Wright-Pierce

PRELIMINARY DESIGN REPORT

FOR

MONHEGAN ISLAND WHARF

SUBMITTED TO

MONHEGAN ISLAND PLANTATION, ME.

[redacted]

JULY 1988

July 11, 1988
W-P Project No. 6045

WRIGHT-PIERCE ENGINEERS

CORPORATE OFFICE
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Topsham
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Mr. Willard Boynton
First Selectman
Monhegan Island Plantation
Monhegan Island, Maine 04852

Dear Mr. Boynton:

We are pleased to submit 6 copies of our preliminary engineering report. Comments received from the final draft of our report have been reflected in the report.

It has been a pleasure to work with you on this project. We look forward to the opportunity to serve you in the future.

Please feel free to contact us with any questions you may have.

Sincerely,

WRIGHT-PIERCE

Mark Gray

Mark Gray, P.E.
Chief Structural Engineer

MG/pd

Enclosure

Portsmouth, N

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Financial assistance for preparation of this document was provided by a grant from Maine's Coastal Program, through funding provided by U.S. Department of Commerce Office of Ocean and Coastal Resource Management, and under the Coastal Zone Management Act of 1972, as amended.

Introduction

The plantation of Monhegan is an island of approximately 500 acres located 12 miles southerly of Port Clyde, Maine. Island population varies from several hundred in the summer months to less than 100 during the winter. The economy is based on tourism and fishing.

The wharf serving the Island was rebuilt in its present form about 50 years ago. Granite blocks of about 10 ton size comprise much of the wharf face which is about 120 feet long and 55 feet wide. The surface of the wharf is about 13 feet above mean low water and the harbor bottom is about 10 feet below mean low water at the west face.

The lifeline of Monhegan Island is the wharf. Virtually everything and everyone coming onto or leaving the Island must use the wharf. Food, clothing, building materials, medicine, consumer goods, fish, tourists and residents all are funneled onto and off the Island via the wharf.

Maintenance costs have been high for the wharf structure. The gravel surface washes off and down through the wharf during storm events. Replacement gravel at 8.00 per cubic yard on the mainland is closer to 30.00/cubic yard after being transported by barge to Monhegan Island. Over topping of the south west end of the wharf may occur two or three times or more in a season, especially during the winter months.

The timber frame supported hoisting mechanism which raises and lowers the loading/unloading ramp to adjust it to tide level is old and worn. The timber frame is decayed and needs replacement. The ramp structure itself is less than five years old of aluminum construction and in good condition.

Two fuel tanks are sited on the wharf surface but lack positive hold down and provisions for spill containment.

The Plantation of Monhegan Island plans to apply for a Waterfront Action Grant to assist them in funding needed improvements to their wharf.

Wright-Pierce Engineers was retained to provide a preliminary engineering study to recommend a program which will help to meet those needs. The maximum grant when matched with local funds yields a total budget for construction and final design activities of$75,000.00. The recommendations made in this report are made recognizing this constraint.

Data Gathering

Monhegan Island was visited on April 12, 1988. Limited survey data was gathered. Spot elevations on the wharf and on the harbor bottom along the face of the wharf were obtained. Cloth tape measurements of topographic features were taken. Color print photographs were taken of the wharf structure and its features.

Test pits excavated on the wharf surface were observed and photographed. Discussions were held with numerous interested island residents and users of the wharf.

Limited wind and wave observations for the Gulf of Maine were obtained from the National Weather Service in Portland.

The State of Maine ferry terminal in Rockland was visited and its personnel interviewed. J.W. Penny and Sons in Mechanic Falls was visited and various mechanical systems to raise and lower the wharf slip were discussed. Supplier's data was researched and internal discussions were held regarding possible approaches to identified wharf problem areas.

Wharf Issues

The following issues have been identified regarding the Monhegan Island Wharf. They are listed here for convenience and will be addressed individually in later sections.

- Surface erosion of the gravel surface of the wharf due to wave action with consideration given to the possible impact of raising the wharf surface on this problem.
- Stability and operational ease of the wharf slip (loading and unloading ramp).
- Wharf fuel tank stability including provisions for potential spill containment.
- General upgrading of fender piling, railing and ladders.

Wharf Surface Erosion

The Monhegan Island Wharf is a granite block wall solid fill pier structure filled with smaller sized pieces of stone, sand and gravel. Test pits reveal (see Figure 2) that the gravel pad is about three feet thick over the wharf surface. Below this level, larger stones bridge in a progression of larger stone size with depth. Significant sized voids occur under the three foot thick gravel layer. The sea water circulates freely under the wharf structure as evidenced by the fresh seaweed pulled from the test pit excavation next to the freight shed (see Figures 9 & 15).

The top of the cap log is approximately 13.5 feet above mean low water, 4.7 feet above mean high water and 3.4 feet above spring tide levels. The harbor bottom is about 24 feet below the cap log elevation off the west face of the wharf.

Loss of gravel from the surface occurs in several ways. Waves from the south wash against the south west corner of the wharf several times a year and slosh sea water onto the wharf surface. Water draining off the surface carries material with it between the cracks in the granite blocks under the cap log. The same water falling vertically through the gravel pad carries fine material with it into the open void stratum of the wharf and into the harbor. Differential pressures caused by wave action on the underside of the gravel pad create a pumping action which locally dislodges soil which progressively loosens the material above, causing localized sink holes in the wharf. In a severe storm condition from the south at high tide, waves can actually reach a height sufficient to wash over the top of the wharf and transport large quantities of material.

It has been suggested that raising the level of the wharf might diminish erosion of the wharf surface. If the surface of the wharf were raised high enough, overtopping of the wharf could be prevented. However, other mechanisms of material loss would remain.

If the wharf elevation were raised, wave energy absorbed by the wharf face would increase dramatically as would lateral forces on the wharf face from internal soil and hydrostatic pressures. Probably most importantly, the utility of the wharf would be adversely affected as loading/unloading boats from the side of the wharf would be harder due to the greater height. The ramp would have to be lengthened and raised in order to serve the new wharf elevation having the effect of diminishing the available surface area available on the wharf. Raising the wharf elevation, if feasible structurally, would also entail considerable expense - well beyond budgets currently contemplated. It is our opinion that raising the elevation of the wharf is not advisable.

Another suggestion for retaining material within the wharf structure involves constructing a sheet pile wall around the present wharf. This approach, while difficult due to the shallow bedrock present, is feasible. However, this approach would be very costly and well beyond the budgets being contemplated.

The wharf structure in its present form has served Monhegan well for over 50 years, weathering even the major storm of february 1978 without major damage to the primary structural system (most damage was due to loss of material from within the wharf). The infrequent overtopping of the wharf surface can be accommodated by minimizing loss of fill materials.

The approach recommended by this report is as follows:

1. Install a rodent resistant filter fabric barrier under the 3 foot thick gravel wharf surface.

2. Construct a concrete cap about 1-0" thick and 4'-0" wide, doweled into the granite, around the perimeter of the wharf to provide continuity with the filter fabric base and to provide a uniform continuous base for the cap log.

3. Remove and reset the present cap log on intermittent 4x12 timbers to allow free drainage of water off the surface of the wharf.

4. Wrap the filter fabric around the top of the gravel pad and cover with 6" of gravel material.

5. provide a few 36"x36"x8" concrete paving units with lifting eyes on the southwest end of the wharf to assist in retention of material in this problem area with an ongoing program to add paving units on an annual basis to the rest of the wharf surface.

6. Transition to a 3/4" crushed stone material for use in repairing and replacing lost surface material.

This approach begins to address the transport of material vertically through the wharf and downward under the cap log between the joints in the granite blocks as well as pumping action/sink hole generation. Time would be needed for the wharf surface to become more fully stabilized as a portion of the gravel pad material must be left below the initial installation of the filter fabric to avoid damaging lower levels of the wharf structure during excavation activities. Over time, the above mechanisms of material transport can be controlled.

Paving the wharf surface with half ton paving stones will ultimately control the overtopping transport mechanism. Budgets will not allow paving of the entire wharf structure. However, the paving approach recommended would allow additional pavers to be added each year on an ongoing basis so that eventually the entire surface could be paved. The individual paving blocks can also be removed and reset as circumstances dictate.

It should also be noted that simply replacing transported surface material as it is lost is a possible approach to the maintenance of the wharf. Possible negative aspects to this approach might be the need to dredge around the wharf at some time in the future and the ongoing need to maintain the surface in a timely fashion immediately after surface material losses.

The recommended approach is in line with the resources which can be brought to bear.

Wharf Slip Operator

The wharf slip (see Figure 2) or loading/unloading ramp is a 7'x30' aluminum platform hinged on the east end and supported on the west end by cables attached to a counter weight and to chain falls. The chain falls are operated by a manually powered pulley and chain mechanism connected to a continuous loop pull chain (see Figures 12 & 13 for photographs.) The counterweight, chain falls and operating mechanism are supported by a timber frame. The operating mechanism requires considerable effort to raise the ramp as it is worn and frequently slips and jambs. Chain falls are not designed to be reliable enough to support structures carrying people. Although no problems have been reported, other lifting methods would be more desirable. The timber frame has considerable dry rot. We recommend replacement of the entire wharf slip operating system, including supporting framework.

Several approaches have been suggested by Island residents as possible replacements to the present system. A primary requirement of the replacement system is that it be capable of being operated with electric power, as well as manually in case of power outage.

Two suggestions involve the use of hydraulics. One places rams mounted on the wharf surface which operate a system of pulleys which guide cables which raise and lower the ramp. A remotely located hydraulic pump driven with an electric motor would provide necessary power via underground hydraulic lines. During power outages, a backup generator would power the electric motor. The second suggestion uses a pair of wharf surface mounted hydraulic motor winches powered by electric motors which raise the slip directly (see Figure 4). Power during outages would be provided with a

backup generator. Disadvantages with hydraulic systems in general are the need to provide spill containment for hydraulic fluid and the lack of viable methods for manual operation.

The system recommended by this report is similar to the system currently in place at Monhegan Wharf and at the Rockland ferry terminal (see Figures 6 & 7) and is shown conceptually on Figure 5. A steel frame supports a counterweight, connected to the end of the ramp via a spreader bar and cables and supports two cable drums on a common shaft playing out cables connected to the ramp. The common shaft is driven by worm gear right angle reducer powered by both an electric motor and another shaft connected to a hand wheel. Manual operation would be possible only after disabling the motor and conversely, power operation would be possible only after disengaging the hand wheel. Advantages of this system are the ability to operate the slip both manually and with power, the system is a proven, widely used approach, and relative economy.

Fuel Tanks

Two cylindrical steel fuel tanks occupy the southeast face of the wharf surface (see Figures 14 & 15) adjacent to the freight shed. The easterly tank rests on a concrete pad and holds approximately 3,000 gallons. The westerly tank rests on a wood frame and holds approximately 2,500 gallons. Neither tank is positively held down to prevent movement or overturning due to earthquake, wind, or wave impact. In addition, no provision currently exists to contain a spill should one occur due to tank leakage. Figure 8 describes a proposed solution which would contain the full contents of the tank if a spill should occur and also keep precipitation out of the containment area.

Necessary costs associated with providing spill containment and positive securement against movement would not be the responsibility of the Plantation of Monhegan Island as the tanks are privately owned.

Other Wharf Elements

Cursory inspection of other elements of the wharf and discussions with residents and persons using the wharf identify other items requiring attention.

The four wood ladders serving the wharf are in need of repair. One or more of the ladders are positioned poorly so that they are inaccessible at low tide or too close to the corner.

Railing along the sides of the slip should be replaced at the time the slip mechanism is replaced to bring it up to height and strength standards.

Fender piling are reported to be deteriorated in places in the intertidal range. Piling immediately adjacent to the slip are worn and should be replaced or built out with dimensioned timber fastened with deeply countersunk fasteners. Consideration should also be given to raising the elevation of some piling along the west wharf face to better serve some vessels under conditions of high tide and heavy seas.

Cost Estimate

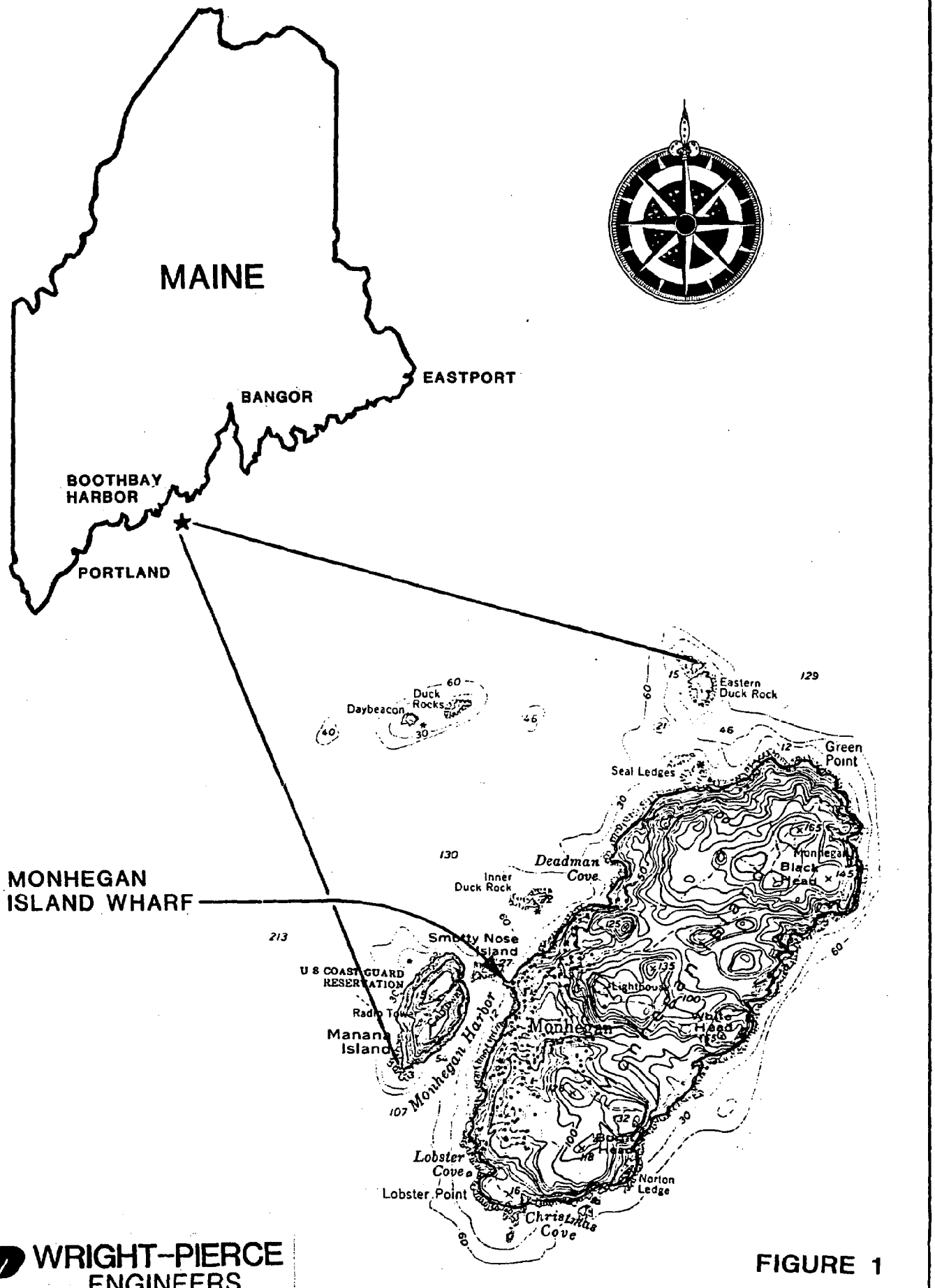
Estimating construction costs for work to be done on Monhegan Island is an uncertain proposition at best. The limited number of contractors who would bid on such work coupled with their perception of the uncertainties involved make precise estimates of cost difficult. However, an attempt has been made to assign costs to each of the program elements listed below.

Mobilization		$10,000.00
Wharf Surface Stabilization		
Excavation & Backfill	375 CY	2,500.00
Filter Fabric	12,000 SF	2,500.00
Concrete Cap	50 CY	20,000.00
Reset Cap Log	210 LF	600.00
Concrete Pavers	45 EA	3,400.00
Wharf Slip Operator Replacement		
Mechanism	1 EA	8,500.00
Frame & Roof	1 EA	3,000.00
Power Distribution	200 LF	1,000.00
Ladders	2 EA	600.00
Piling	6 EA	1,800.00
Railing	60 LF	2,400.00
	Subtotal	$56,300.00
	Add 25% Contingencies	14,075.00
	Add 25% Engineering for Final Design	14,075.00
	Budget Total	$84,450.00

This program appears to address the issues identified, close to the budgetary constraints.

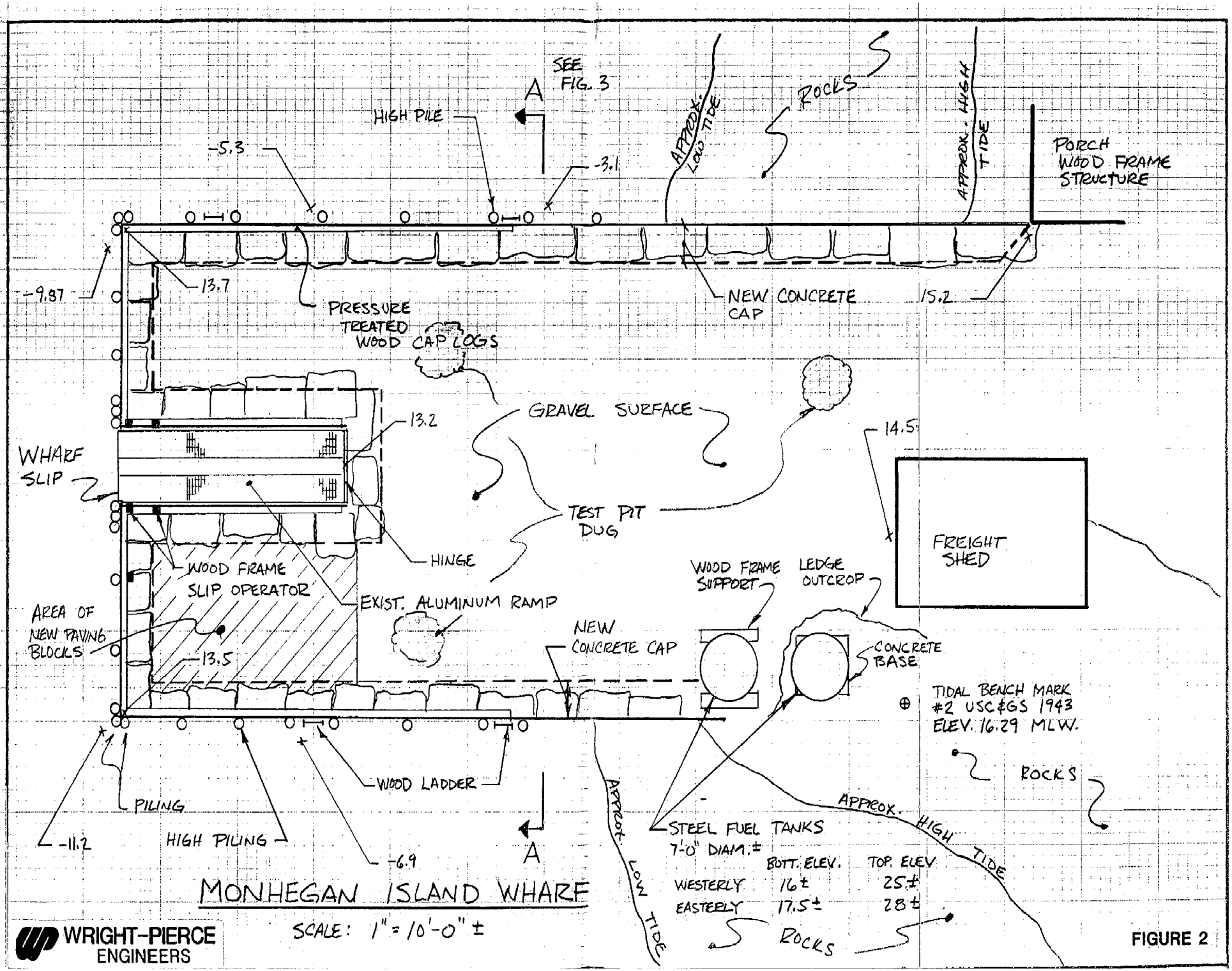
Recommendations

Monhegan Island's granite wharf structure is sound and serves the needs of Monhegan Island well. No change in elevation of the wharf surface is recommended. The mechanism which raises and lowers the ramp in the wharf slip and the timber frame which supports it is recommended to be replaced. The replacement system would be similar to the present one in concept with improvements in material and design. The railing around the slip should be replaced to bring it up to accepted standards. Wood piling and ladders should be repaired or replaced as necessary. Wharf surface stabilization measures as outlined in the report are recommended.



WRIGHT-PIERCE ENGINEERS

FIGURE 1



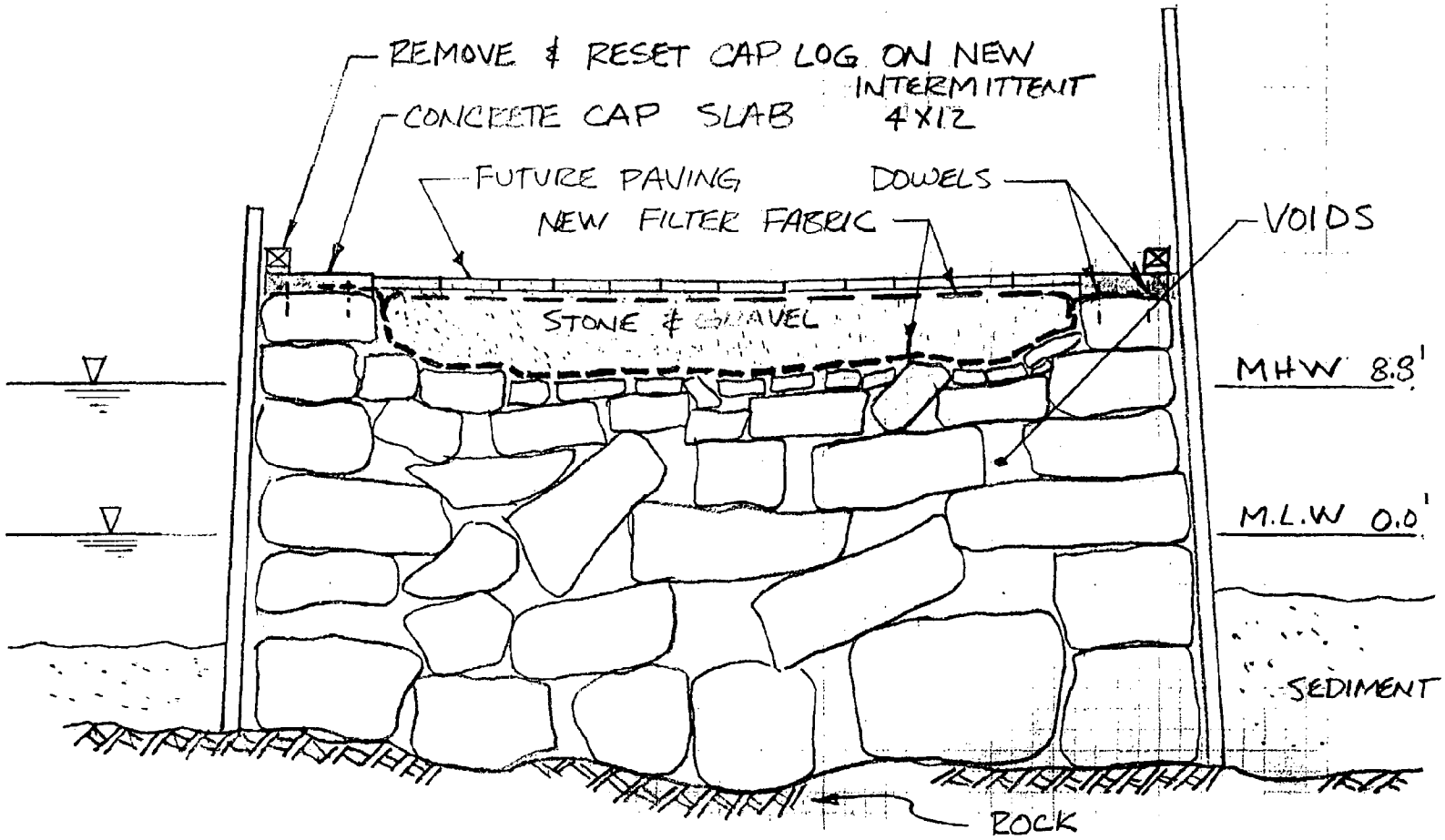
MONHEGAN ISLAND WHARF

SCALE: 1" = 10'-0" ±

WRIGHT-PIERCE ENGINEERS

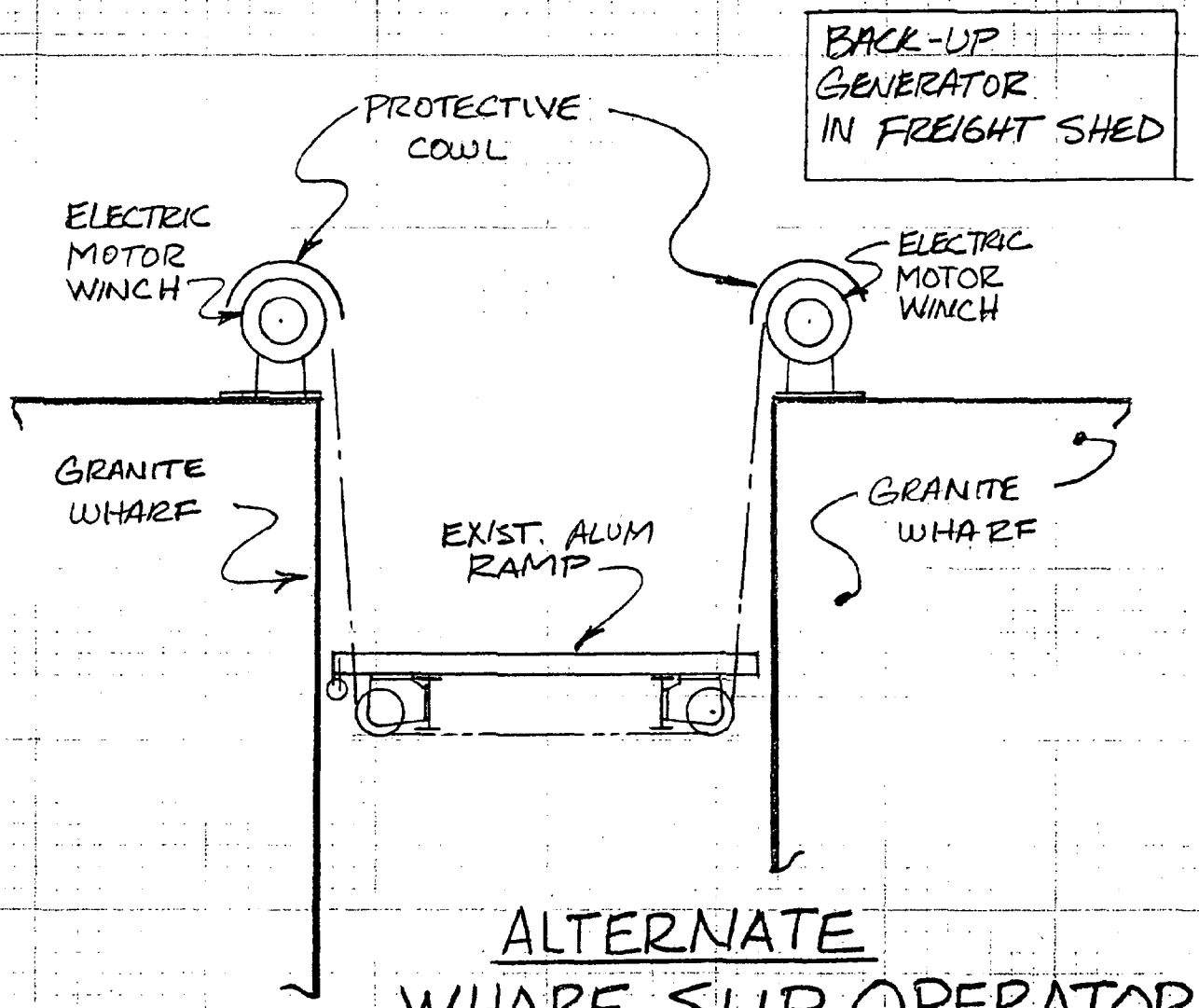
FIGURE 2

WRIGHT-PIERCE
ENGINEERS



SECTION A-A

FIGURE 3



ALTERNATE WHARF SLIP OPERATOR

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FIGURE 4

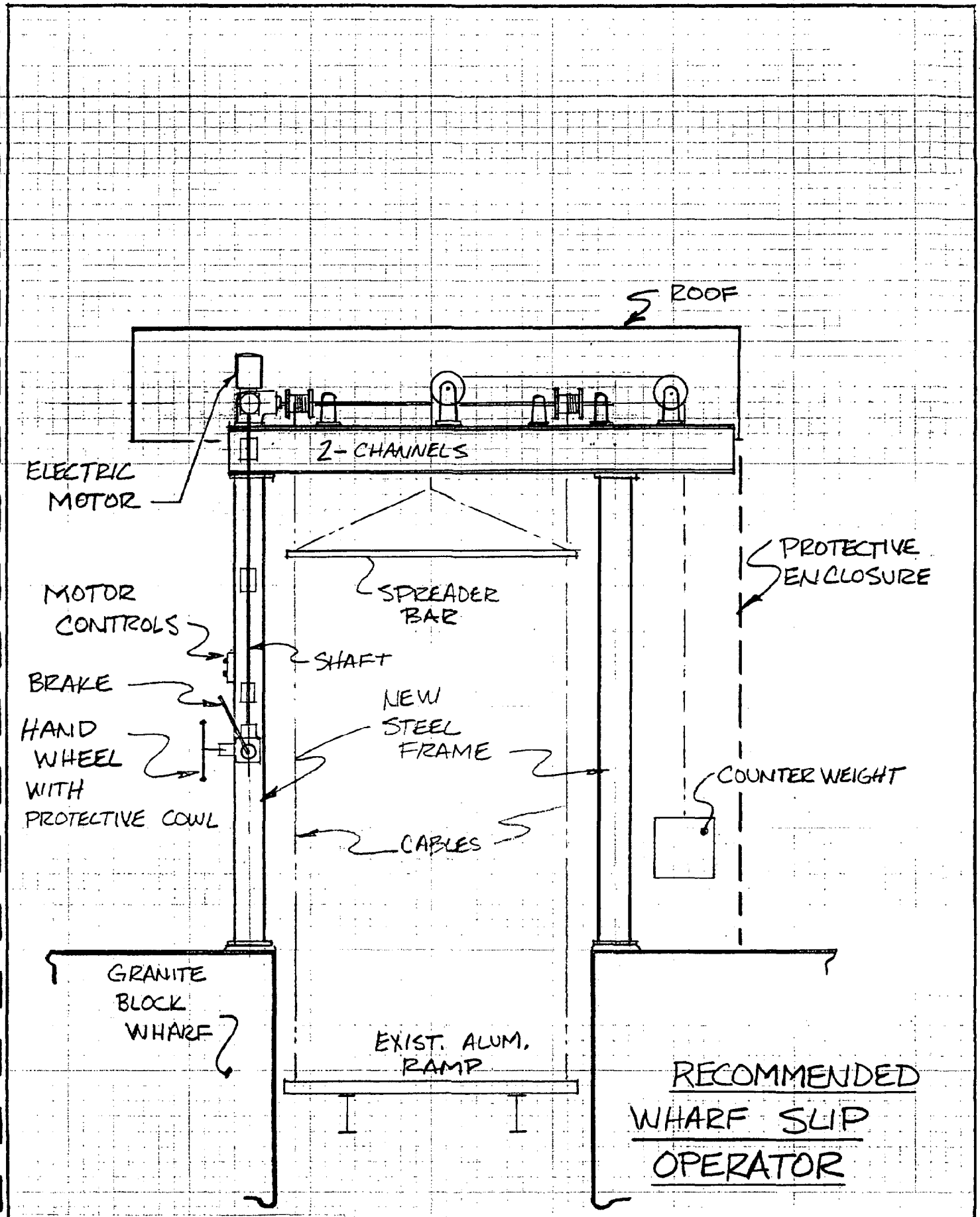

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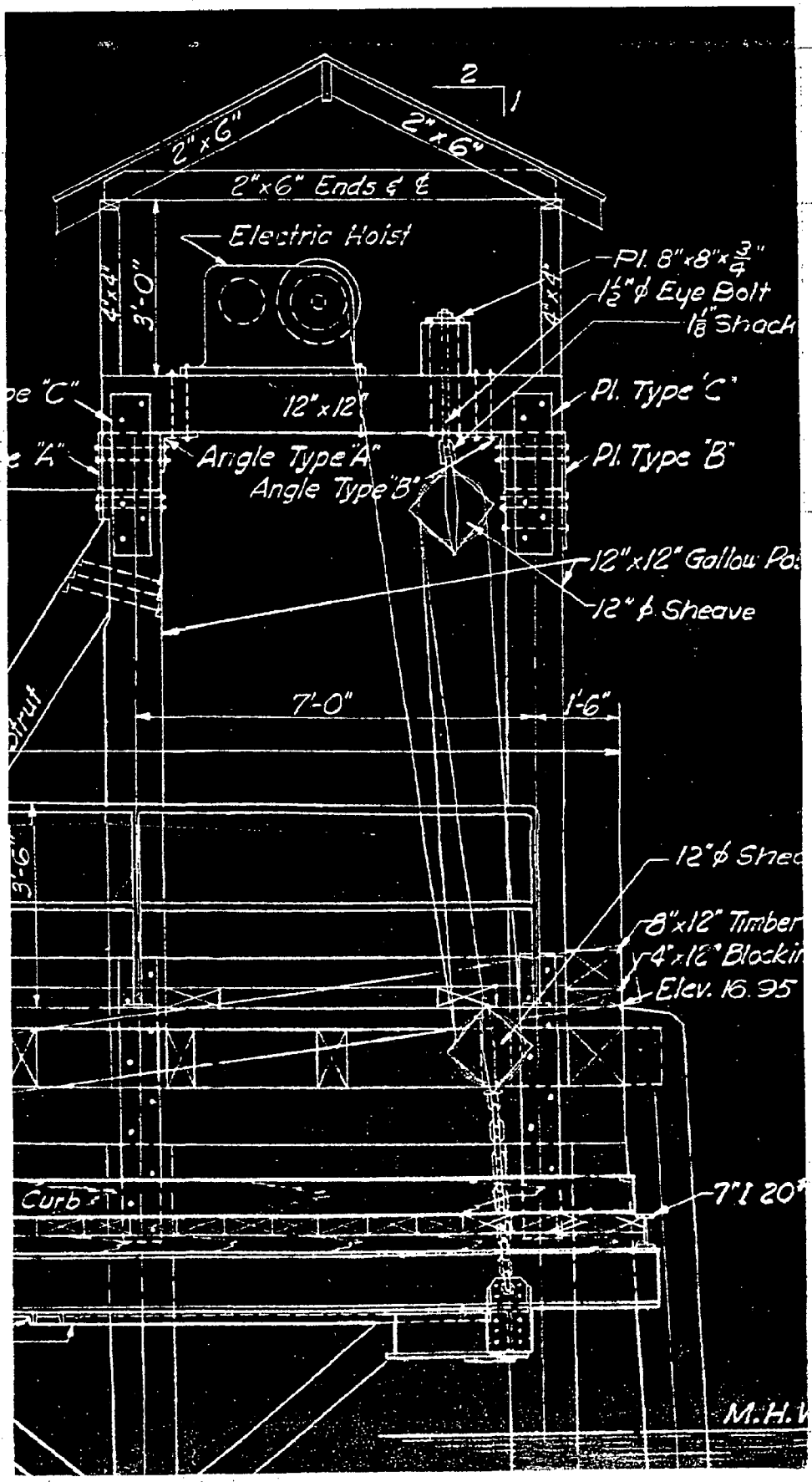
FIGURE 5

THIS FIGURE AND FIGURE 7 ARE FROM A 1957 PLAN OF FAY, SPOFFORD AND THORNDIKE.



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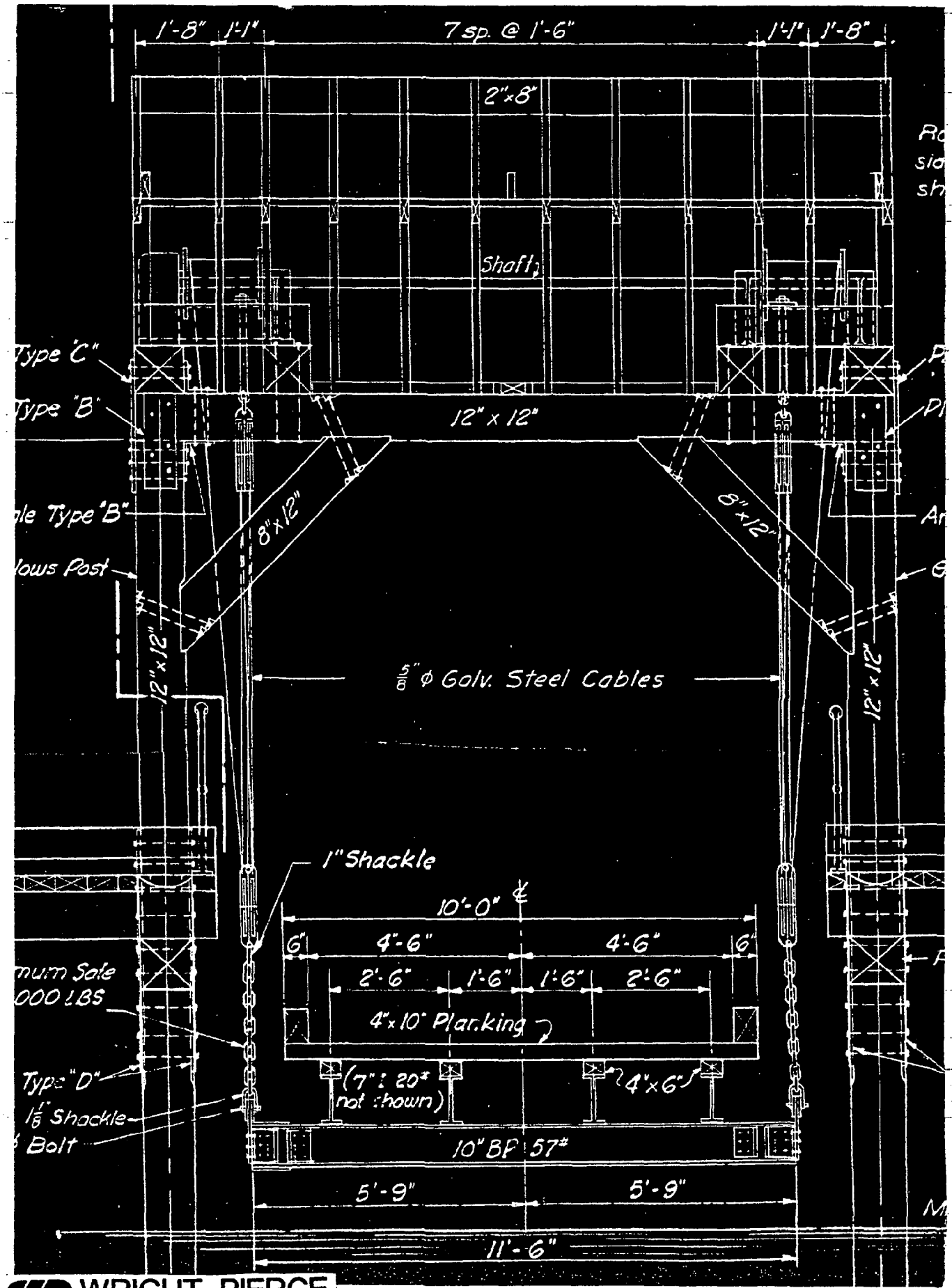
EXISTING ROCKLAND UNIT

FIGURE 6



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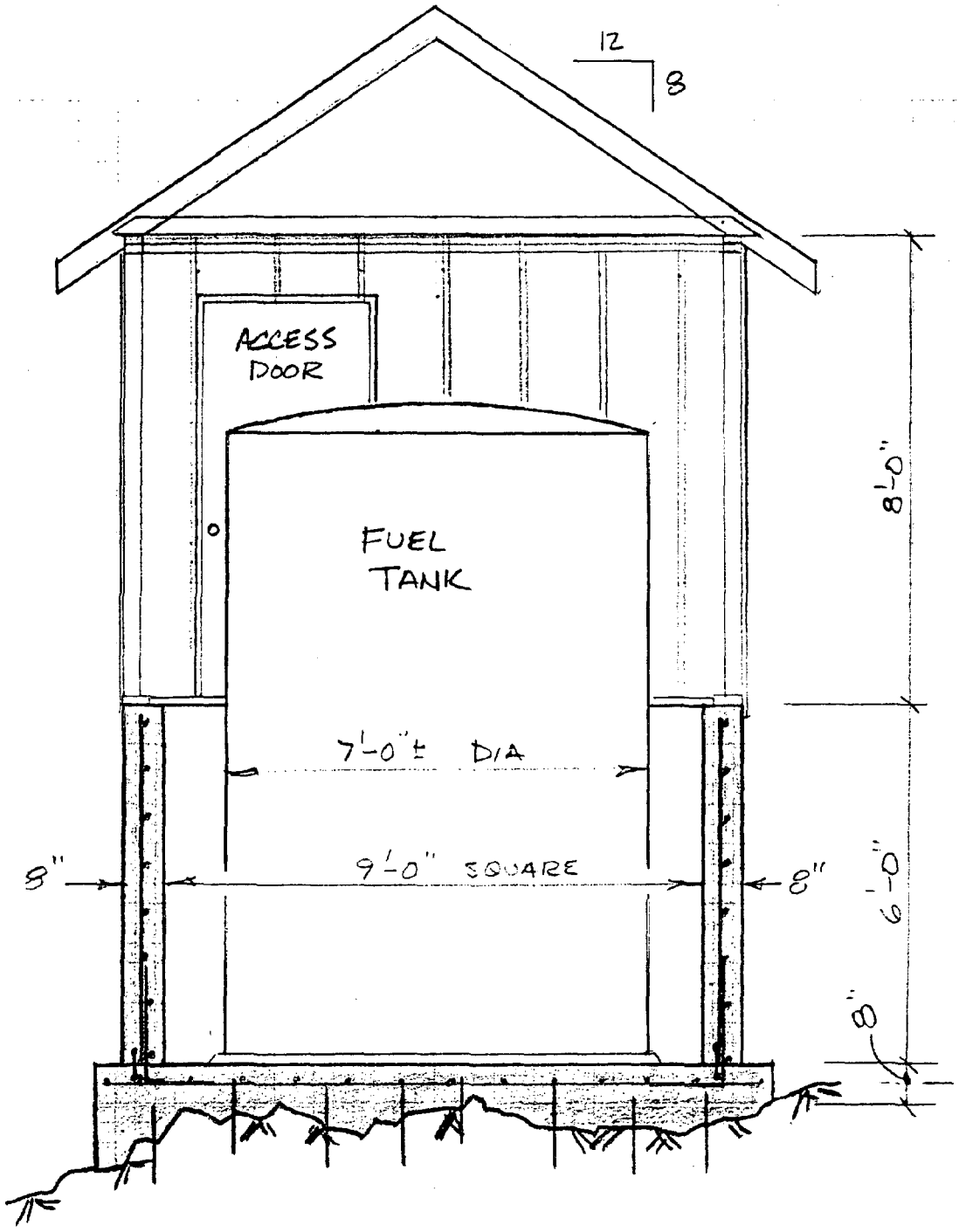
EXISTING ROCKLAND UNIT FIGURE 7



SPILL CONTAINMENT STRUCTURE

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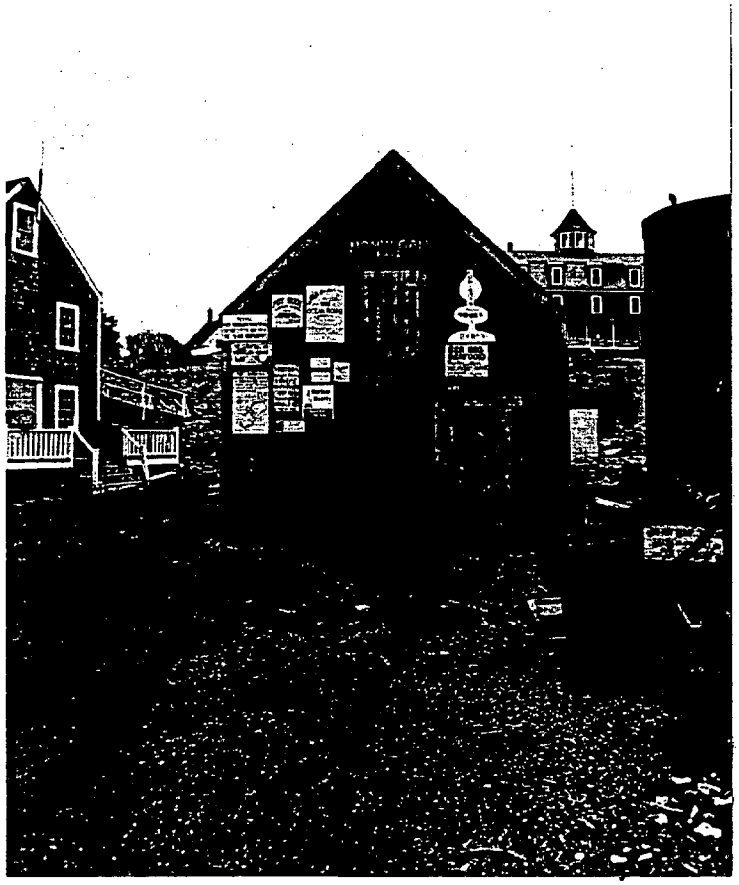
FIGURE 8



Freight shed

Voids in South wall of wharf showing Bob Burton inside the wharf

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FIGURE 9

North side of wharf looking East

North side of wharf looking West

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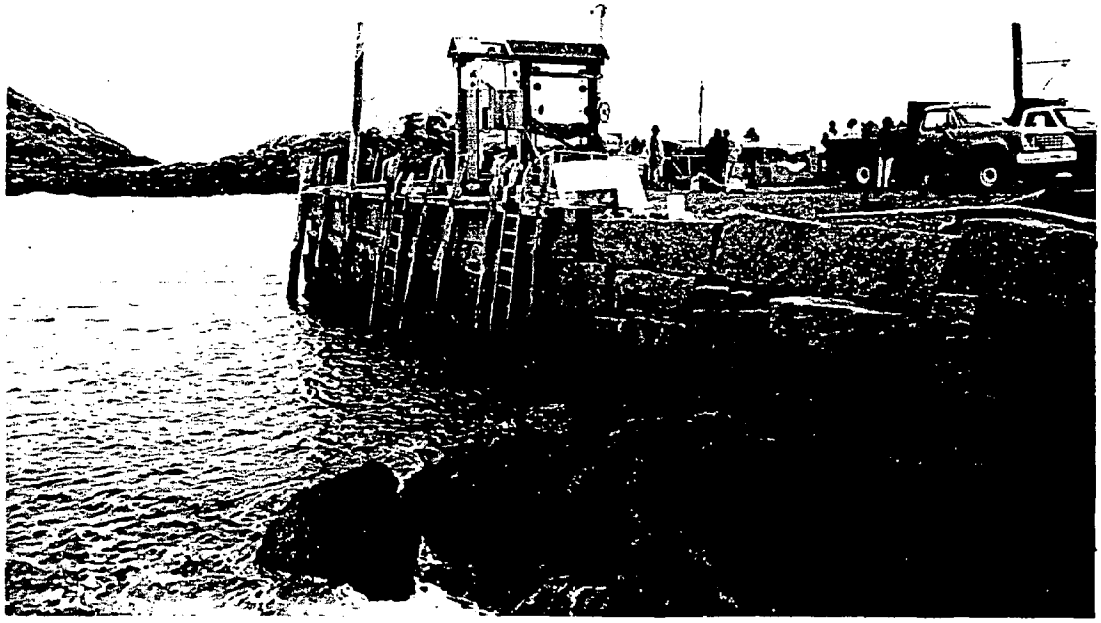
FIGURE 10

South side of wharf looking East



South side of wharf looking West

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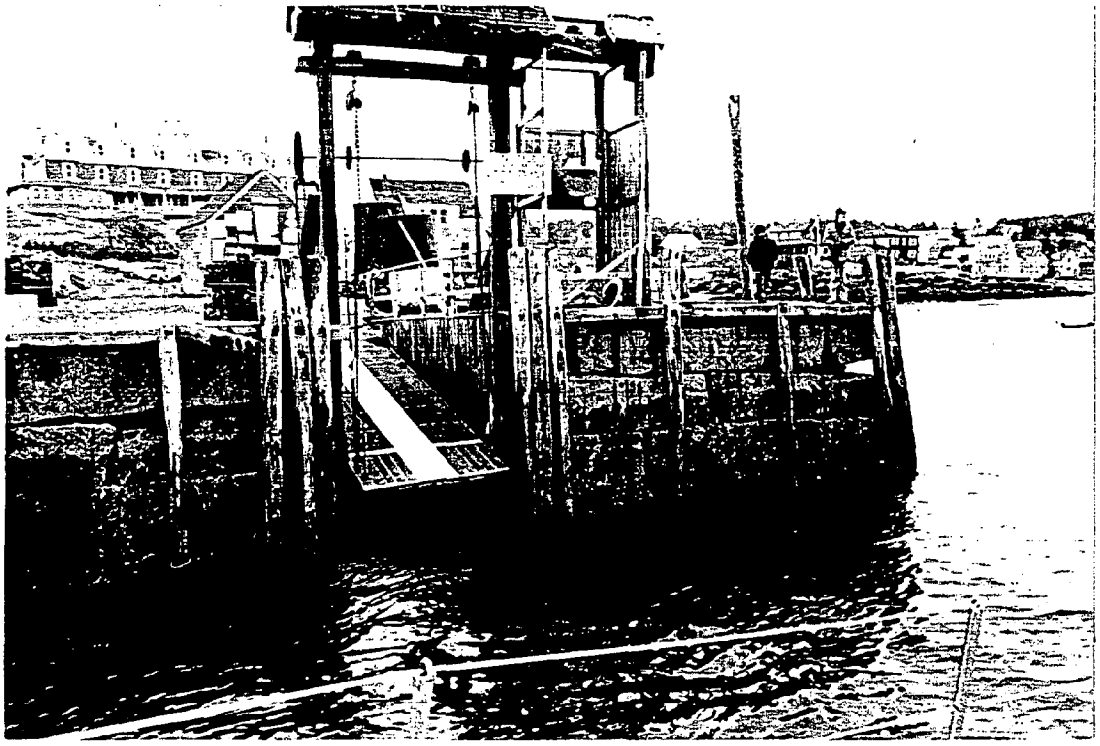
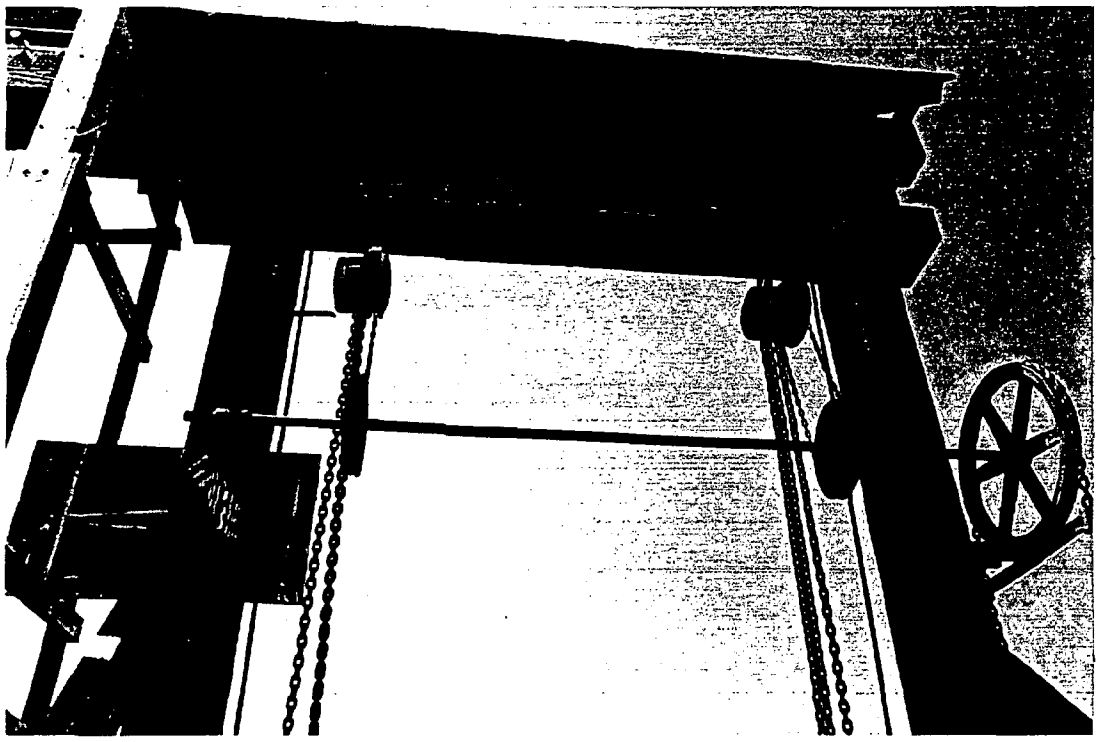
FIGURE 11



Wharf slip



Ramp lifting mechanism

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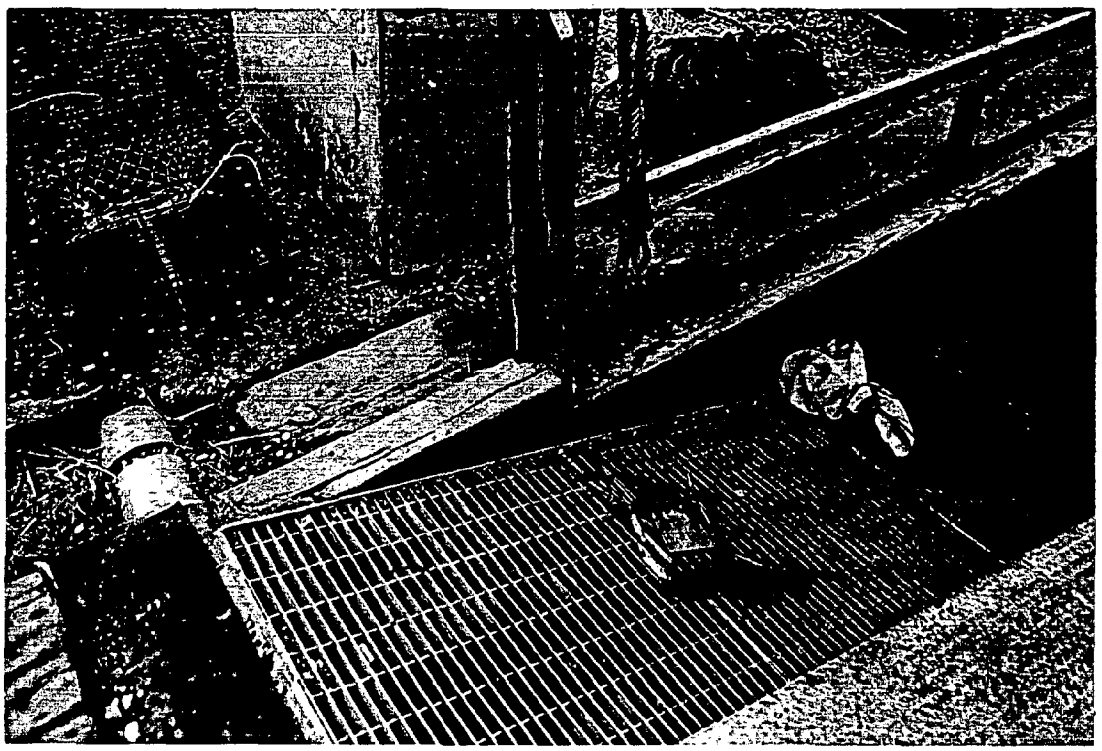
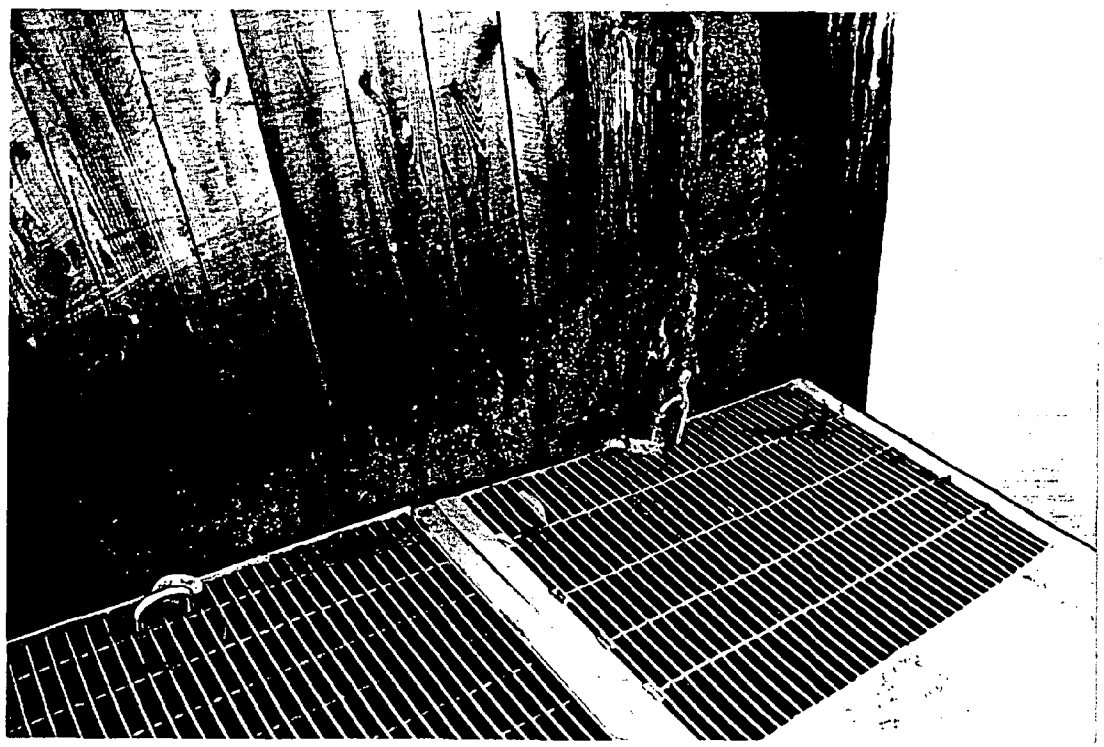
FIGURE 12



Ramp – hinge end



Ramp – adjustable end

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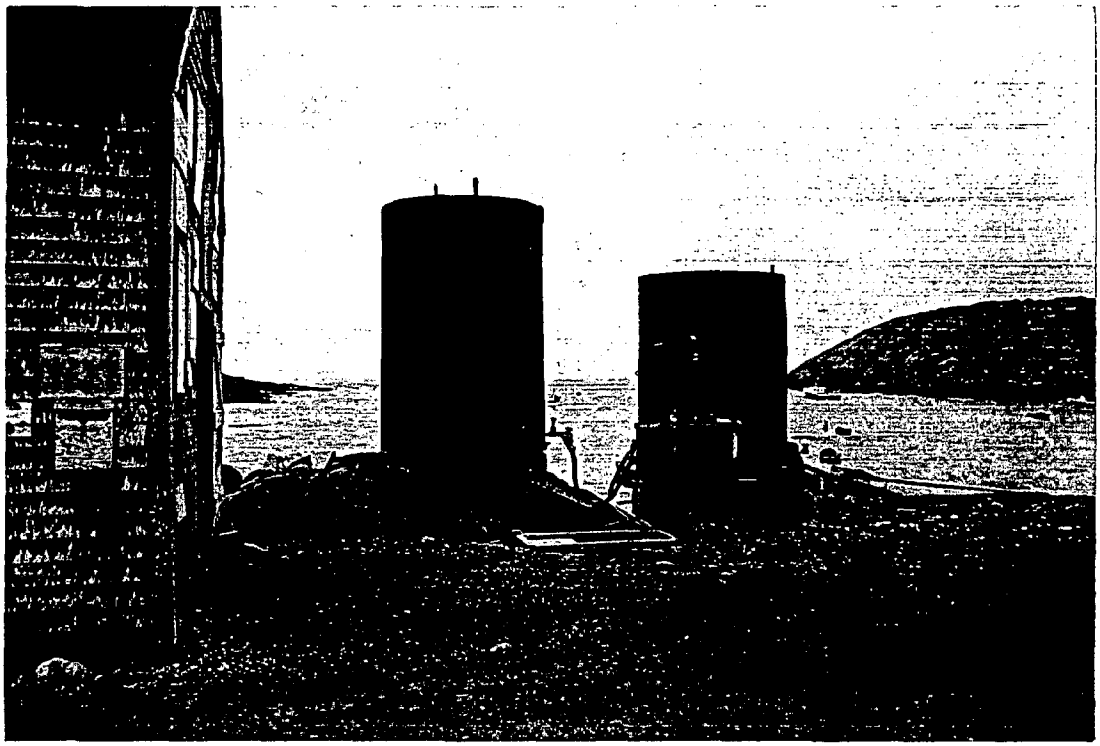
FIGURE 13



Fuel tanks looking South

Fuel tanks looking North

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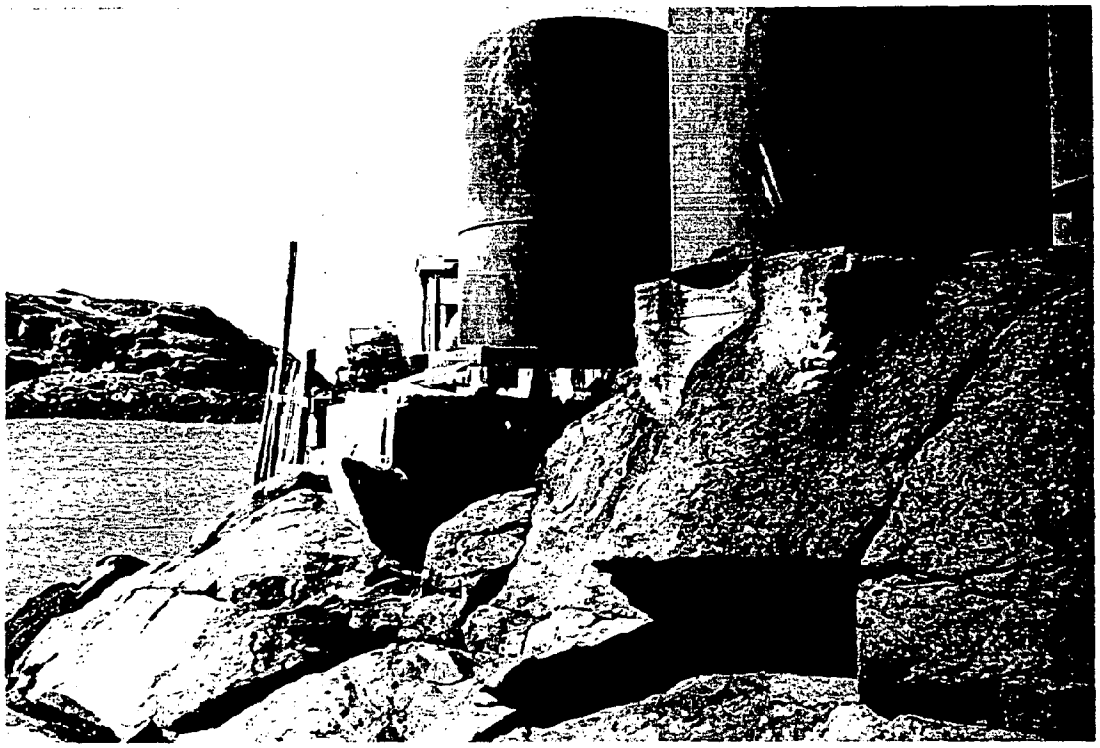
FIGURE 14



Fuel tanks looking West

3± feet deep test pit - showing cobble sized stones in bottom

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FIGURE 15

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