05 at http://www.designation-systems.net.

Polaris A1 - United States Nuclear Forces. Accessed on May 3, 2005 at www.fas.org/nuke/guide/usa/slbm/a-1.htm.

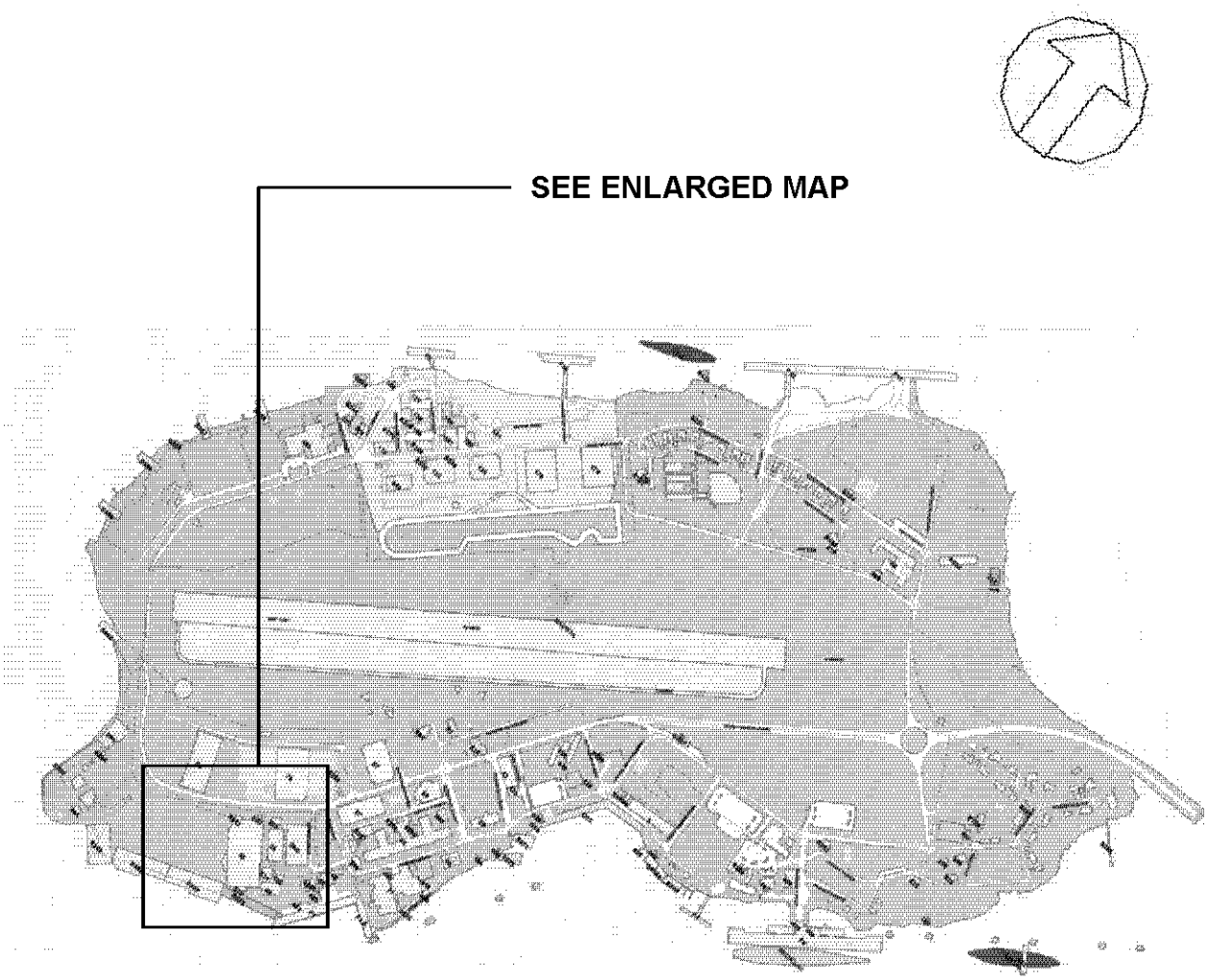
Poseidon C3 - United States Nuclear Forces, accessed on May 1, 2005 at www.fas.org/nuke/guide/usa/slbm/c-3.htm.

United States Naval Nuclear Fleet Ballistic Missile Submarine Fleet (by Class), accessed on May 5, 2005 at http://www.subnet.com/fleet/ssbnflt.htm.

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

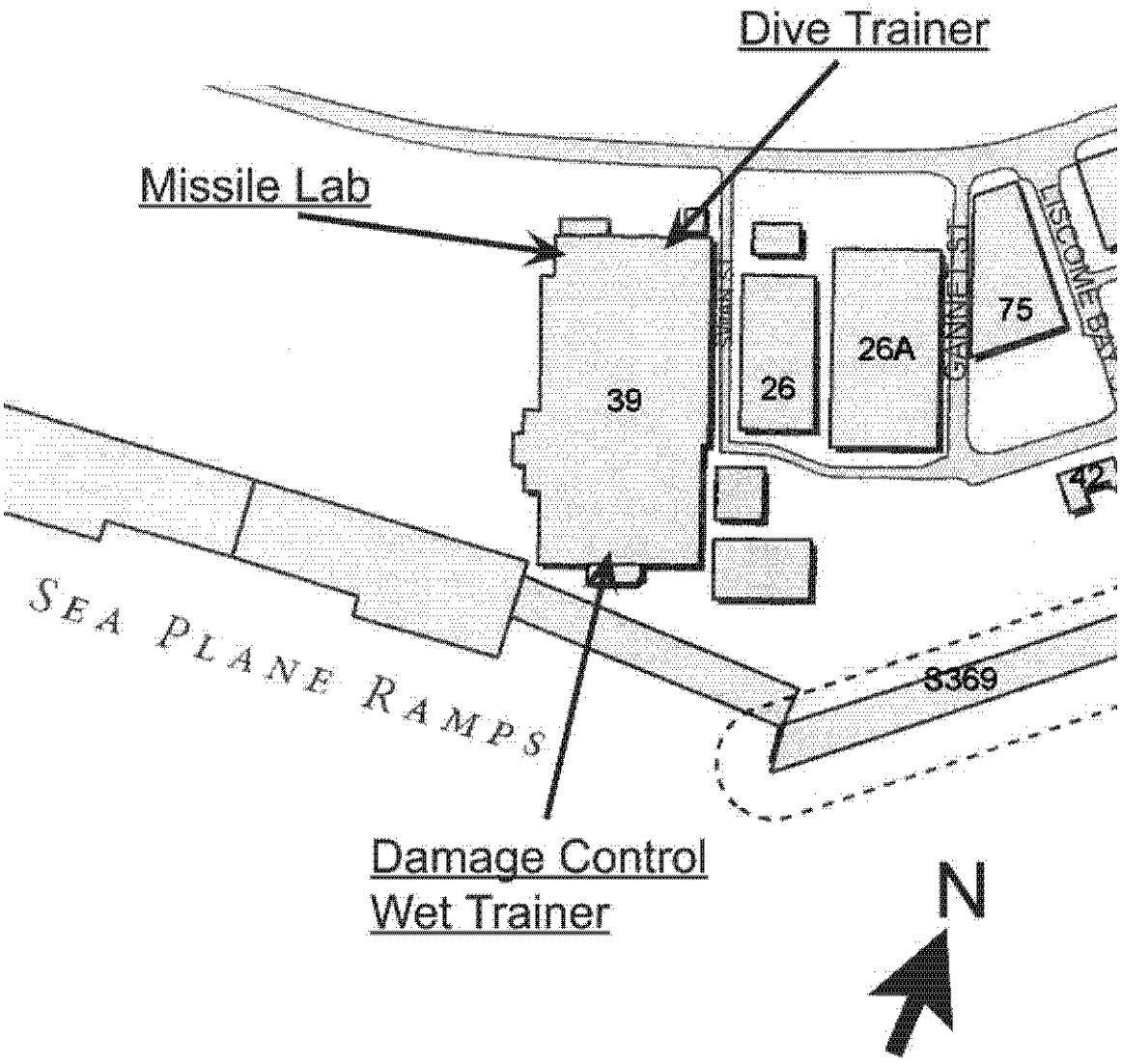
West, Walter. *Adventure in Partnership; The Story of the Polaris*, 1963. Danbury, CT.

Ford Island Map

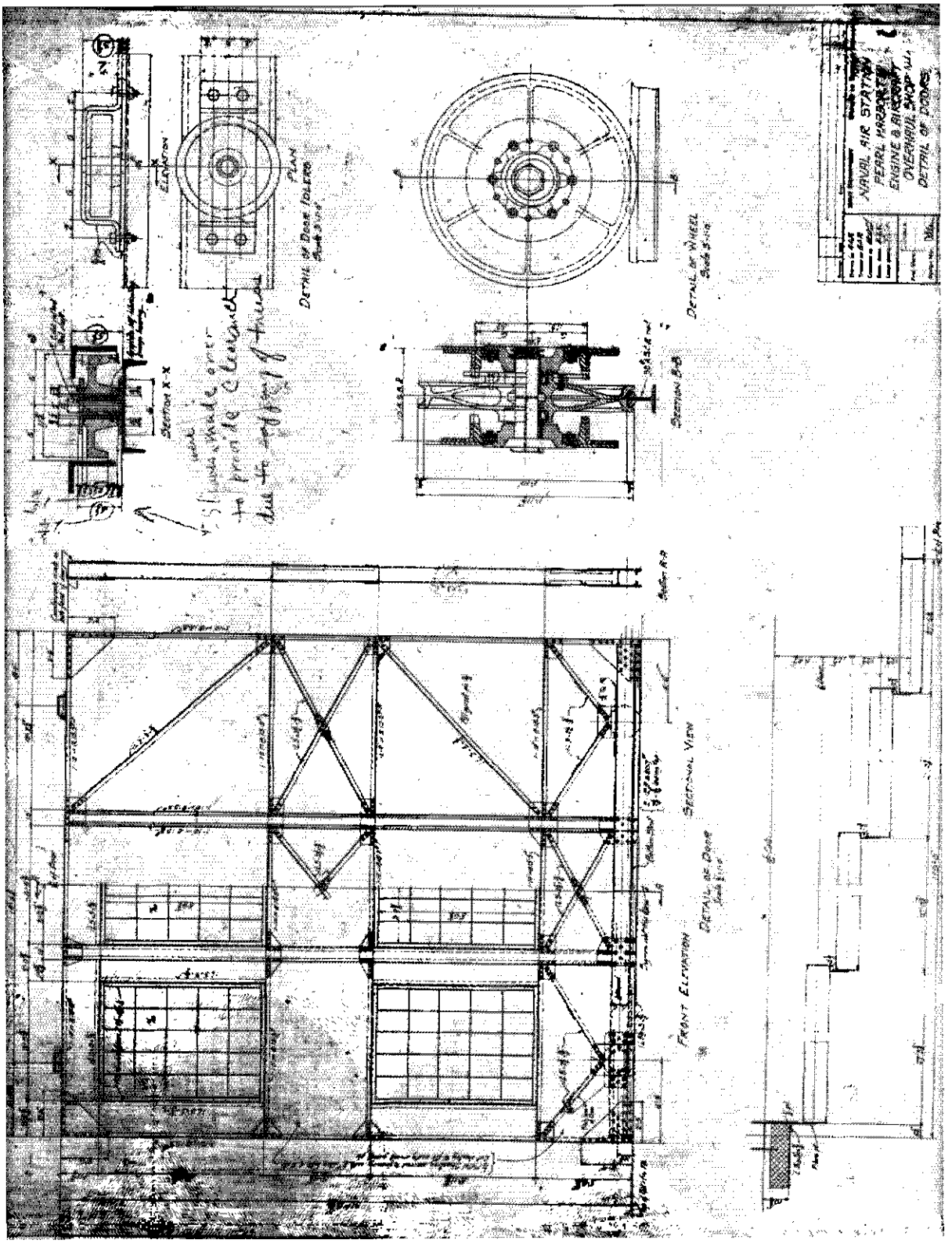


Enlarged Map: Location of Facility 39.

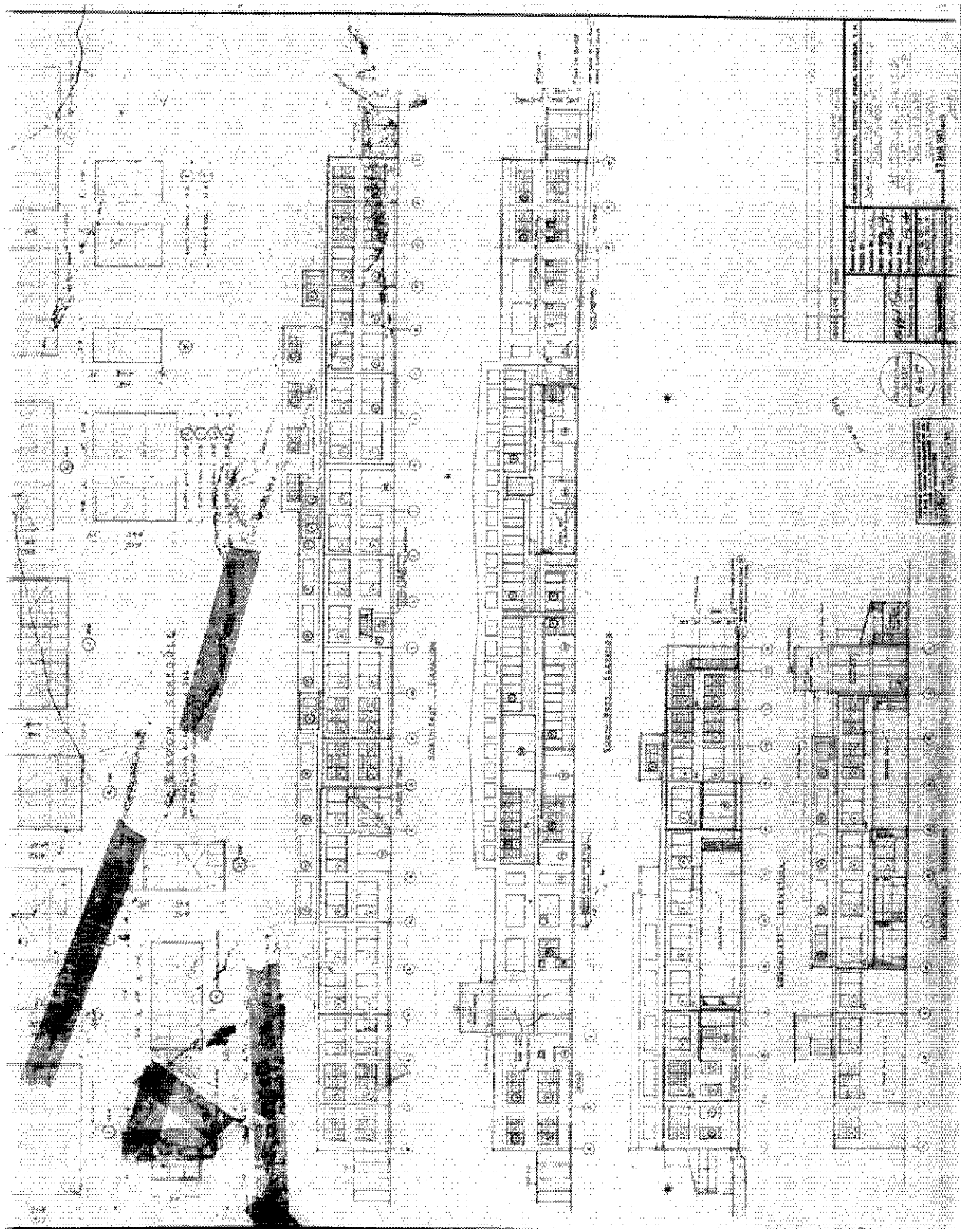
Showing approximate locations of areas within the building that are covered in this report.



Detail of Doors
(Drawing No. 112624, dated Dec. 4, 1931) (reduced, not to scale)



Addition to Engine and Aircraft Overhaul Shop - Elevations
(Drawing No. V-N10-599, dated Mar. 17, 1943) (reduced, not to scale)



Addition to Engine and Aircraft Overhaul Shop – First Floor Plan
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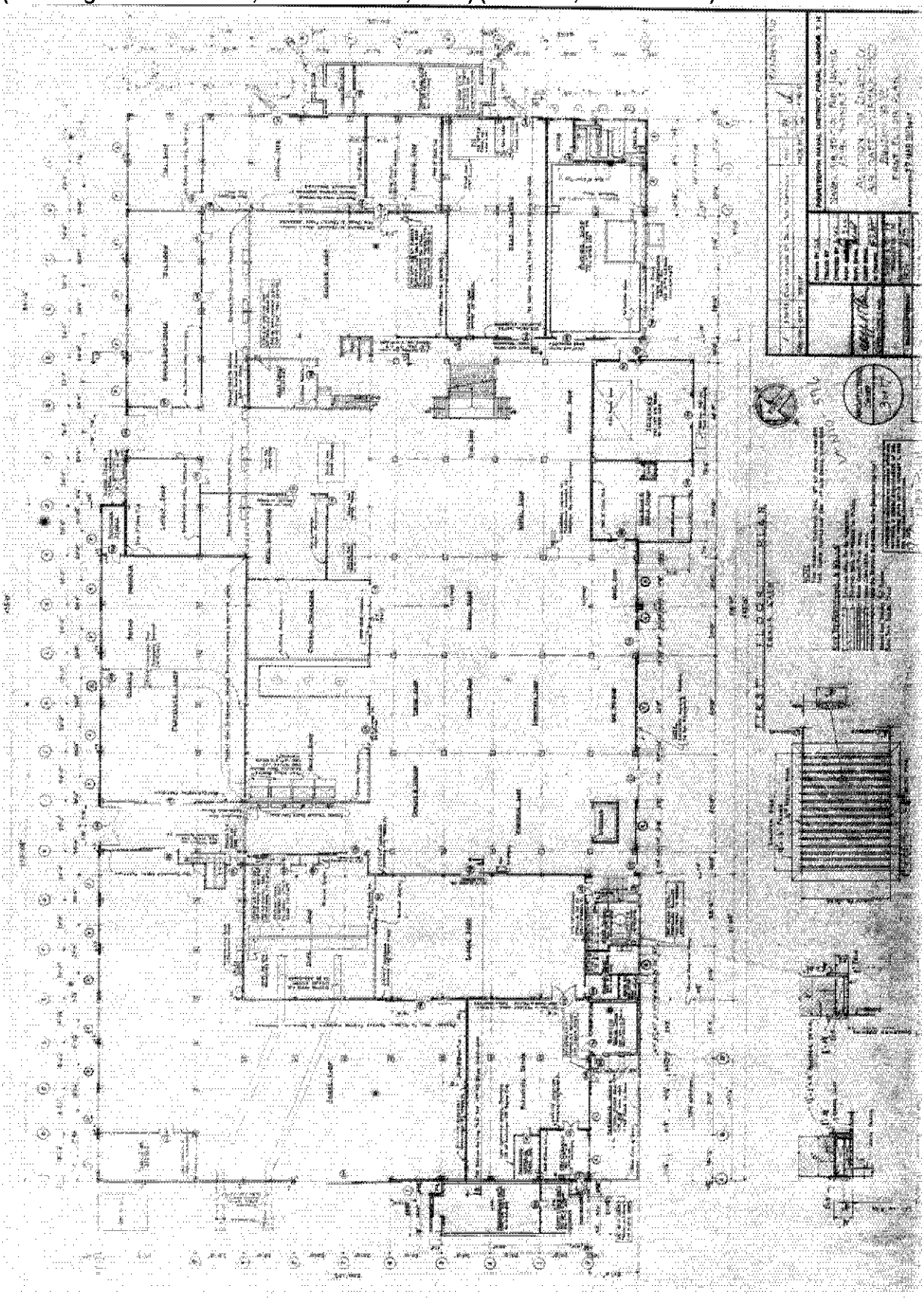

Addition to Engine and Aircraft Overhaul Shop – First Floor Plan
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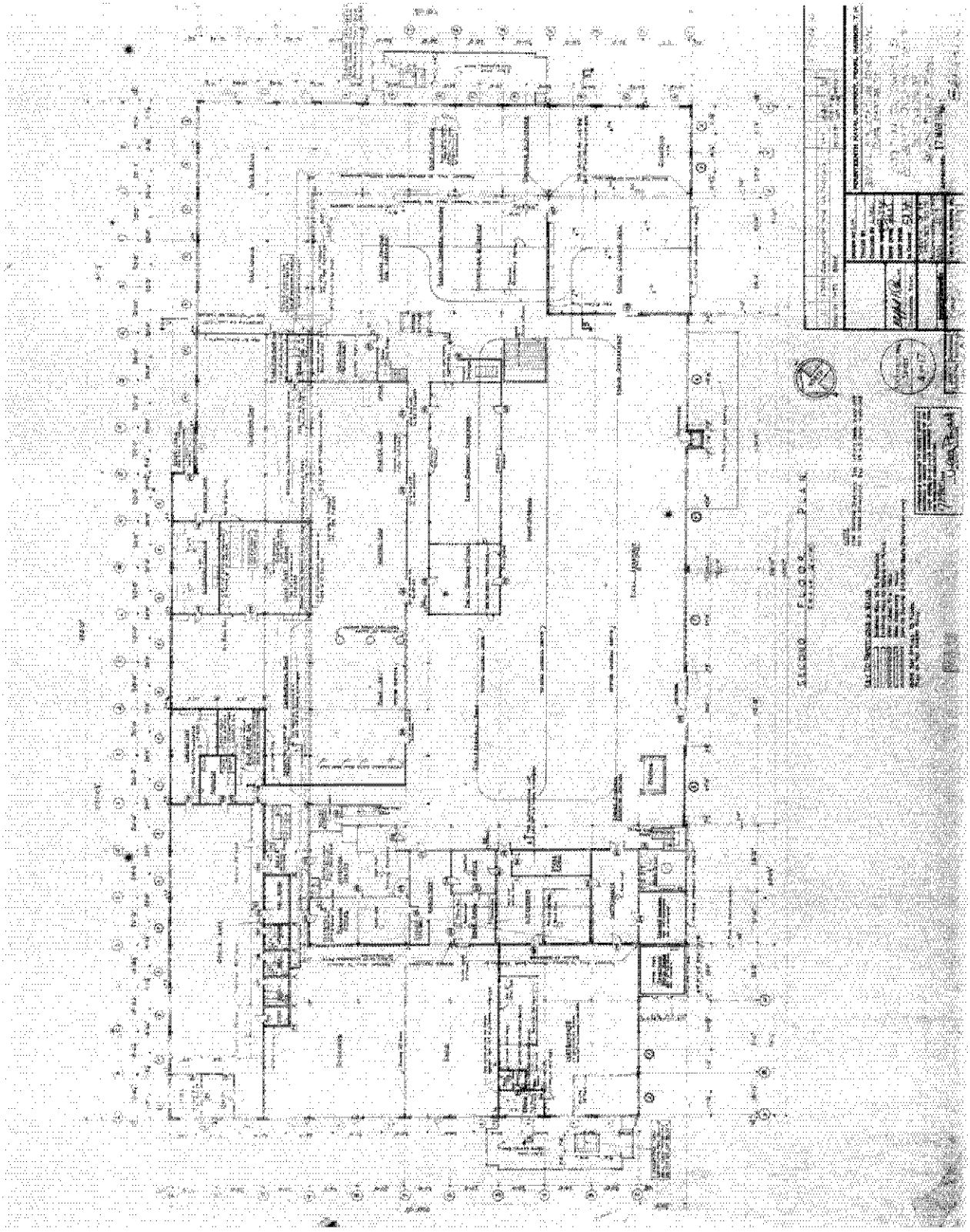
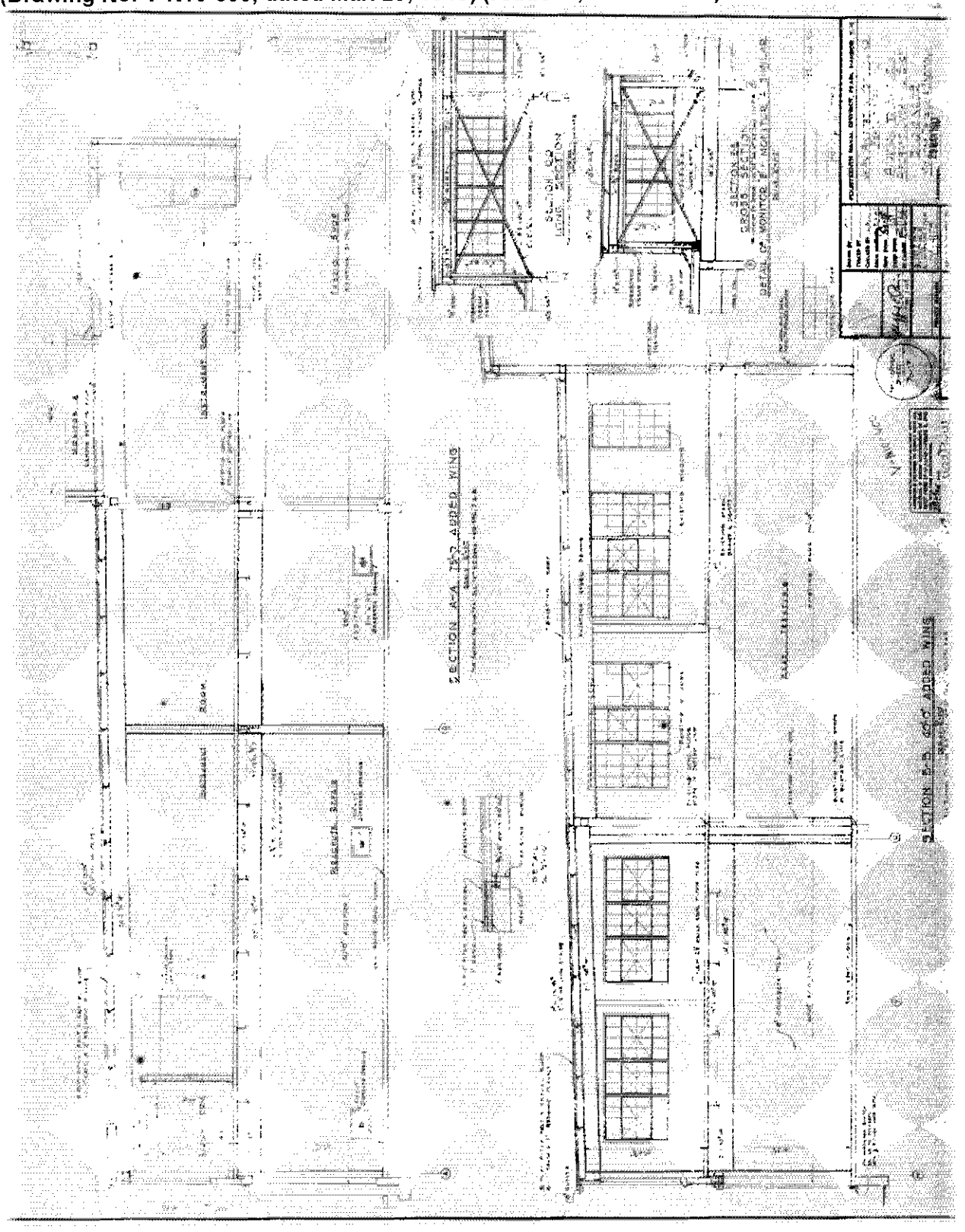
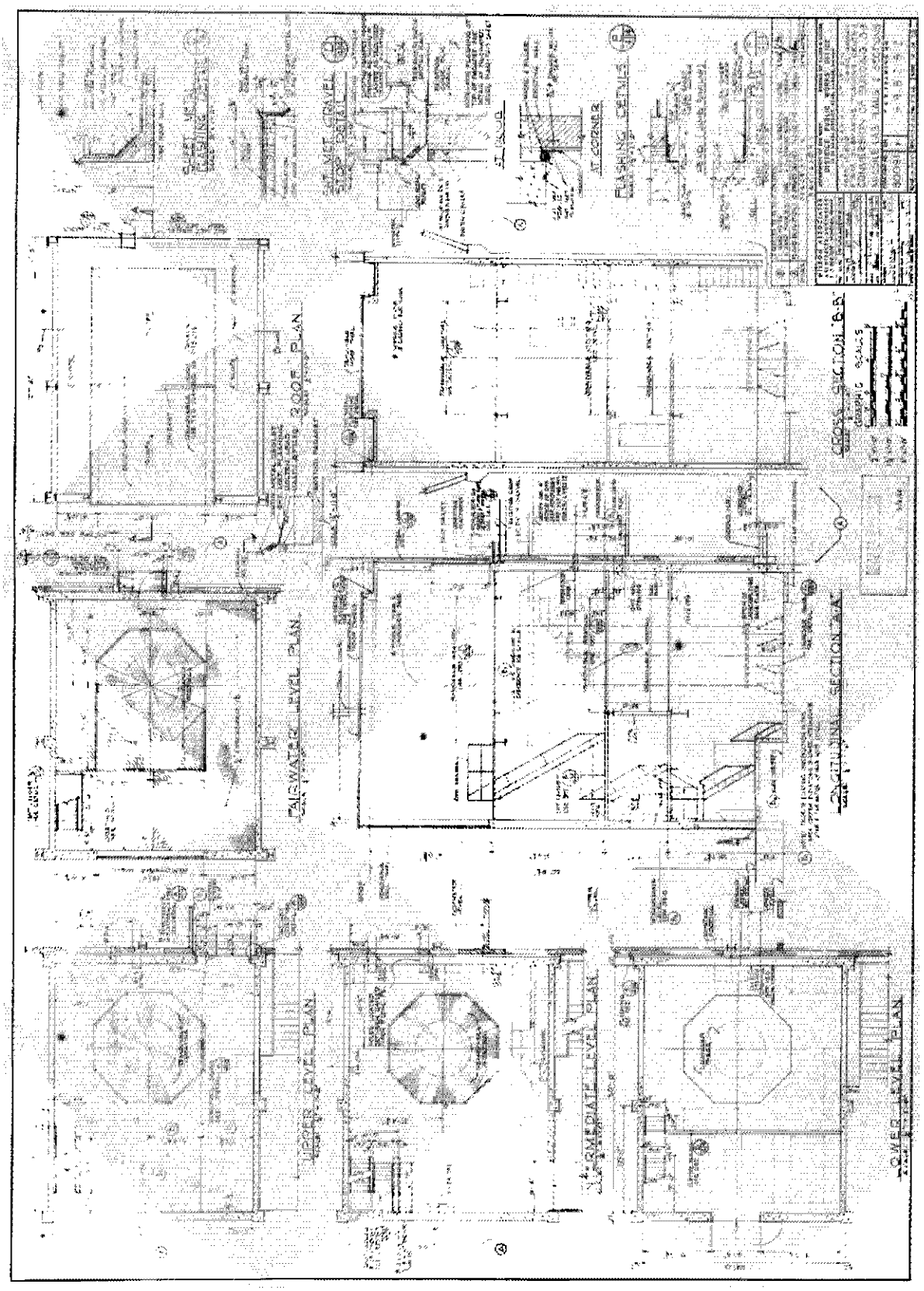


Addition to Engine and Aircraft Overhaul Shop – Monitor Details and Sections (Drawing No. V-N10-600, dated Mar. 29, 1943) (reduced, not to scale)



Conversion of Building 39 – Missile Lab Plans and Sections
(Drawing No. 998282, dated Mar. 28, 1963) (reduced, not to scale)



Conversion of Building 39 – Framing Plans and Details
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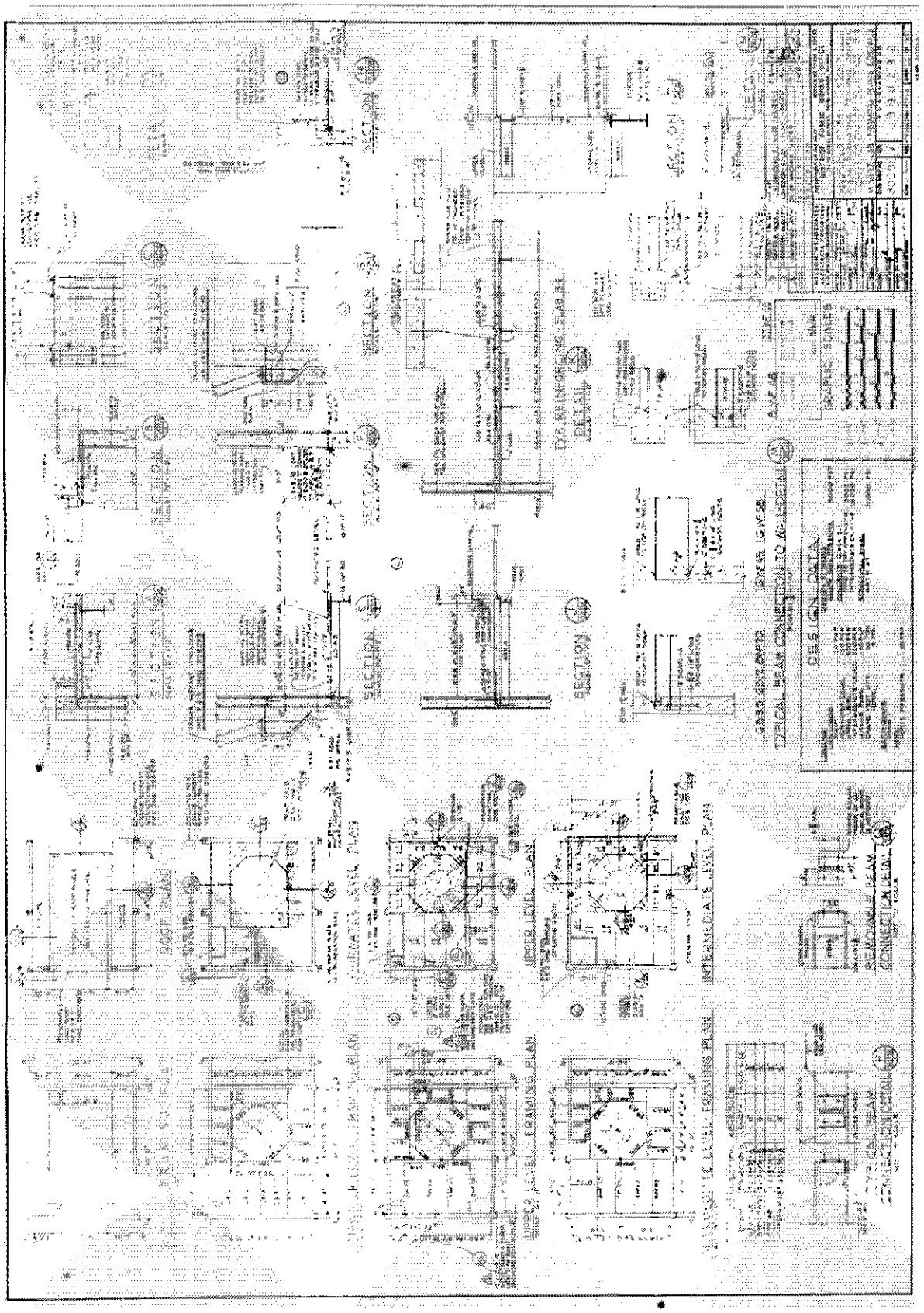

Conversion of Building 39 – Missile Lab Foundation Plans and Details
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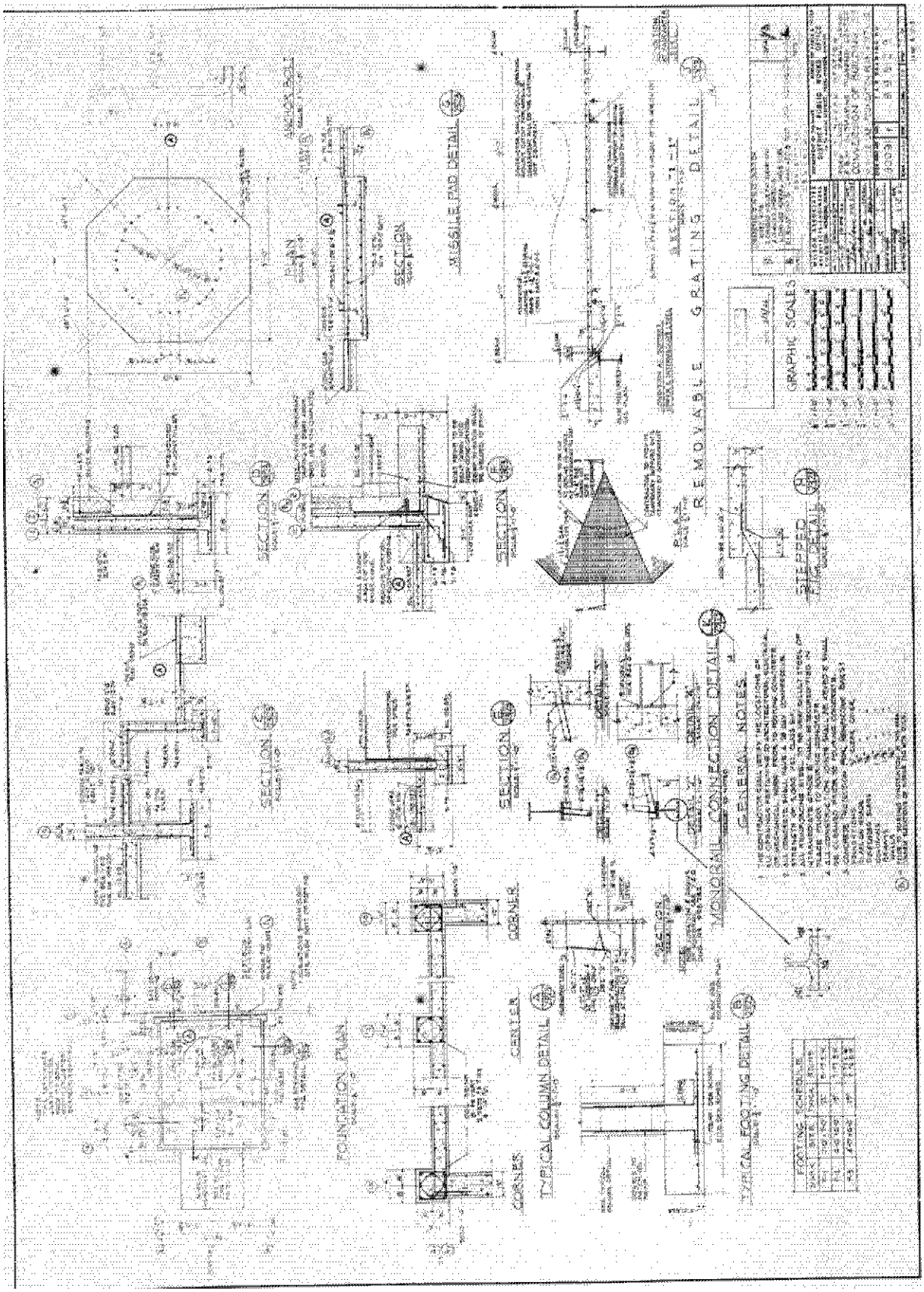
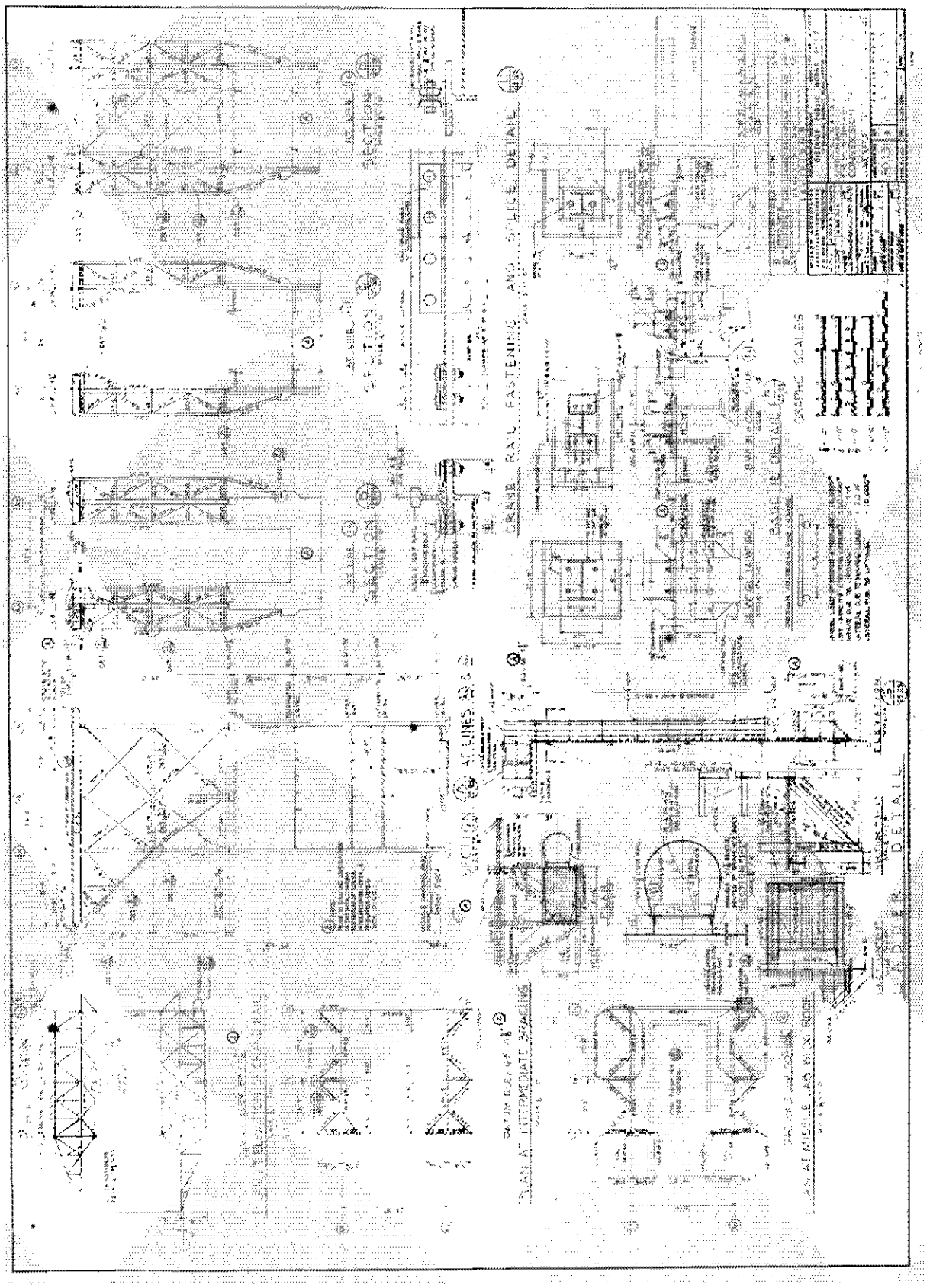


Conversion of Building 39 – Crane Support Structure Framing, Plans & Details (Drawing No. 998293, dated Mar. 28, 1963) (reduced, not to scale)



Conversion of Building 39 – Crane Support Structure Details
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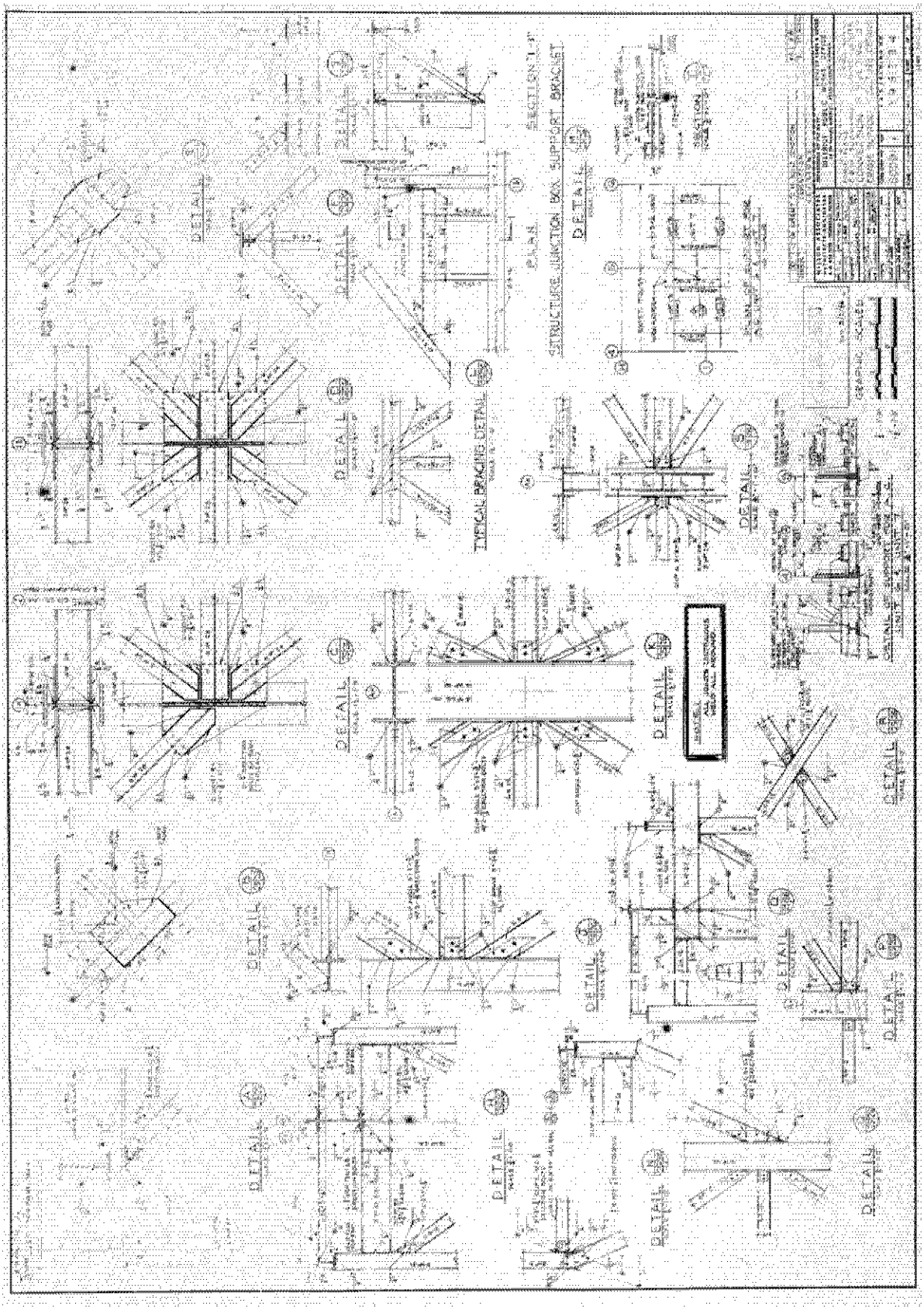
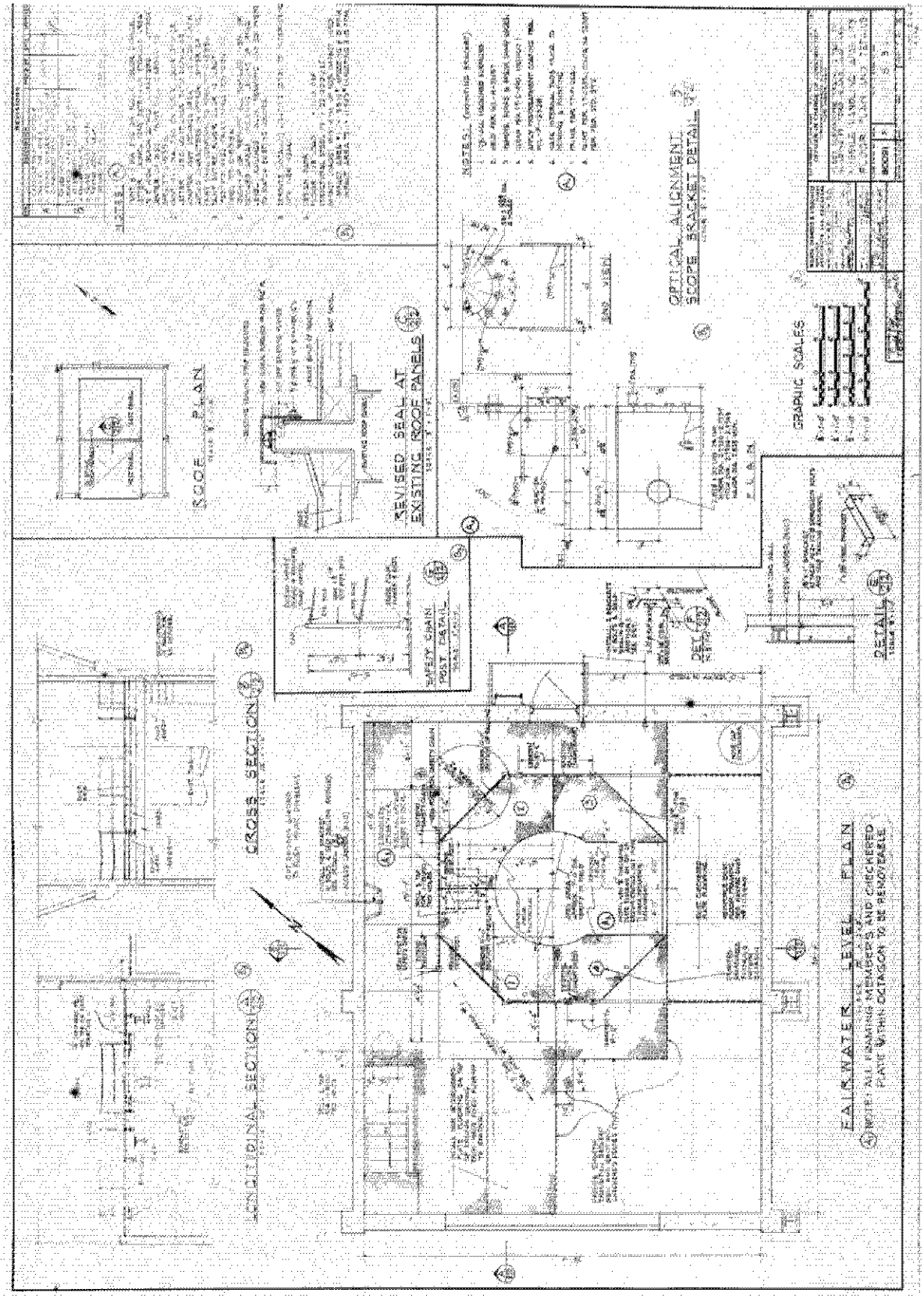
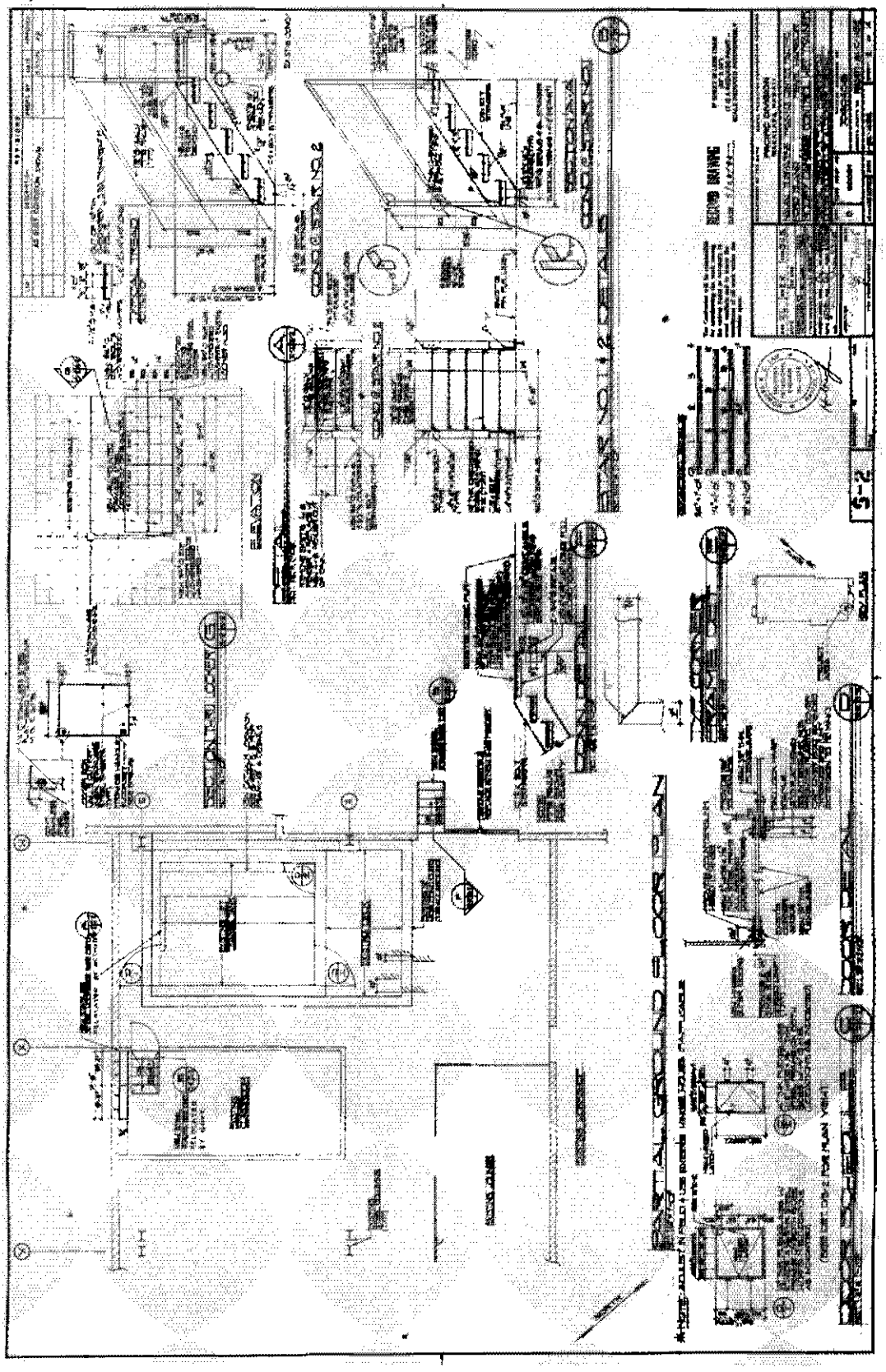


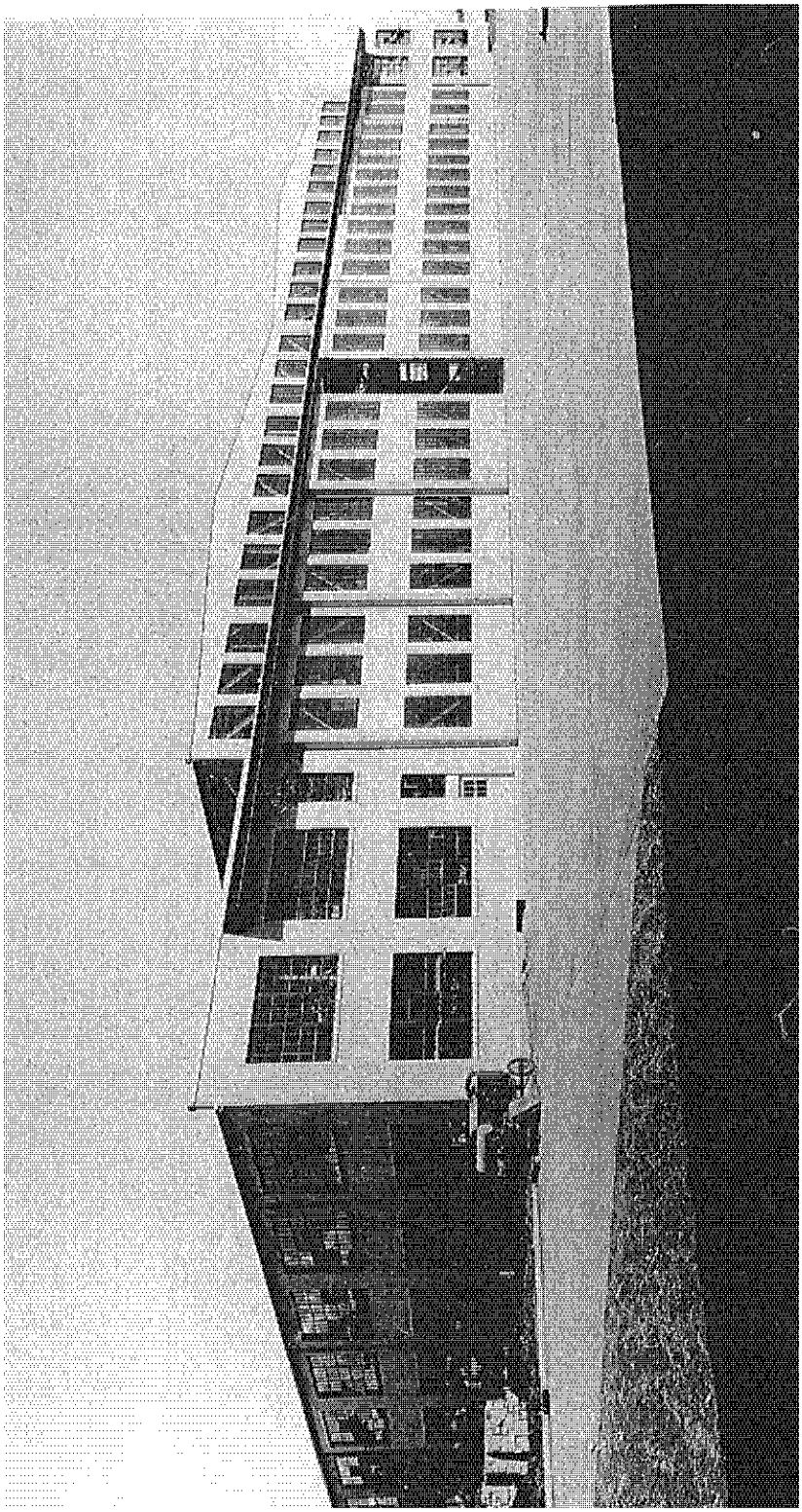
Missile Handling Capability – Floor Plan and Details
(Drawing No. 1118134, dated Dec. 17, 1965) (reduced, not to scale)



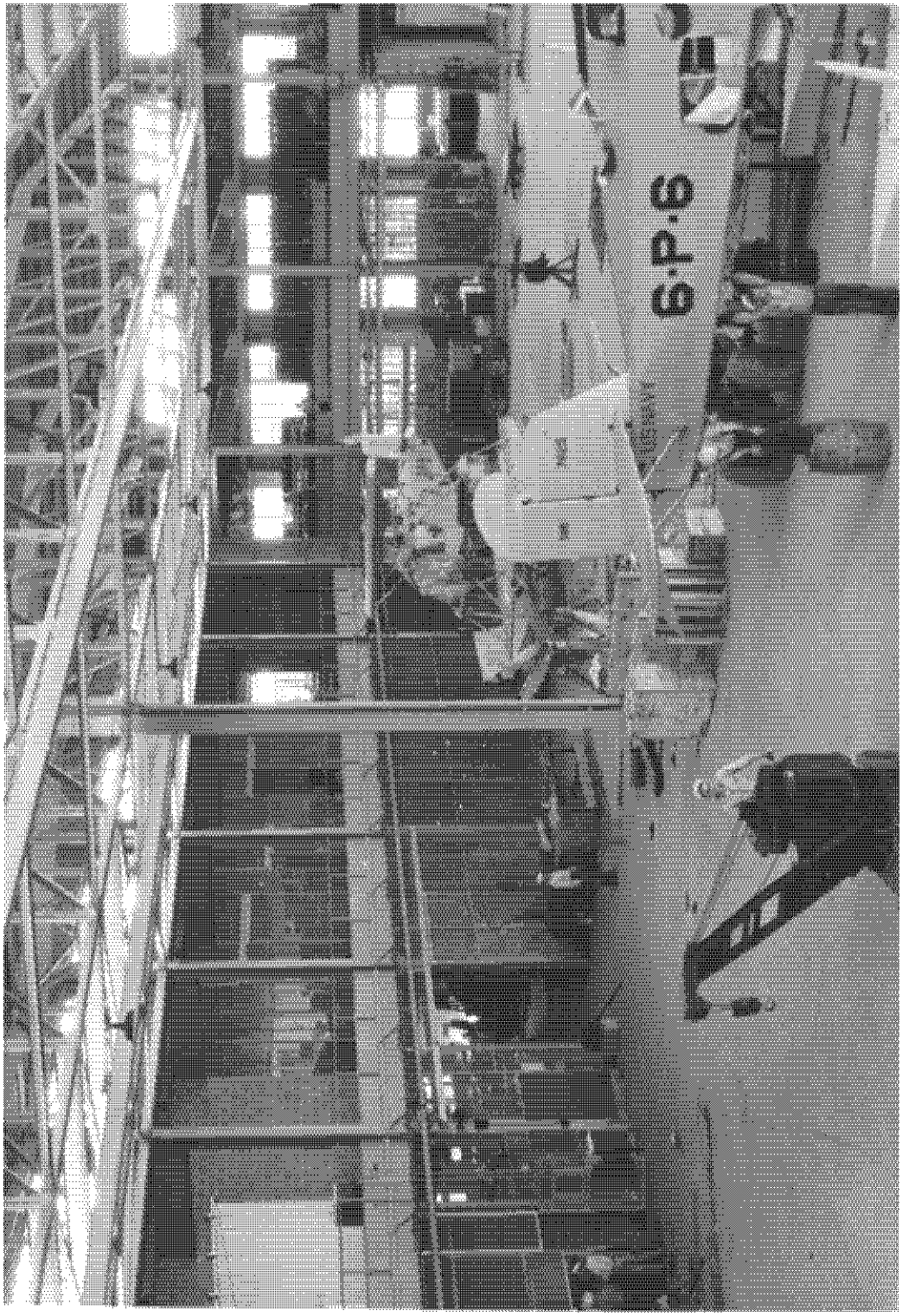
Modify Damage Control Wet Trainer – Partial Ground Floor Plan Stair Detail, Door Schedule and Locker Detail (Drawing No. 7060408, dated Jan. 31, 1985) (reduced, not to scale)



General view of the southwest-facing long side of the nearly completed facility on December 1, 1932. The northwest-facing end extends to the left. Photograph from the 14th Naval District Historic Photograph Collection, No. 10307.



Interior view showing the mezzanines and double-height hangar space dated June 2, 1933. Photograph from the 14th Naval District Historic Photograph Collection, No. 10471.



Rear extension under construction. Photo dated January 8, 1943. Photograph from the National Archives, Record Group RG71-CA-154, photo No. 318032.