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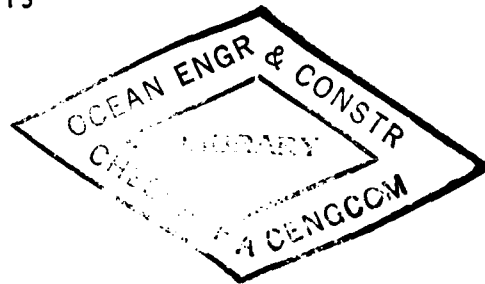
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UNDERWATER FACILITIES
INSPECTIONS
&
ASSESSMENTS

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U. S. NAVAL STATION
GUANTANAMO BAY, CUBA

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FPO-1-80(8)

AUGUST 1980

PERFORMED BY:
UNDERWATER CONSTRUCTION TEAM ONE

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The underwater inspection was conducted between 19 and 28 June 1979 and included the following facilities: Pier V, Pier L, Pier Q, Pier C, Mooring BB-1, Pier A, Wharf B, Wharf T, and various section of quaywall between the piers. A representative number of piles or sections of wharves and (Con't)

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quaywalls were inspected in detail, including scraping off growth and products of corrosion, measuring material thicknesses, and taking underwater photographs. All significant evidence of underwater deterioration was recorded and the condition of the surface and abovewater structure was noted.

The inspection revealed that the underwater and below deck portions of Pier L were deteriorated to the extent that pier usage should be limited until a more thorough underwater inspection and analysis could be performed. The inspection of Piers V, C, D, and Q revealed that portions of the structures were in various stages of deterioration but limitations on pier utilization were not required. However, repairs and pier utilization procedures should be initiated to prevent or curtail further deterioration which will result in limitation of pier capacity in the near future.

Pier A, Wharf T, Wharf B, and Mooring BB-1 did not reveal significant deterioration requiring replacement or repair; however, procedures for utilization and maintenance of these structures should be institute to minimize the causes of deterioration affecting the other waterfront structures. In general, damage to minor waterfront structures have already been noted by resident inspectors and their condition was not included in this inspection.

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EXECUTIVE SUMMARY

At the request of the U. S. Naval Station, Guantanamo Bay, Cuba, the Commander, Naval Construction Battalions, U. S. Atlantic Fleet (COMCBLANT) tasked Underwater Construction Team One (UCT ONE) to conduct an underwater inspection of the waterfront facilities at NAVSTA GTMO. The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) was in turn requested by UCT ONE to provide engineering assistance in developing an inspection plan and to participate in the inspection.

The underwater inspection was conducted between 19 and 28 June 1979 and included the following facilities: Pier V, Pier L, Pier Q, Pier C, Mooring BB-1, Pier A, Wharf B, Wharf T, and various sections of quaywall between the piers. A representative number of piles or sections of wharves and quaywalls were inspected in detail, including scraping off growth and products of corrosion, measuring material thicknesses, and taking underwater photographs. All significant evidence of underwater deterioration was recorded and the condition of the surface and above-water structure was noted.

The inspection revealed that the underwater and below deck portions of Pier L were deteriorated to the extent that pier usage should be limited until a more thorough underwater inspection and analysis could be performed. The inspection of Piers V, C, D, and Q revealed that portions of the structures were in various stages of deterioration but limitations on pier utilization were not required. However, repairs and pier utilization procedures should be initiated to prevent or curtail further deterioration which will result in limitation of pier capacity in the near future.

Pier A, Wharf T, Wharf B, and Mooring BB-1 did not reveal significant deterioration requiring replacement or repair; however, procedures for utilization and maintenance of these structures should be instituted to minimize the causes of deterioration affecting the other waterfront structures. In general, damage to minor waterfront structures have already been noted by resident inspectors and their condition was not included in this inspection.

PREFACE

BACKGROUND

The Chief of Naval Operations (CNO), in reference (1), assigned to UCT ONE the responsibility for the underwater inspection of waterfront facilities over a two and one-half year period. This assignment included an inspection of the facilities at NAVSTA GTMO which had previously been requested by reference 2. A detail from UCT ONE became available to undertake this inspection work during the June-July 1979 time frame due to the cancellation of a previously scheduled project. This detail was available on 18 June 1979 and it was estimated that the underwater inspection could be completed in a three to four week period. Accordingly, by reference 3, COMCBLANT tasked UCT ONE to perform the Guantanamo Bay facilities inspection during this period.

By reference 4, UCT ONE requested from CHESNAVFACENGCOCM the on-site engineering support necessary for developing an inspection plan and for participation in the inspection. Additionally, by reference 5, NAVSTA GTMO was requested to provide a small boat with outboard motor, a 2 1/2 ton truck, and dive locker support in the event that UCT ONE gear failed to arrive at Guantanamo Bay in time for the underwater inspection.

INSPECTION PRIORITIES AND PROCEDURES

The Chesapeake Division, Naval Facilities Engineering Command was requested by Underwater Construction Team One to provide assistance in developing an inspection plan, to participate in the underwater facilities inspection, and to write the final inspection report. The inspections began on the 19th of June 1979 and the inspection team departed the Naval Station, Guantanamo Bay, Cuba on the 28th of June 1979. Upon arrival, a meeting with the Public Works Center personnel established the following priorities for pier inspections:

1. Pier V
2. Pier L
3. Pier D
4. Pier Q
5. Mooring BB-1
6. Other waterfront facilities as schedule permits

The area covered by these inspections is illustrated in the General Area Location Map, Figure 1, which shows Pier Q, the only pier that was inspected on the Leeward Side of Guantanamo Bay. Facilities that were inspected on the Windward Side are shown on the Windward Side Pier Area of Figure 2.

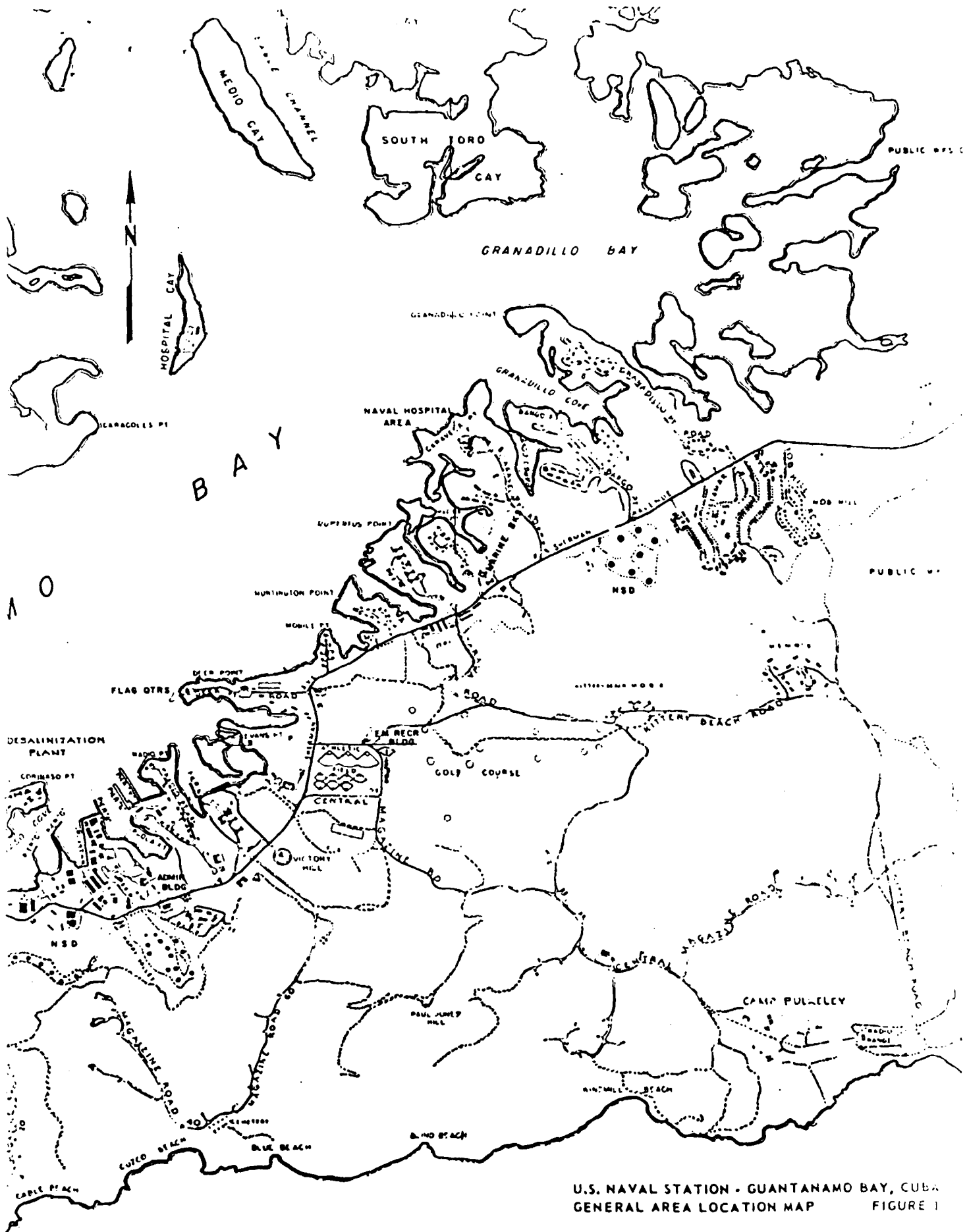
After reviewing available drawings and a previous inspection report, reference (6), and having a conference with on-site personnel, a final inspection plan was established. The inspection consisted of the following procedures:

- o Determine the general condition of the underwater portions of the piers and wharves.
- o Establish the prevalent mode of deterioration and inspect a representative number of piles or sections of wharves and quaywalls.
- o Inspect, in detail, readily apparent forms of extreme deterioration.
- o Obtain photographs of deterioration.
- o Note condition of surface and above water structure.

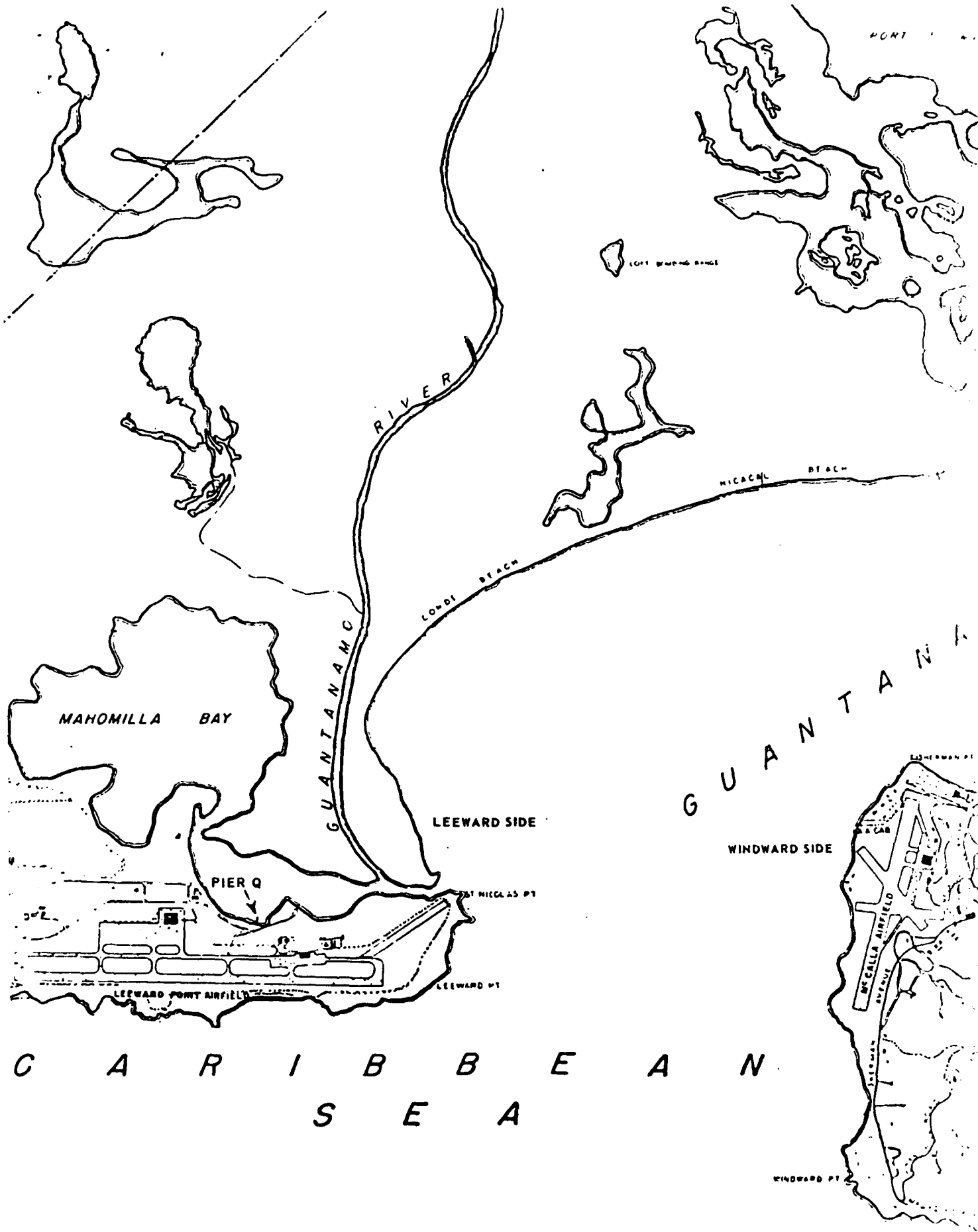
The pile numbering system used in this report designates the first bent away from shore as Bent No. 1 and the piles in each bent are labeled A, B, C, ... from left to right while facing away from the shore. Some of the photographs for Pier L are mislabeled as Pier V but the figures are labeled correctly.

FORMAT OF FACILITIES UNDERWATER INSPECTION REPORT

This report describes the results of the underwater facilities inspection at the Naval Station, Guantanamo Bay, Cuba. The underwater inspection was conducted by the Underwater Construction Team One based at Little Creek, Virginia. This preliminary inspection demonstrates the necessity for a more thorough underwater inspection and structural analysis. For each facility inspected there is given a general inspection plan, photographic details of the observed problems, a tabulated or written description of the observed deterioration or damage, and a series of recommendations as to conditions that should be corrected in each facility. Additionally, there are given a set of conclusions and recommendations applicable to all facilities relative



U.S. NAVAL STATION - GUANTANAMO BAY, CUBA
 GENERAL AREA LOCATION MAP FIGURE 1



C A R I B B E A N
S E A

MONT

FORT BROWNING RANGE

NICACÓN BEACH

LOWE BEACH

MAHOMILLA BAY

GUANTANAMO RIVER

LEEWARD SIDE

WINDWARD SIDE

PIER Q

PT NICOLAS PT

LEEWARD POINT AIRFIELD

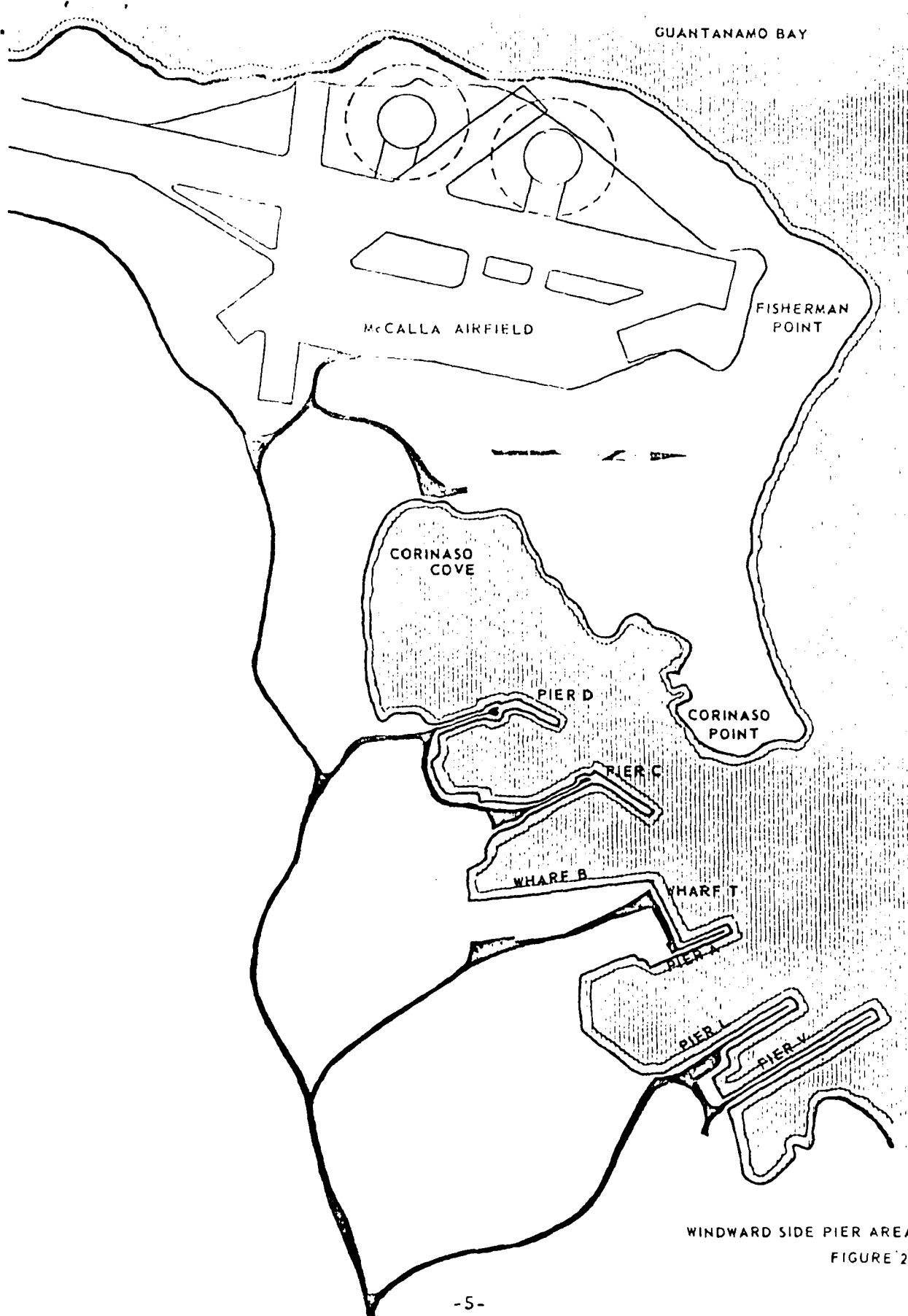
LEEWARD PT

LEWISMAN PT

MCALLA AIRFIELD

WINDWARD PT

GUANTANAMO



WINDWARD SIDE PIER AREA
FIGURE 2

to maintenance of records and future inspection requirements and procedures. The extent of damage, methods of repair, and repair priorities are beyond the scope of this report; the treatment of these subjects requires a more detailed underwater inspection and priority scheduling and funding by the facility.

PIER V (VICTOR)

DESCRIPTION

Pier V is an open-type reinforced concrete pier that is approximately 1008 feet long and 60 feet wide. The concrete beam and deck structure is supported on precast reinforced concrete piles arranged in sixty-four bents with eleven bearing piles and one batter pile per bent as shown in Figure 3. Also illustrated in Figure 3 is the pile designation system used in the following illustrations and tables.

INSPECTION RESULTS

The underwater inspection revealed that the concrete was spalling from most of the structural members, and that the reinforcing bars were exposed. Typical examples of the concrete deterioration underwater are shown in the following:

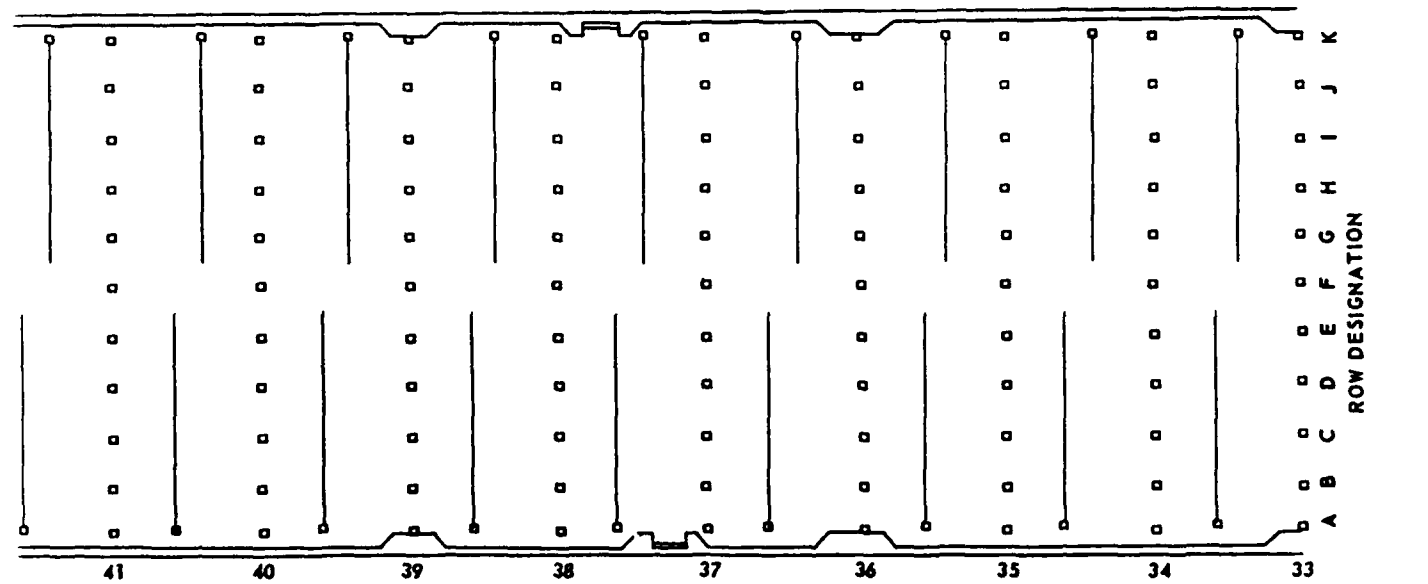
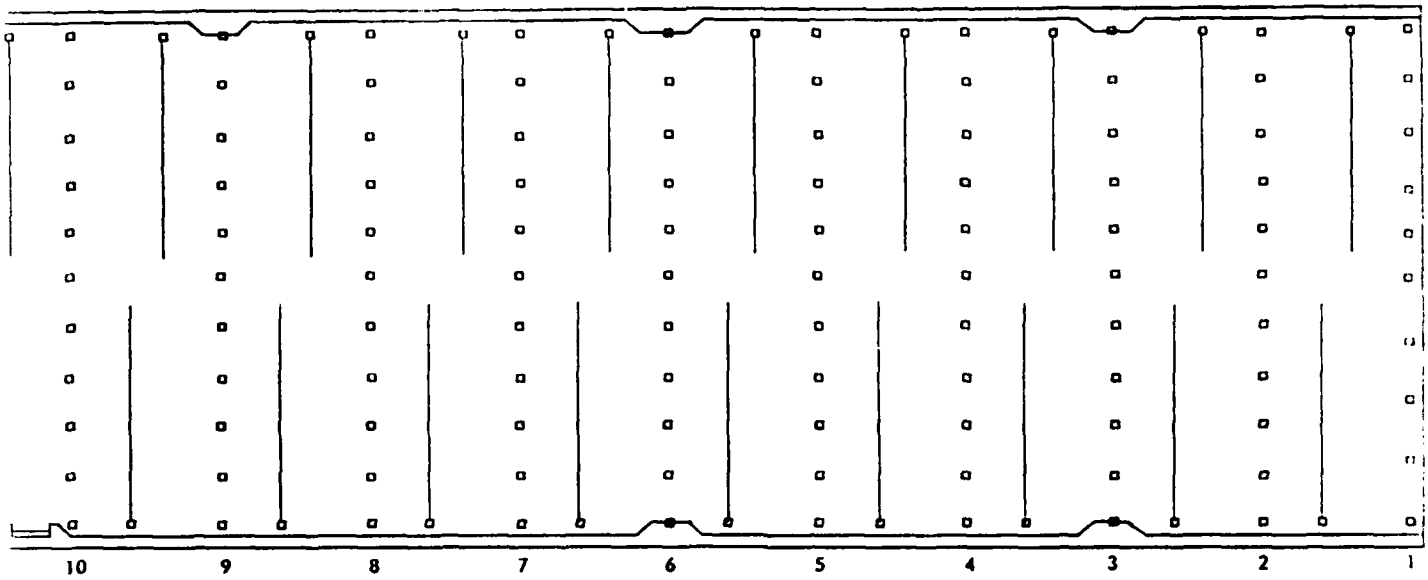
- o Figures 4, 5, and 6: Vertical cracks in piles 21K at 12 feet, 41A at 15 feet, and 64K - depth not noted.
- o Figures 7 and 8: Horizontal cracks in piles 64A at 15 feet, and 64B at 25 feet.
- o Figures 9, 10, and 11: General spalling on piles 10K at 25 feet, 37G at 5 feet, and BP-43B at 1 foot.
- o Figures 12 and 13: Complete exposure of reinforcing bar on piles 64H and 64K - depth not noted.

The location of some of these damaged areas can be envisioned by reference to Figure 13A which is a cross section of Pier V.

Various portions of the Pier V fender system require repair because of the mechanical damage caused by ship impact. This damage is listed in Table VI.

CONCLUSIONS AND RECOMMENDATIONS

The practice of securing the fender system directly to the bearing piles will cause early deterioration of the concrete piles. The future utilization of Pier Victor depends upon the rate of progressive deterioration of

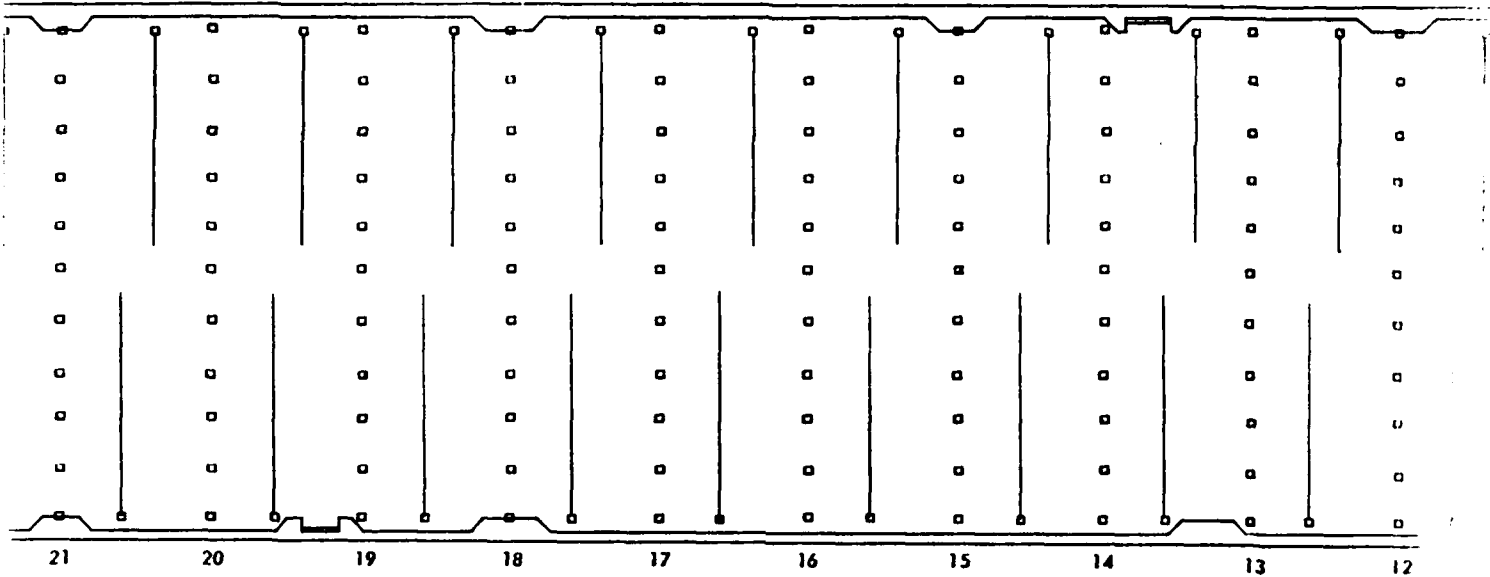


PIER V (VICTOR) - US NAVAL STATION - GUANTANAMO BAY
INSPECTION PLAN

FIGURE 3

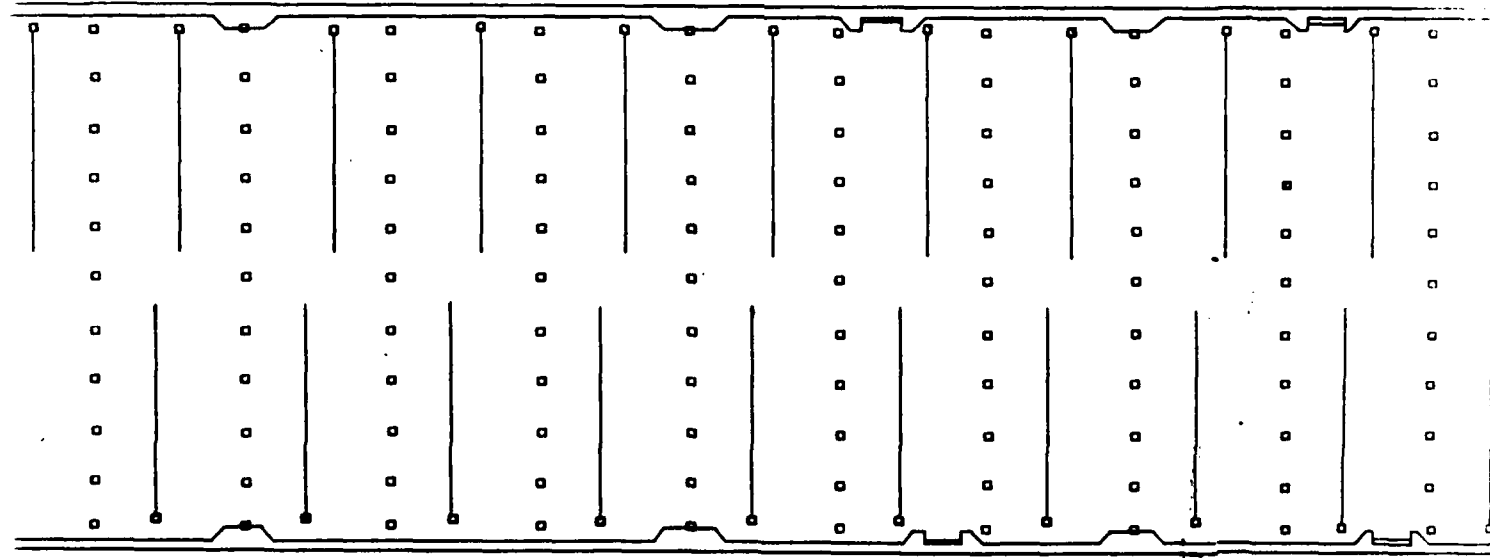


○ FENDER PILE



- INSHORE HALF OF PIER V

BENT NUMBER

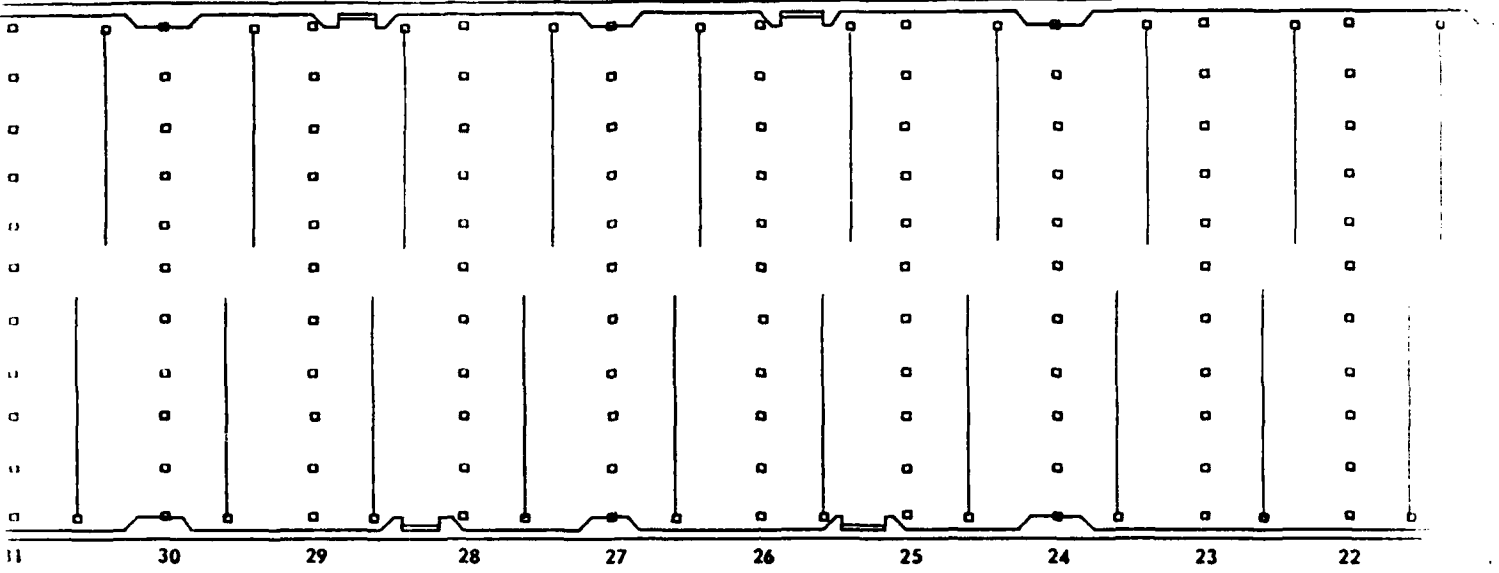


- OUTSHORE HALF OF PIER V

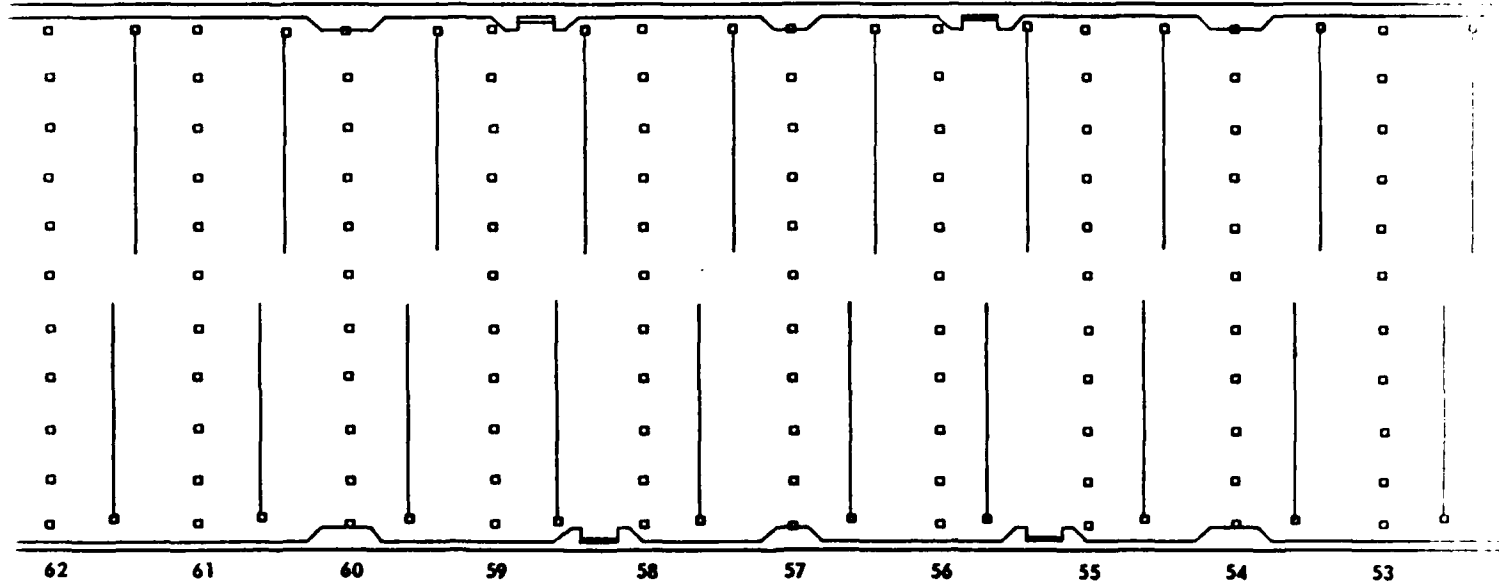
BENT NUMBER

□ STANDARD CONCRETE PILE

○ BATTER PILE

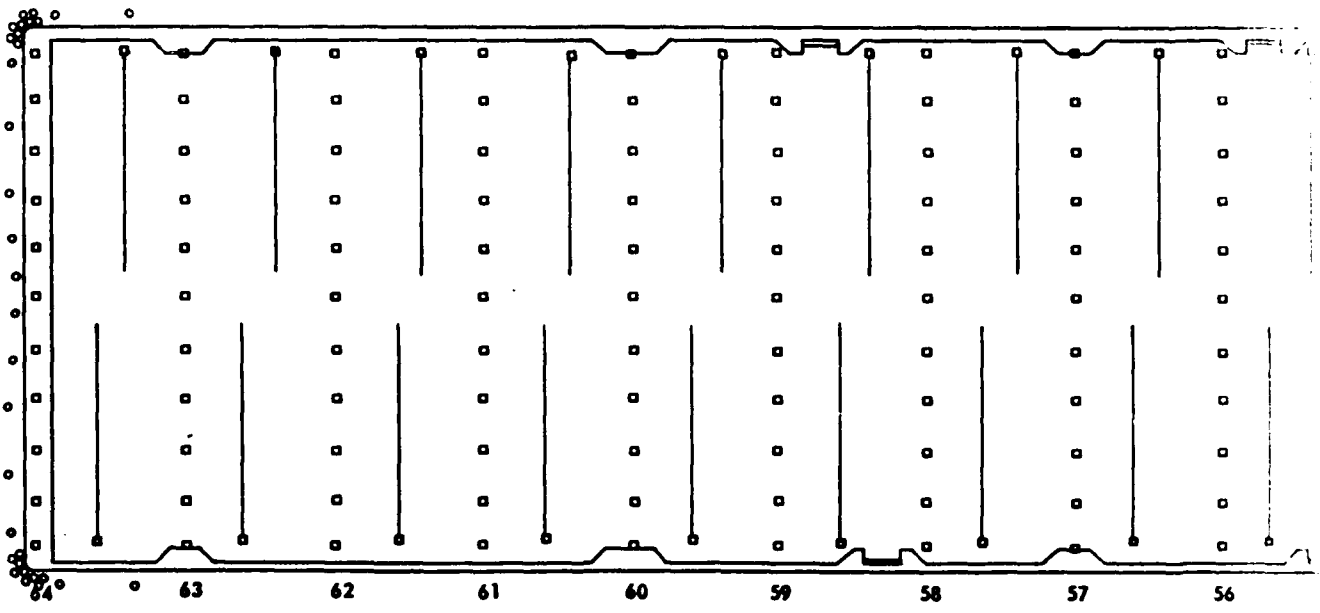
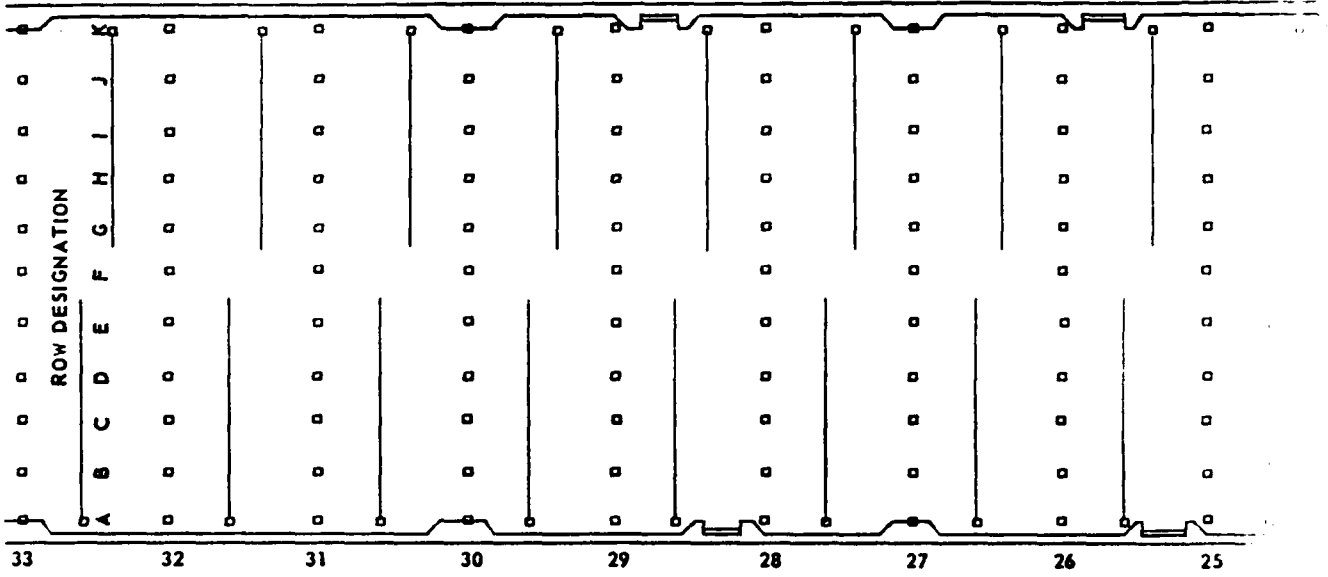


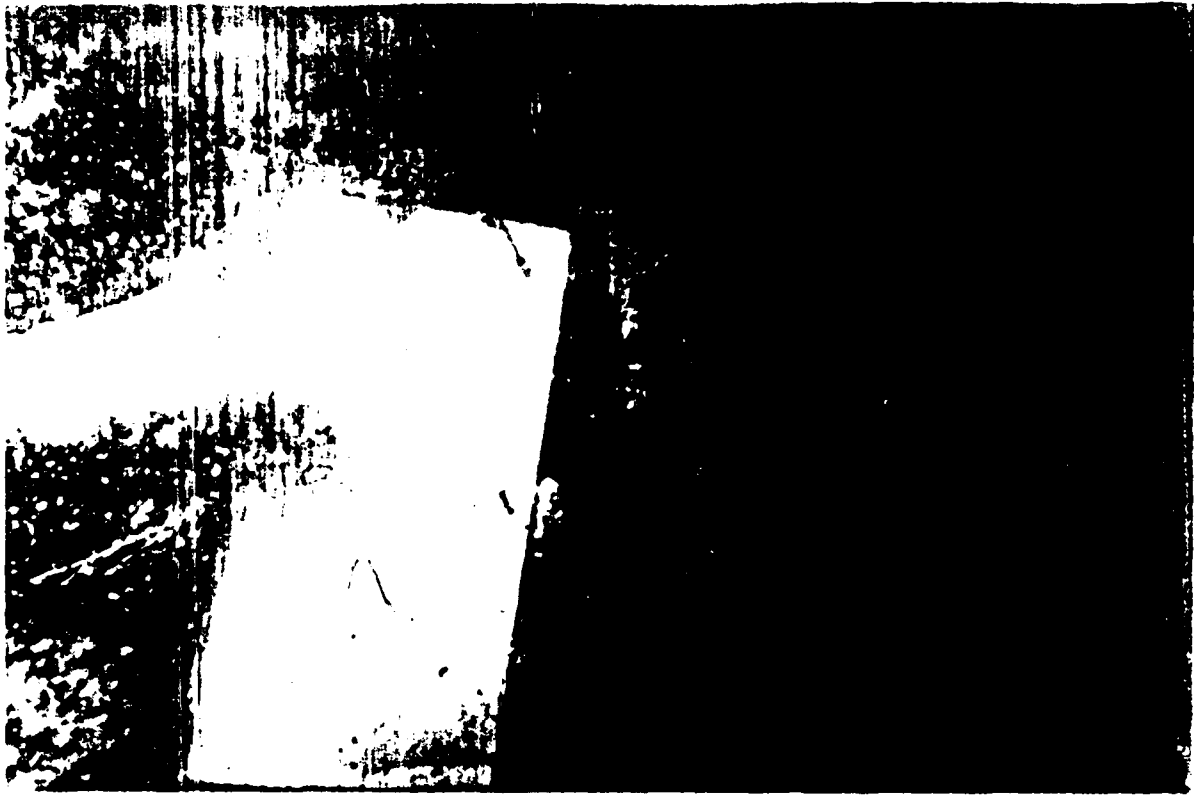
PILE PLAN - IN



PILE PLAN - OUT

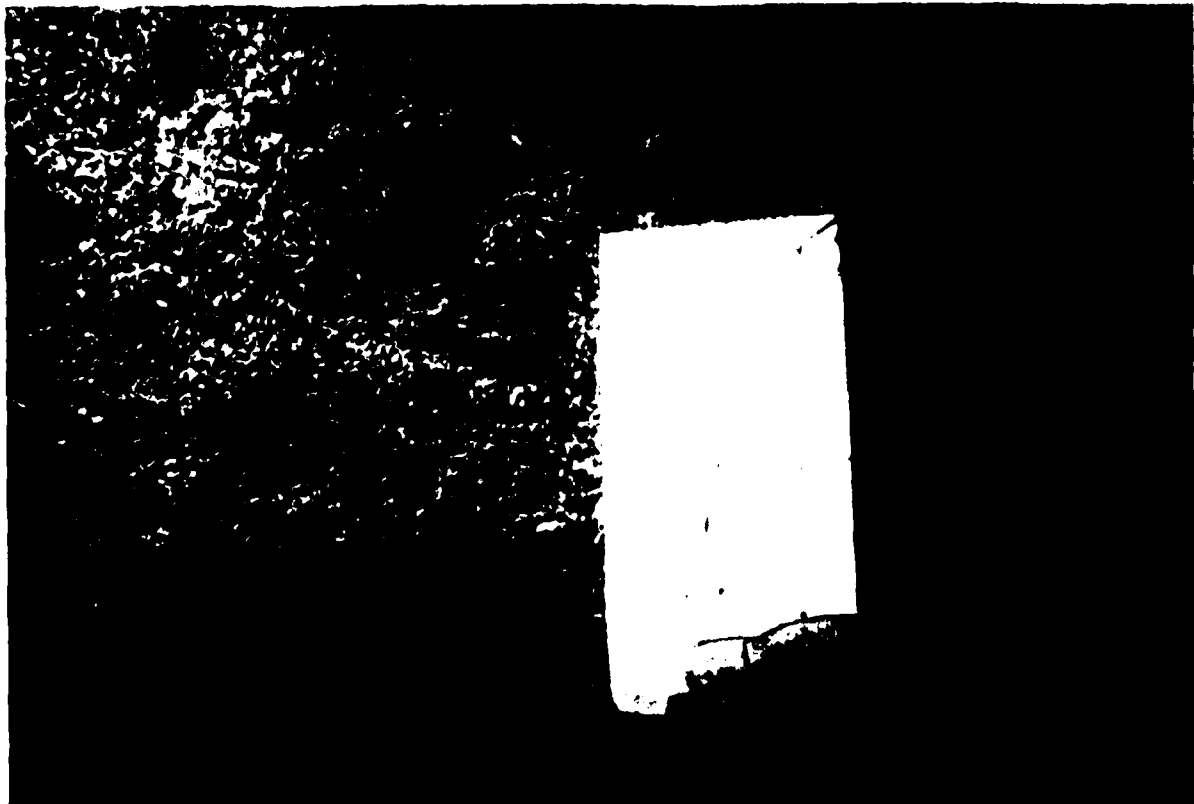
• STANDARD CONCRETE PILE





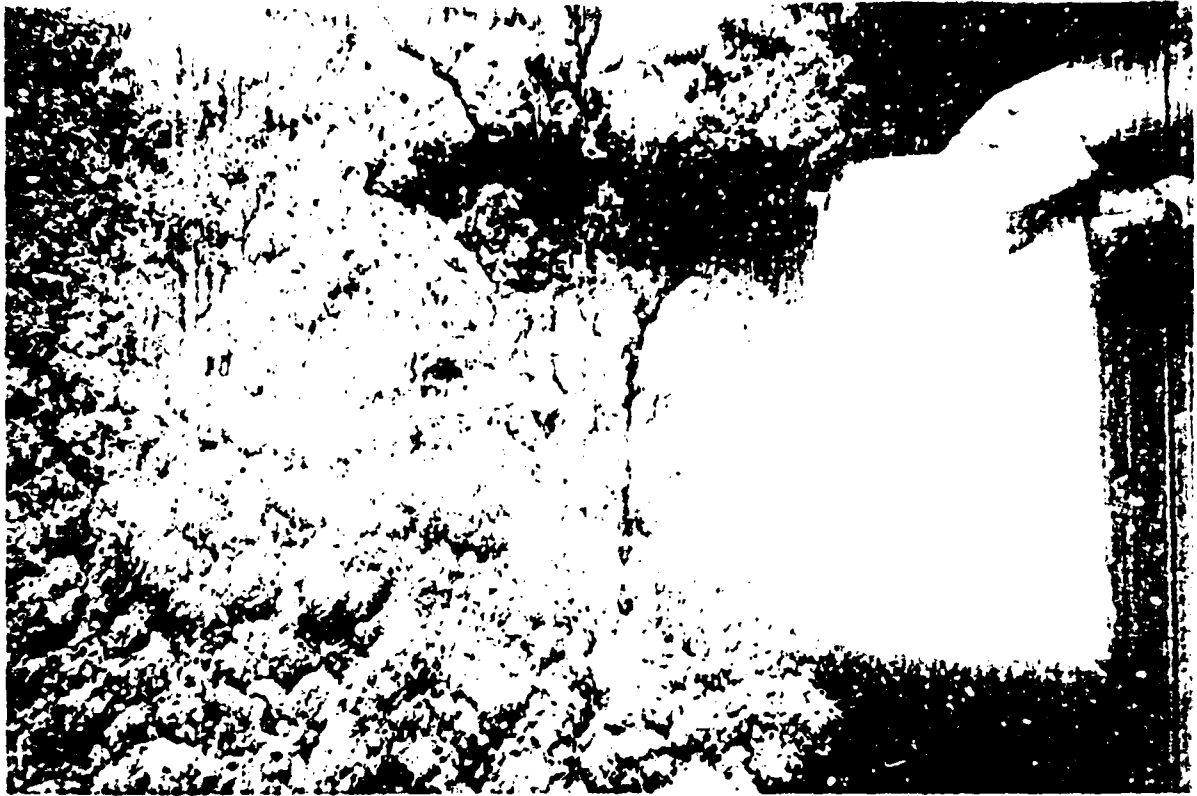
VERTICAL CRACK, PIER V; V - 21K AT 12 FEET DEPTH

FIGURE 4



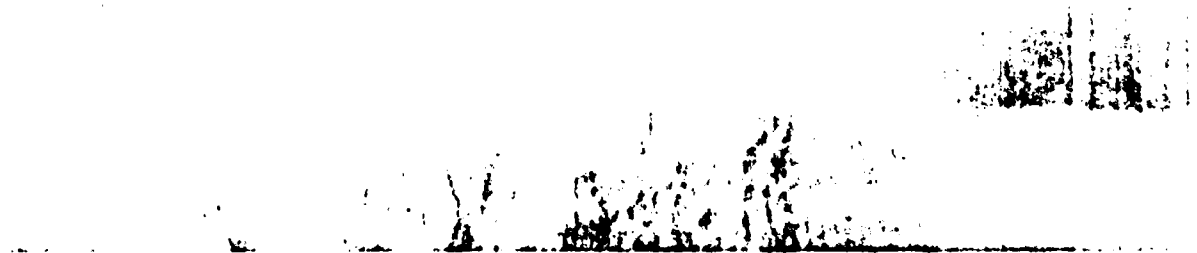
VERTICAL CRACK, PIER V; V - 41A AT 15 FEET DEPTH

FIGURE 5



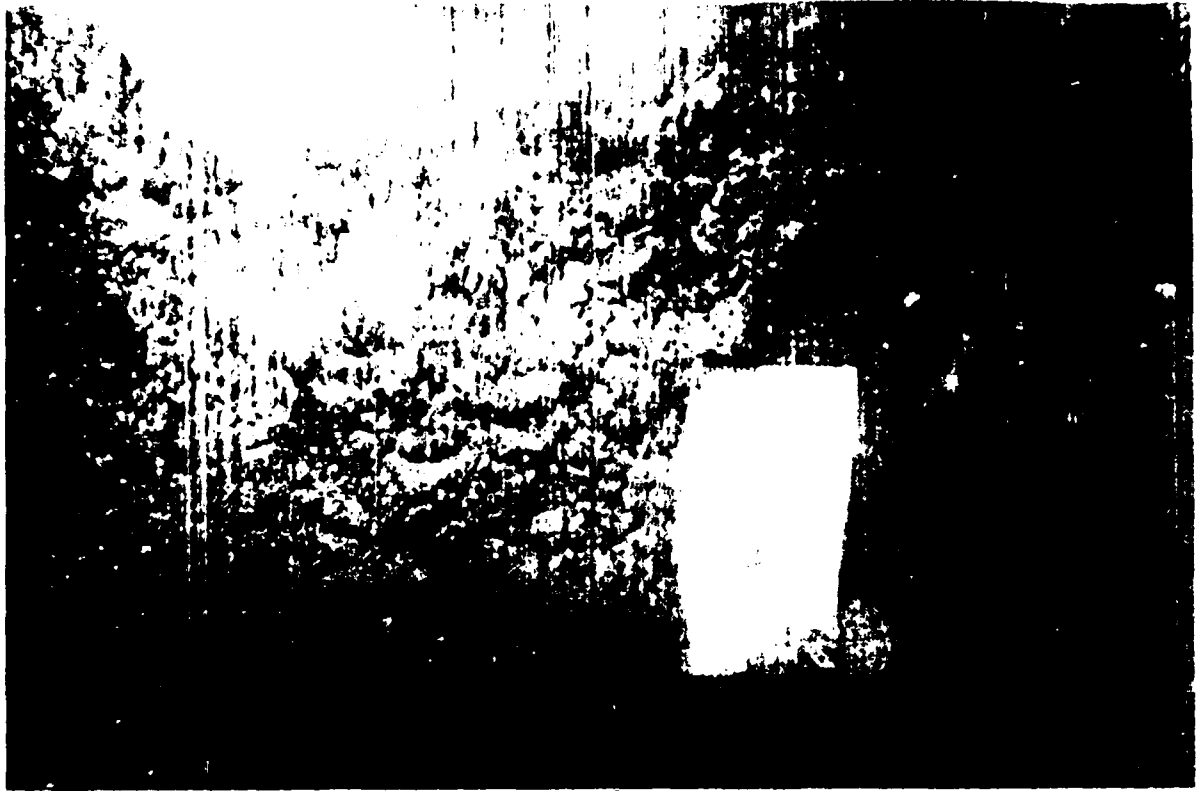
VERTICAL CRACK, PIER V; V - 64K - DEPTH NOT NOTED

FIGURE 6



HORIZONTAL CRACK, PIER V; V - 64A AT 15 FEET DEPTH

FIGURE 7



HORIZONTAL CRACK, PIER V; V- 64B AT 25 FEET DEPTH

FIGURE 8



GENERAL SPALLING, PIER V; V 10K AT 25 FEET DEPTH

FIGURE 9



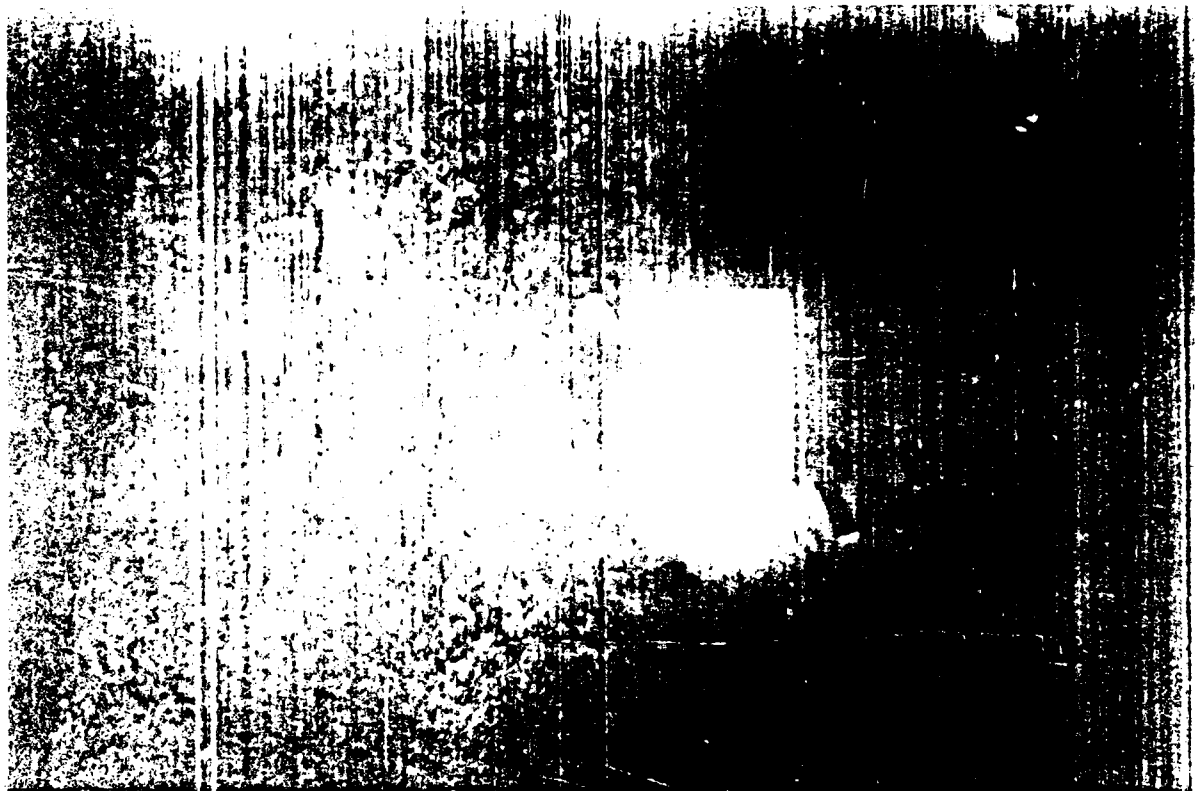
GENERAL SPALLING, PIER V; V - 37G AT 5 FEET DEPTH

FIGURE 1



GENERAL SPALLING, PIER V; V - 34BP-B AT 1 FOOT DEPTH

FIGURE 2



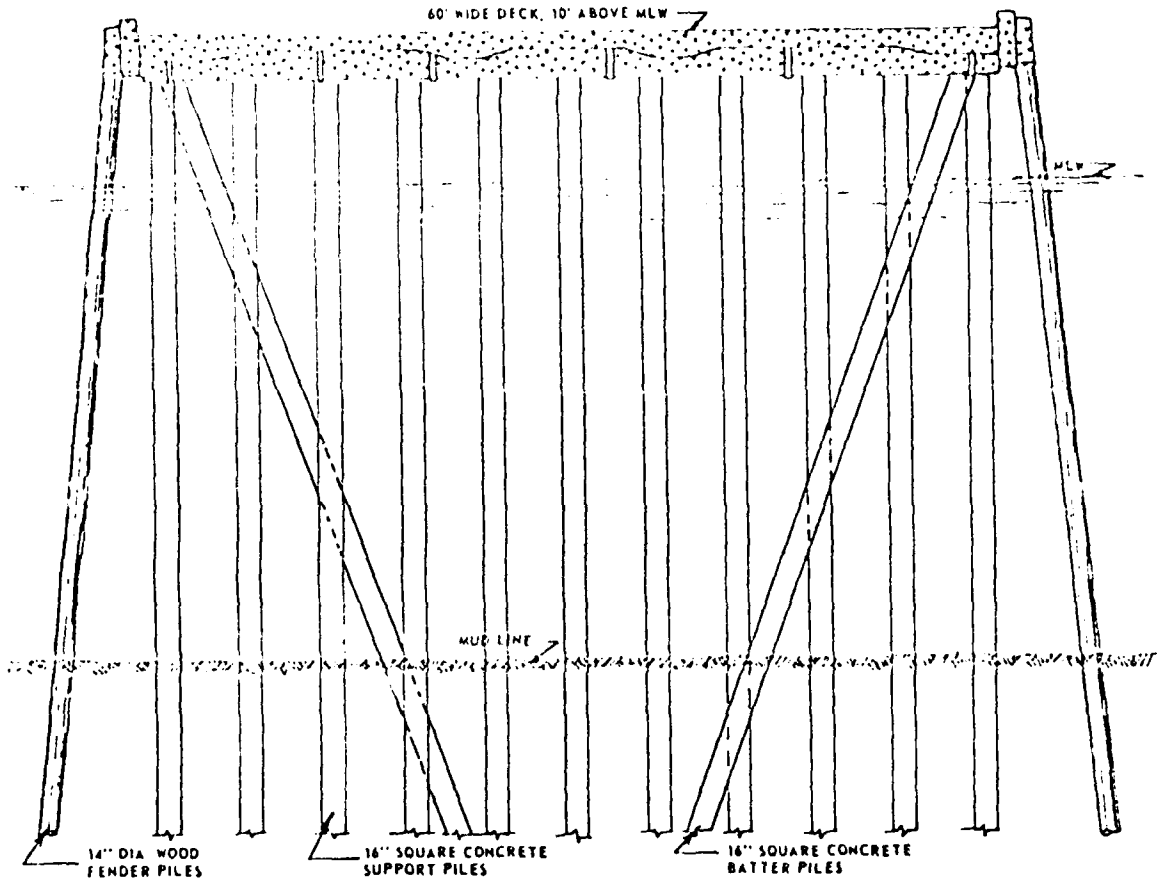
REINFORCING BAR EXPOSURE, PIER V, V - 64H - DEPTH NOT NOTED

FIGURE 1



REINFORCING BAR EXPOSURE, PIER V, V - 64K - DEPTH NOT NOTED

FIGURE 2



CROSS SECTION OF PIER VICTOR

FIGURE 13A

TABLE VI RESULTS OF FLEET VICTOR
FENDER PILE INSPECTION

BAY NO.	DAMAGE RECEIVED		BAY NO.	DAMAGE RECEIVED		BAY NO.	DAMAGE RECEIVED	
	WEST	EAST		WEST	EAST		WEST	EAST
1	L	L	22	L	H	43	L	H
2	L	L	23	L	L	44	L	L
3	L	H	24	L	L	45	L	L
4	L	H	25	L	H	46	L	L
5	L	N	26	L	H	47	L	H
6	L	N	27	L	L	48	L	L
7	L	L	28	L	L	49	H	L
8	L	H	29	H	H	50	L	L
9	L	H	30	H	H	51	L	L
10	L	N	31	L	L	52	H	L
11	L	N	32	L	L	53	H	L
12	L	L	33	L	L	54	L	L
13	L	L	34	L	H	55	H	H
14	L	L	35	H	H	56	L	L
15	L	L	36	L	H	57	N	L
16	L	L	37	L	H	58	L	L
17	L	L	38	H	L	59	L	L
18	L	H	39	H	L	60	L	L
19	H	N	40	H	H	61	L	H
20	L	L	41	H	L	62	H	L
21	L	L	42	N	H	63	L	H

CODE: L - LIGHT DAMAGE; H - HEAVY DAMAGE; N - NO APPARENT DAMAGE

ALSO THE FENDER SYSTEM AT THE NORTH OR OFFSHORE END
OF THE PIER IS HEAVILY DAMAGED

the pier structure. It is recommended that:

- o Repairs to the concrete piles be initiated, as soon as possible;
- o An effective fender system be designed and maintained to protect the bearing and support piles.

PIER L (LIMA)

DESCRIPTION

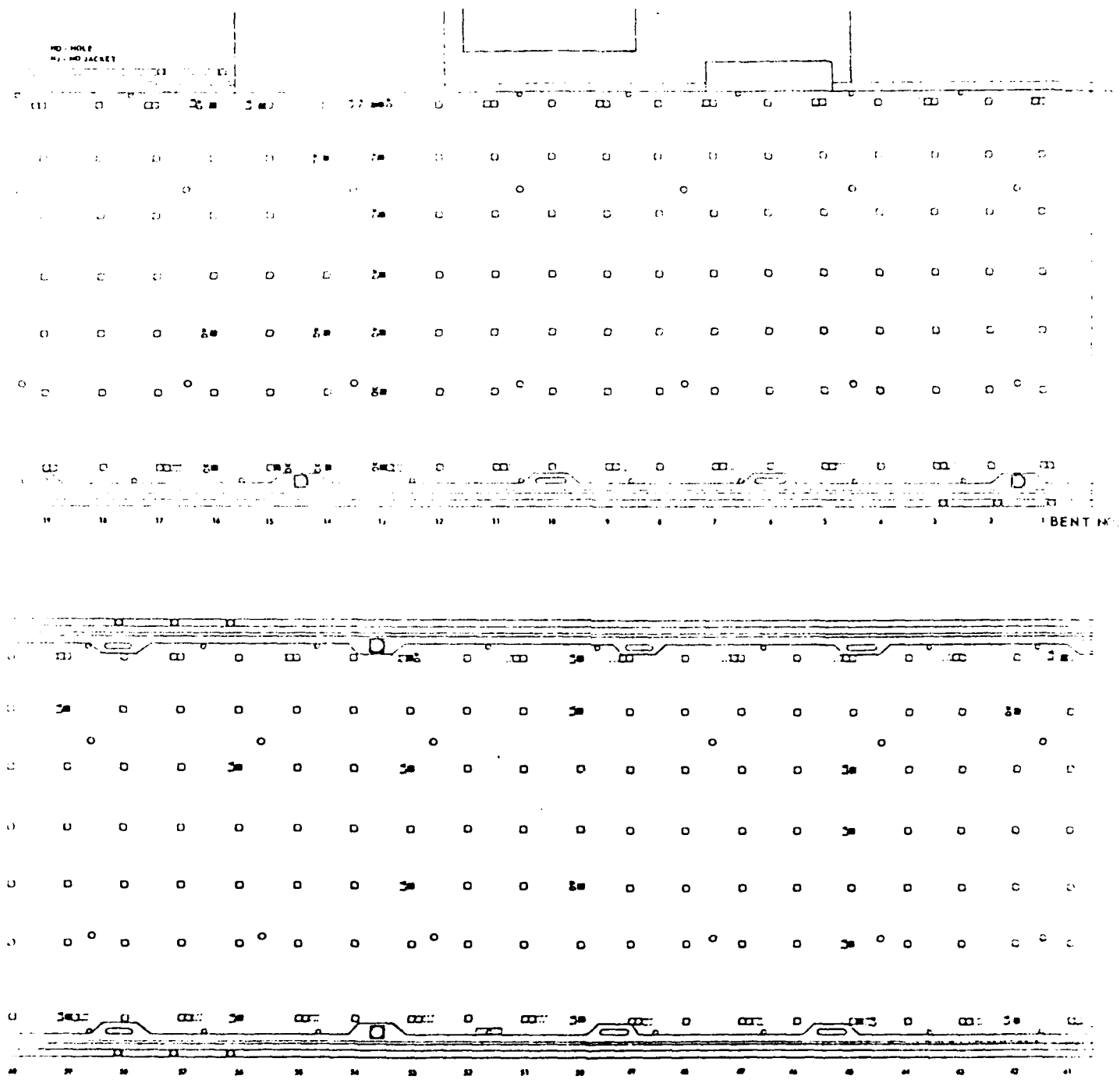
Pier L is an open-type reinforced concrete pier approximately 60 feet wide and 644 feet long. The pier is supported by steel H-piles arranged in 81 bents with seven bearing piles and two batter piles per bent. The piles are presently partially protected by a wooden fender system that extends to the vicinity of the mean low water line, where intact, and by concrete collars that extend approximately three to four feet above and to two feet below the mean low water line. The arrangement of support and batter piles is shown in Figure 14 together with the alpha-numeric designation of the various piles discussed below and in Table L1.

INSPECTION RESULTS

The general condition of Pier Lima can be described as follows:

- a. The upper and lower portion of the reinforced concrete collars appear to be in good usable condition.
- b. The fender systems have been systematically destroyed by combined actions of mechanical mishaps, extensive limnoria attack, wind and wave action, and floating debris.
- c. The concrete jackets that have been placed on the H-piles to provide protection in the tidal/splash zone are either:
 - o cracked by the expanding forces of the corroding H-pile;
 - o accelerating the corrosion process of the H-pile;
 - o providing limited or no protection to the H-pile;
 - o missing entirely.
- d. The steel H-piles that were inspected are severely deteriorated by a process resulting in layered corrosion (Figures 15-17). The laminations appear to be a form of iron oxide that develops on the steel and progressively forms subsequent layers as pits form in the oxide coating and let moisture into the interface. These oxide coatings either remain intact or are removed by the impact of debris, the wave action, or the excessive accumulation of corrosion products between oxide layers.

A representative sampling of the piles over the entire pier was



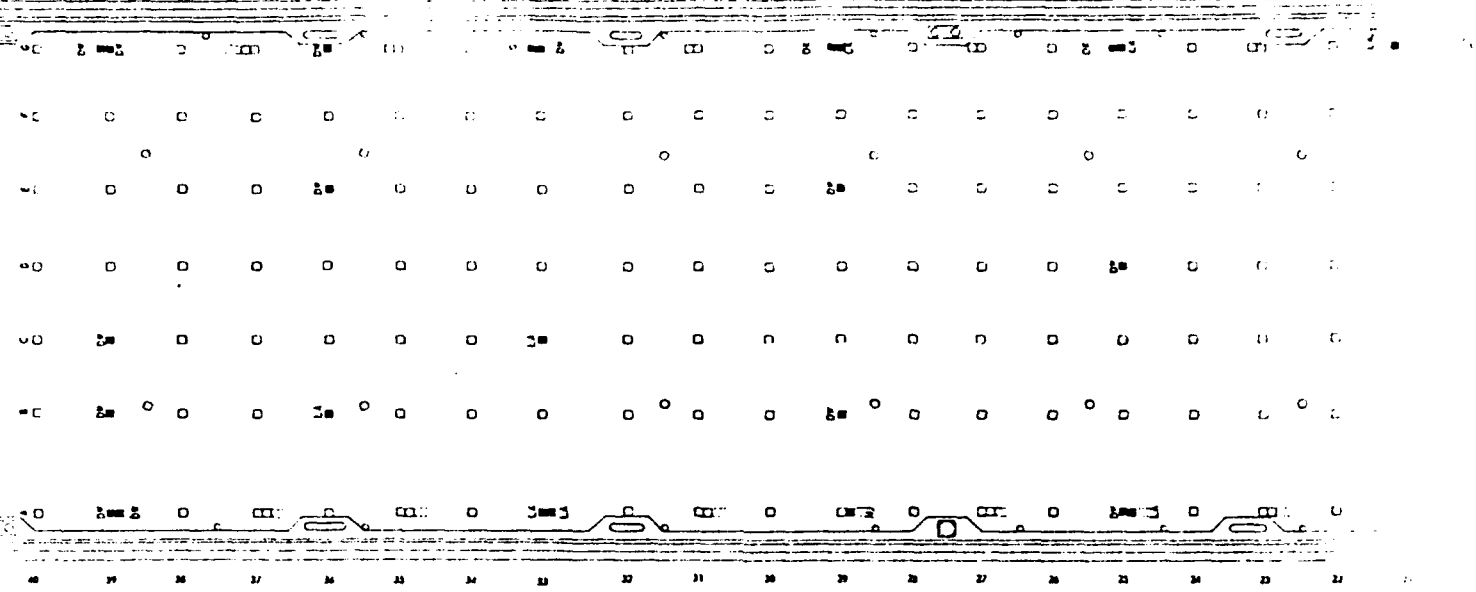
PIER L (LIMA) - US NAVAL STATION - GUANTANAMO BAY
INSPECTION PLAN

FIGURE 14

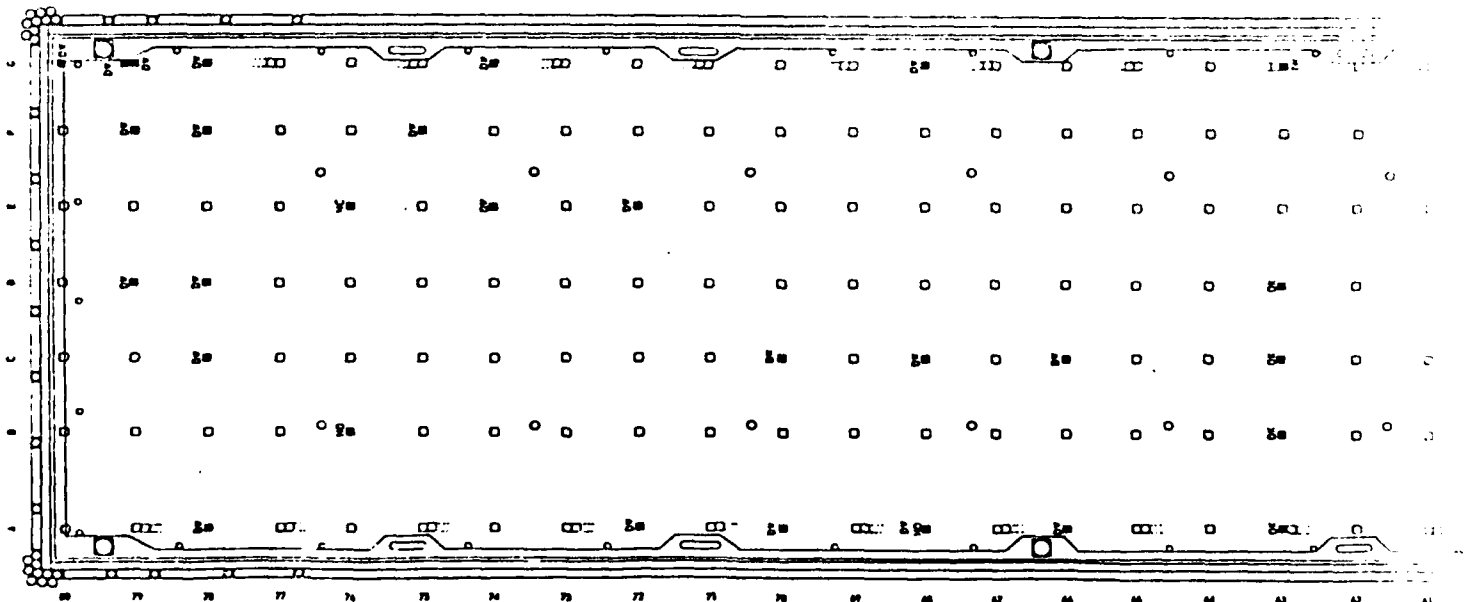


UNINSPECTED PILE UNINSPECTED PILE BATTER PILE LA - LABINATIONS VISIBLE
DE - NOT READILY VISIBLE PROBLEMS DR - DETECTION POINTS
NC - NOT CONNECTED

PILE ROW DESIGNATION

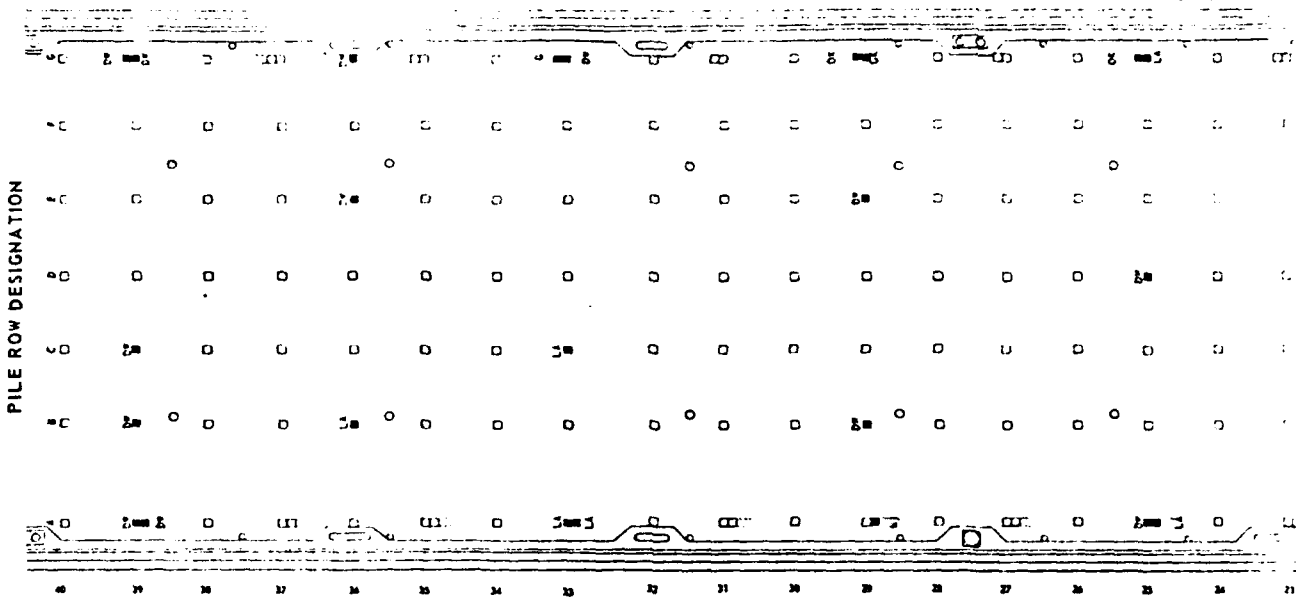


PILE PLAN - INSHORE HALF OF PIER L

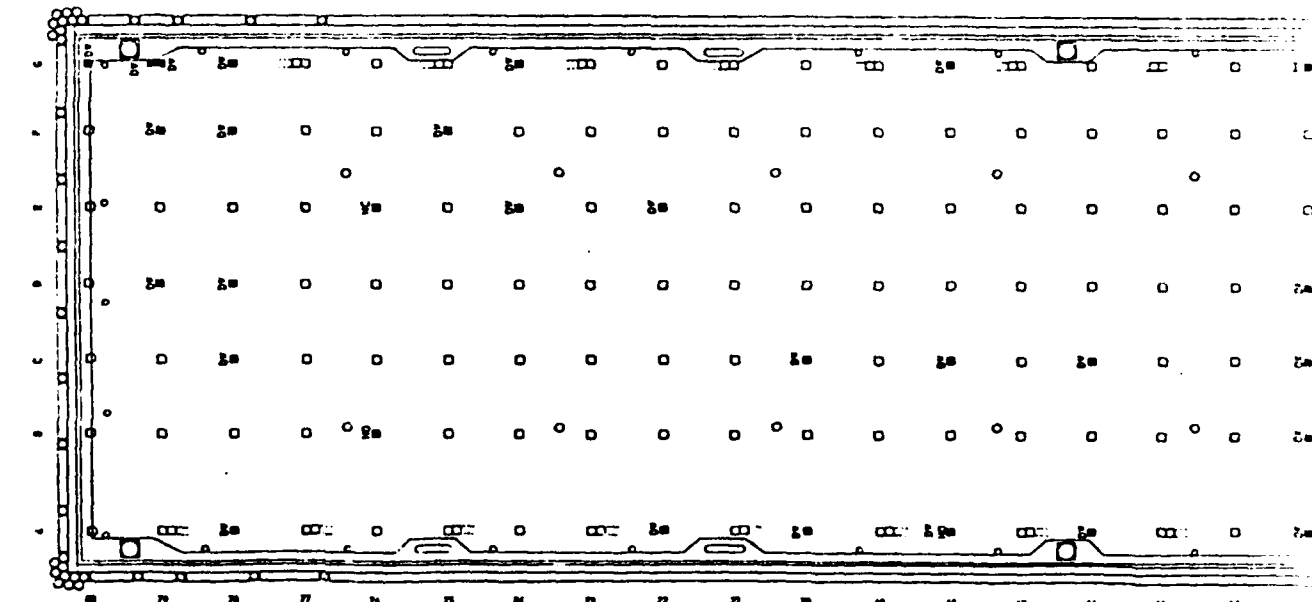


PILE PLAN - OFFSHORE HALF OF PIER L

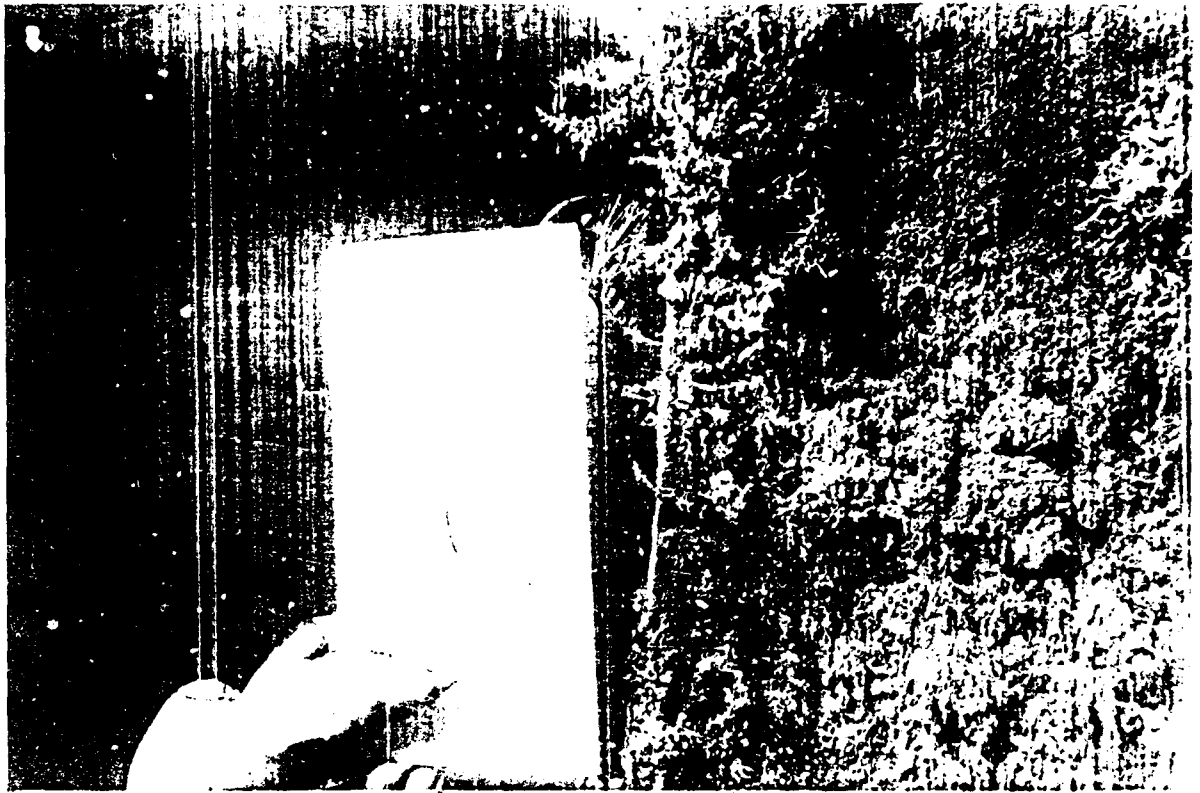
11-80-1
 B - INSPECTED PILE U - UNINSPECTED PILE D - BATTER PILE LA - EXAMINATION VISIBLE DE - NO REASON VISIBLE PROBLEMS



PILE PLAN - INSHORE HALF OF PIER L

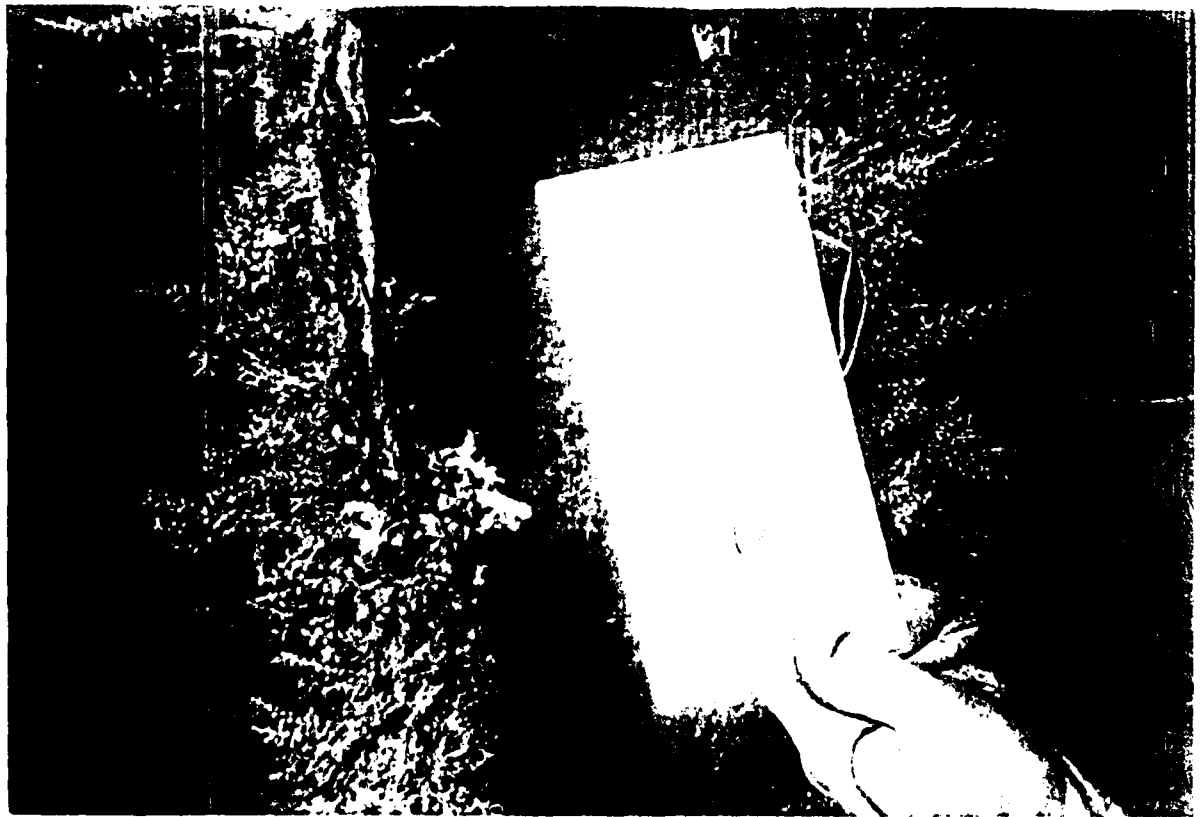


PILE PLAN - OFFSHORE HALF OF PIER L



SINGLE SHEET OF METAL OXIDE, PIER L; L - 20A

FIGURE 1



SEPARATION OF CORROSION LAYERS, PIER L; L - 45B

FIGURE 2



SEPARATION OF CORROSION LAYERS, PIER L; L - 80G

FIGURE 15

examined to see if the condition prevailed throughout the structure. Batter piles, or piles with readily apparent problems, were also inspected. Ninety piles of the approximately 729 H-piles supporting Pier Lima, were inspected. Of these ninety piles, seventy-eight were determined to be deteriorated to the extent that only minimal support can be provided by the H-pile. Typical examples of the H-pile deterioration are provided, as follows:

- o Figure 15: Deterioration is in the final stages and only a thinned piece of metal or a single oxide lamination remains.
- o Figures 16 and 17: Separation of laminations as corrosion product expands.

Additional designations of damage or deterioration are given both in Figure 14 and in Table L1.

CONCLUSIONS AND RECOMMENDATIONS

The utilization of Pier L should be severely reduced or eliminated until a detailed diver inspection can be performed to evaluate the extent and

TABLE 11. RESULTS OF INSPECTION OF PIER LIMA
MAIN SUPPORT PILING AND BATTER PILES

BENT NO.	PILE							BATTER PILE	
	A	B	C	D	E	F	G	A	B
13	OK	OK	DW	DW	DW	OK	DW		LA DW
14	OK		DW			DW			
15									LA
16	OK		DW				DW		
20	DW		DW				DW/LA		
21				DW				LA	LA
25	DW				DW			OK	OK
29		DW						NJ	OK
33	LA		LA					LA	
36		LA			DW			DW	
39	DW	DW	DW					DW	DW
42	LA					DW		LA	
45		LA		LA	LA			LA	
50	LA		DW			LA DW	LA DW		
53			LA		LA		DW		
56	LA				LA				
59	LA					LA/HO			
63	OK	OK	OK	OK			TH		
66	DW		DW						
68	DW, HO		DW				DW		
70	DW		DW						
72	DW				DW				
74					DW			DW	
75						DW/HO			
76		HO			NC				
78	DW		DW	DW		DW	DW		DW
79						DW	LA		
80									

CODE: DW - DECREASING WIDTH; LA - CORROSION LAYERS; OK - NO OBSERVED DAMAGE; HO - HOLE; NC - NOT CONNECTED; NJ - NO JACKET; TH - THIN SECTION. THE PILES AT BENT NOS. 1-12 WERE IN SATISFACTORY CONDITION.

severity of deterioration. It is recommended that:

- o The concrete collars be removed from the H-piles and replaced with an effective system.
- o An effective fender and batter pile system be designed and maintained to provide adequate protection to the pier structure.
- o The connections between the concrete cap and stringer support system be repaired to enable the H-piles adequately to support the pier.

PIER D (DELTA)

DESCRIPTION

Pier D is an open-type reinforced concrete pier that is approximately 295 feet long with a varying width from 14 to 30 feet. The concrete cap and deck structure is supported on precast reinforced concrete piles arranged in thirty bents containing a varying number of piles with a maximum of four bearing piles and two batter piles per bent. This arrangement, together with pile designations, is shown in Figure 18.

INSPECTION RESULTS

The underwater condition of the piles below the mean low water line appears good. The divers did not find any underwater deterioration which would be detrimental to the overall structure. The concrete pile caps, the deck support stringers, and the fender system are deteriorated and should be repaired. Typical examples are shown in the following:

- o Figure 19: Exposed reinforcing bar of pile caps and stringers.
- o Figure 20: Destroyed fender system.
- o Figure 21: Fungus rot of fender pile top and anodic degradation of cleat.
- o Figure 22: Destructive camel system.
- o Figure 23: Deteriorated repair of pile top and stringer.
- o Figure 24: Limnoria attack and fungus rot of dolphin piles.

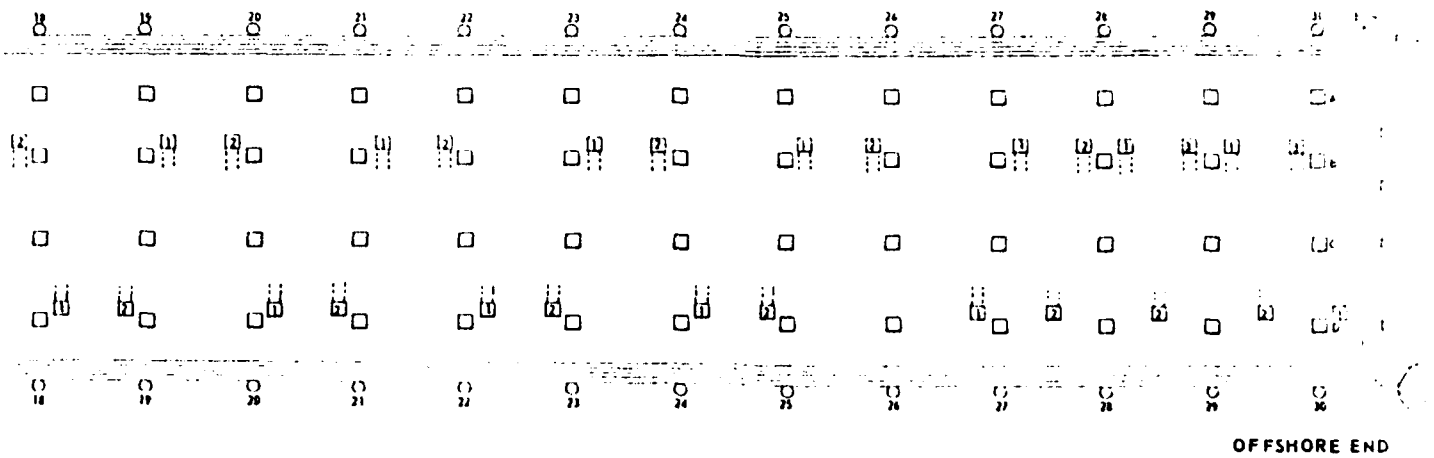
Areas of deterioration can be determined by reference to Figure 24A.

CONCLUSIONS AND RECOMMENDATIONS

Future utilization of Pier D will depend upon the rate of progressive deterioration of the pier structure. It is recommended that:

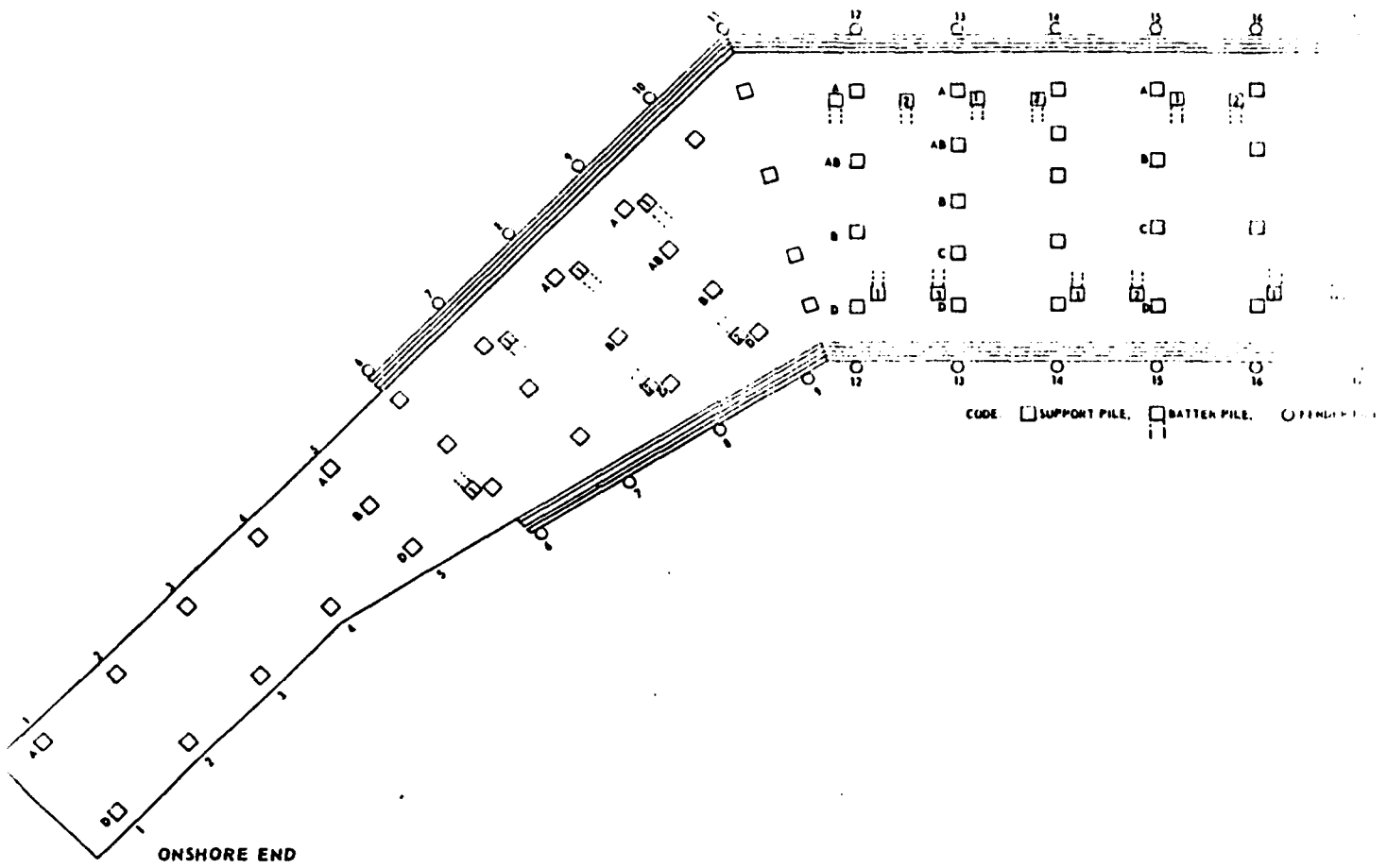
- o Repairs to the deteriorated concrete be initiated, as soon as possible.

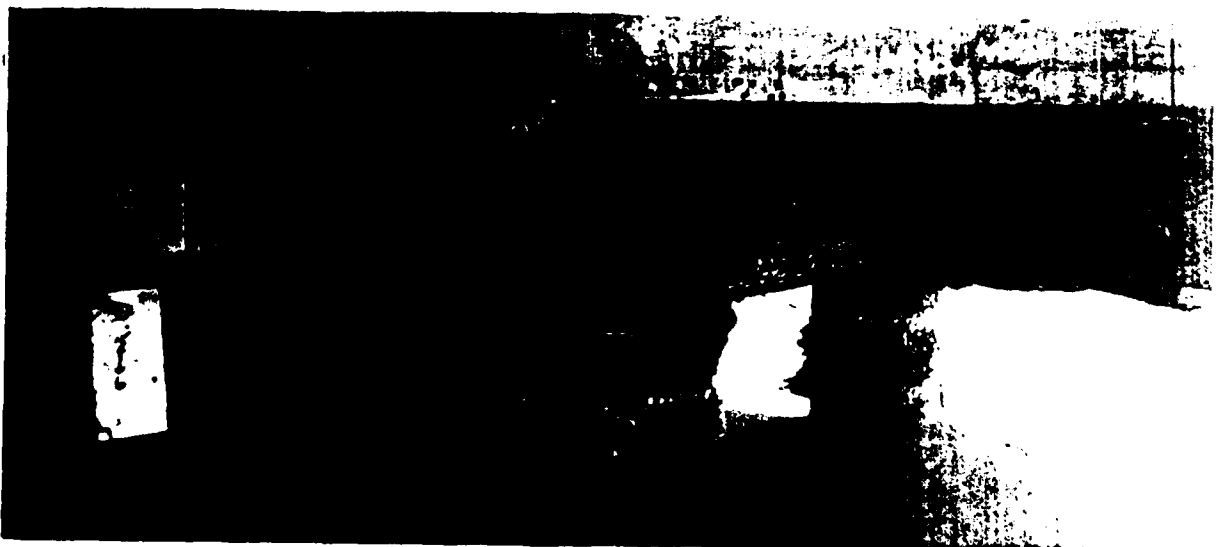
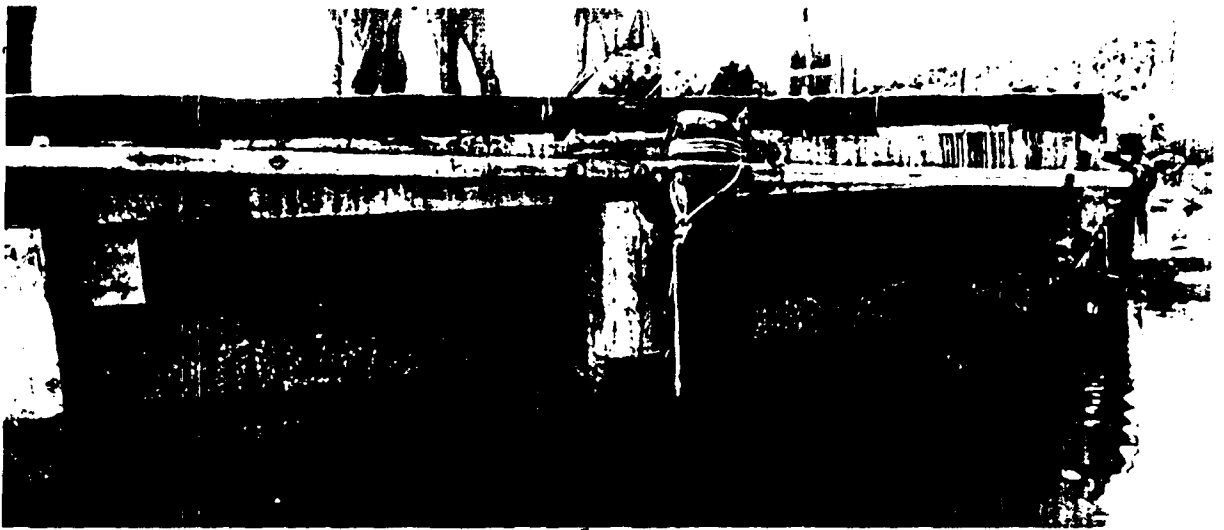
FENDER PILE CLUSTER



PIER D (DELTA) - U. S. NAVAL STATION - GUANTANAMO BAY
INSPECTION PLAN

FIGURE 1a





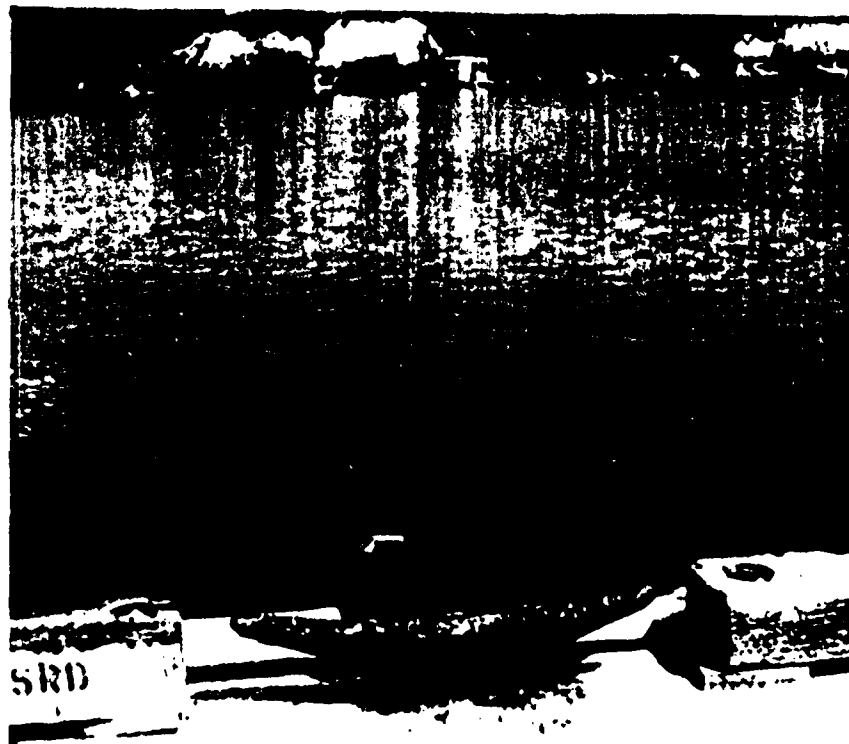
EXPOSED REINFORCING BAR OF PILE CAPS AND DECK BEAMS, PIER D

FIGURE 1



DESTROYED FENDER SYSTEM; PIER D

FIGURE 20



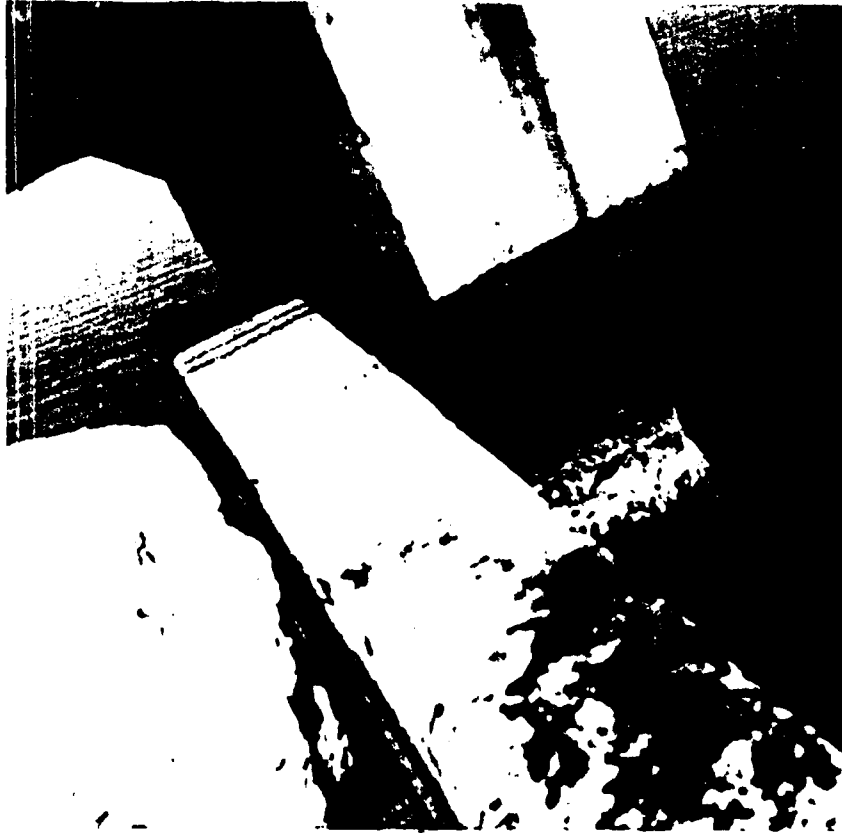
FUNGUS ROT OF FENDER PILE TOP
AND ANODIC DEGRADATION OF CLEAT;
PIER D

FIGURE 21



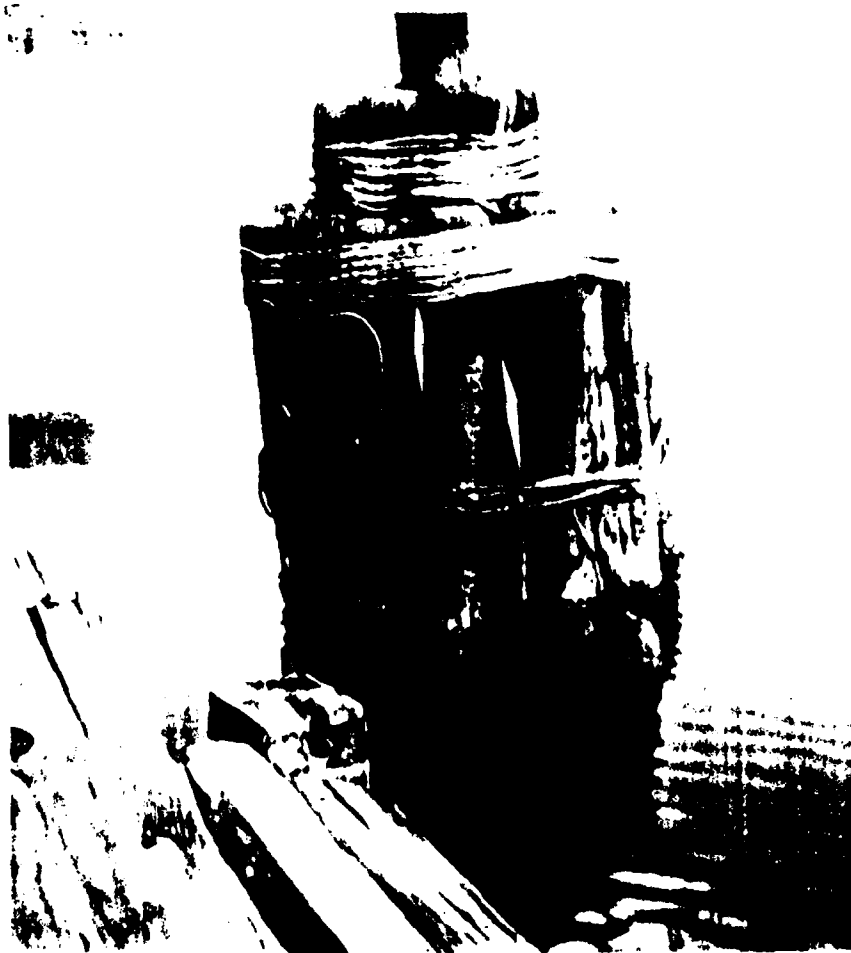
DESTRUCTIVE CAMEL SYSTEM; PIER D

FIGURE 22



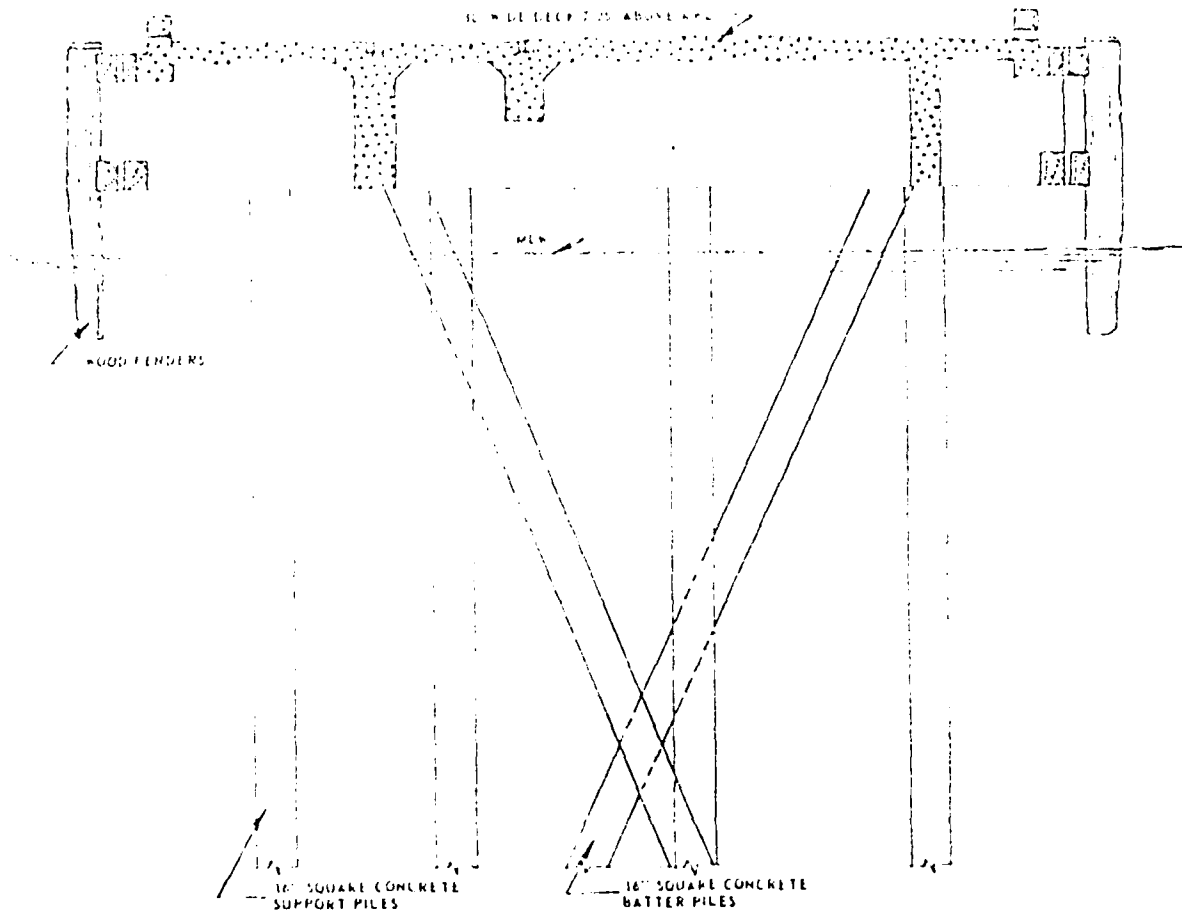
DETERIORATED REPAIR OF PILE TOP
AND DECK BEAM; PIER D

FIGURE 23



LIMNORIA ATTACK AND FUNGUS ROT OF
DOLPHIN PILES; PIER D

FIGURE 24



CROSS SECTION OF PIER DELTA

FIGURE 24A

- o The present system of floating wood camels be removed from contact with the pier and that a camel system be designed and installed in a manner that is not detrimental to the structure.
- o The fender system be repaired and maintained to prevent destruction of the pier support system.
- o The pile tops be treated and capped to prevent fungus rot.
- o Dolphin piles be removed or repaired and protected to prevent degradation by limnoria attack.
- o Deck hardware be protected by isolation or protective coatings applied to prevent accelerated degradation by concrete. Deck hardware degrades because it is anodic to the passivated steel within the adjacent concrete.

PIER Q (QUEBEC)

DESCRIPTION

Pier Q is an open-type timber pile pier approximately 180 feet in length and 30 feet wide located on the Leeward Side of Guantanamo Bay. The timber deck is supported by timber piles arranged in 19 bents with four bearing piles and two to four batter piles per bent as shown in Figure 25. The pier is protected by four timber and steel dolphins and a timber fender system. Overall views of Pier Q are provided in Figure 26.

INSPECTION RESULTS

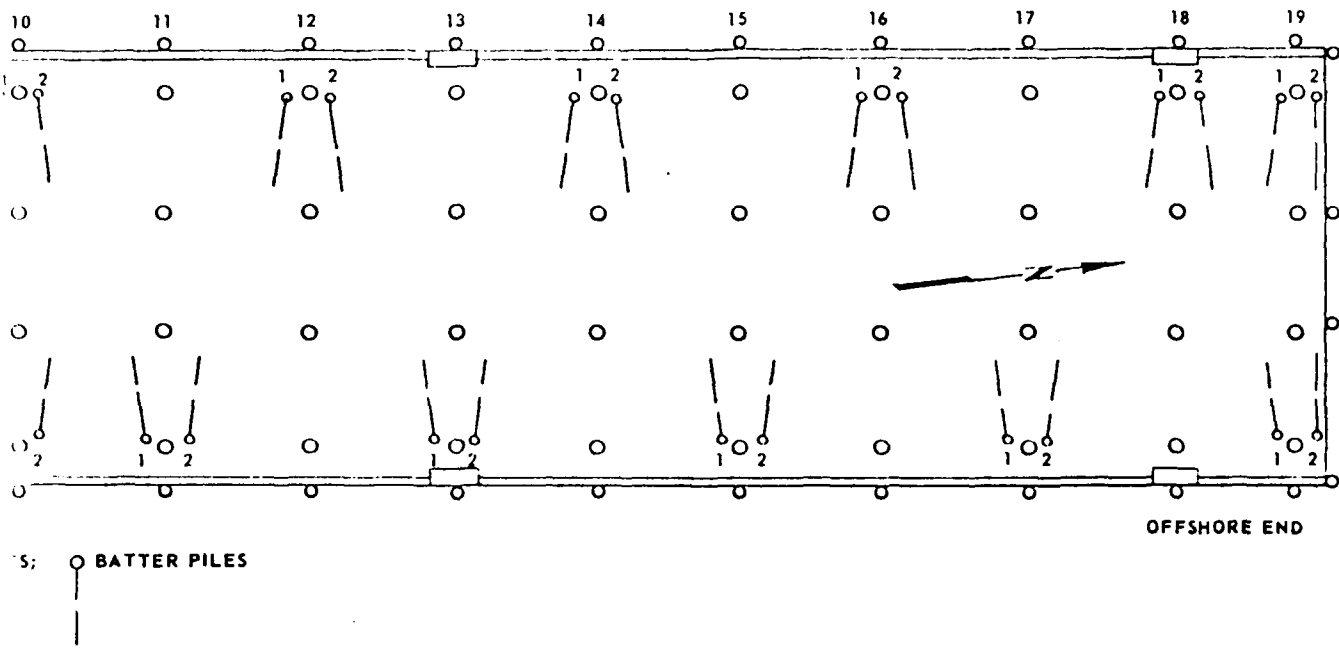
The creosoted timbers, utilized as bearing and batter piles, are beginning to show the effects of limnoria attack. Piles in the protective dolphins have experienced *hour-glassing* and some of the piles have separated. The tops of the pier fender piles and the timber piles in the dolphins are being seriously degraded by fungus rot. Typical examples of the deterioration are shown in the following:

- o Figure 27: Hour-glassing of piles Bent 11, Bent 12, and Bent 16 batter piles.
- o Figure 28: Fungus rot of fender piles.
- o Figure 29: Degradation of dolphin piles by limnoria attack showing hour-glassing and complete separation.

CONCLUSIONS AND RECOMMENDATIONS

Future utilization of Pier Q will depend on the rate of progressive deterioration of the pier structure. It is recommended that:

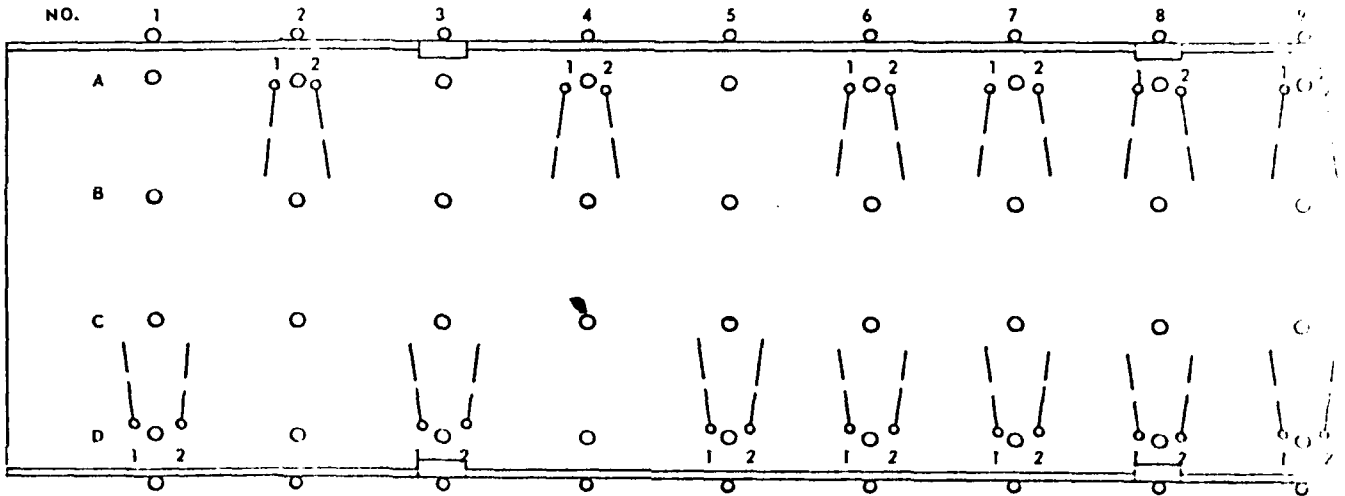
- o Repairs to dolphin piles be initiated as soon as possible to prevent damage to the pier structure.
- o Repairs to the underwater portion be initiated to prevent further deterioration of sound piles.
- o Pile tops be coated and capped to prevent fungus rot.



PIER Q (QUEBEC) - U. S. NAVAL STATION - GUANTANAMO BAY
INSPECTION PLAN

FIGURE 25

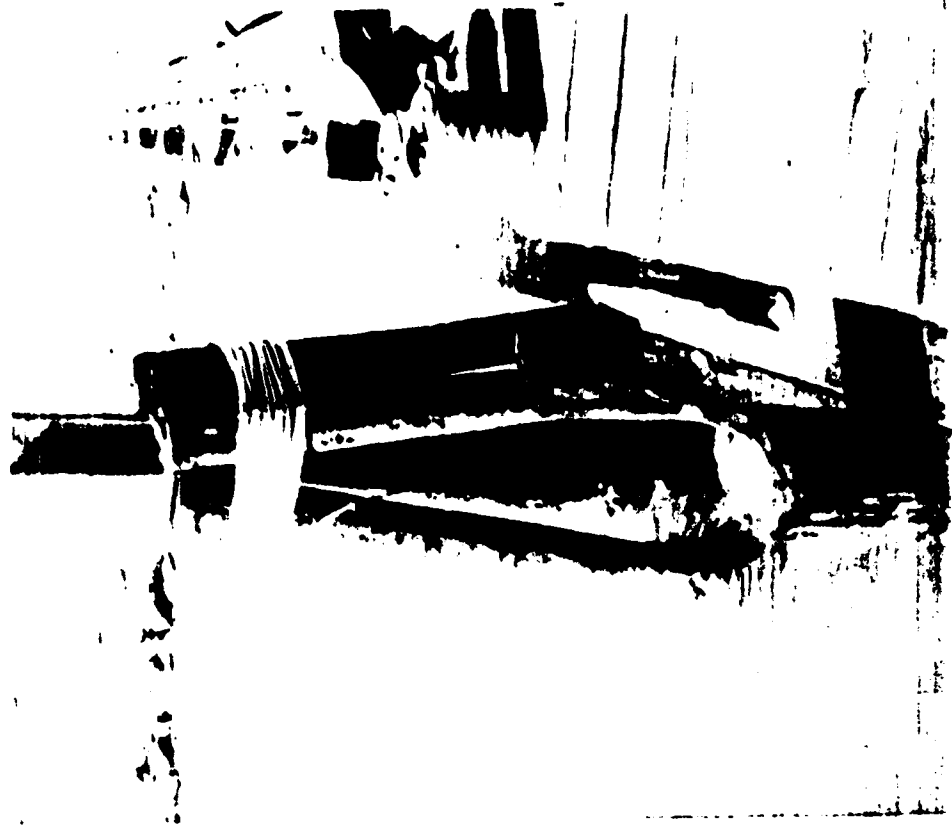
BENT
NO.



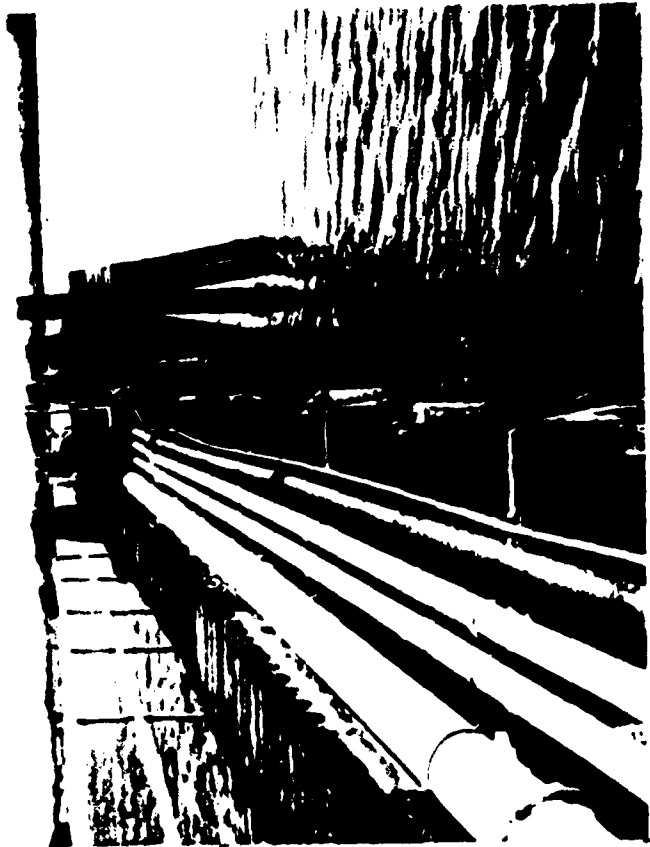
ONSHORE END

CODE: ○ SUPPORT PILES; ○ FENDER

ALL PIERS AND PILES ARE TYPICAL

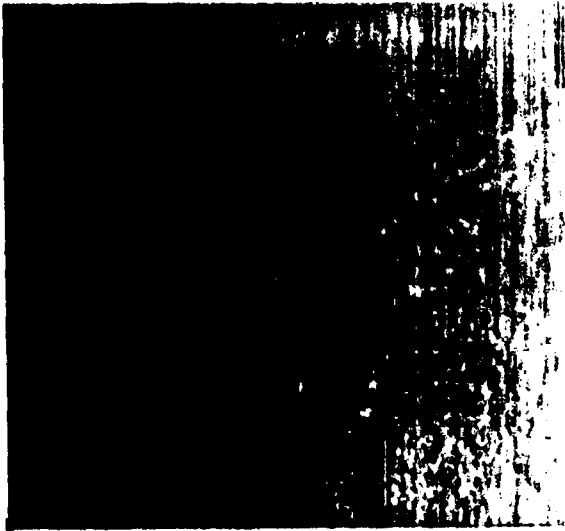


LOOKING SOUTH
FIGURE 24

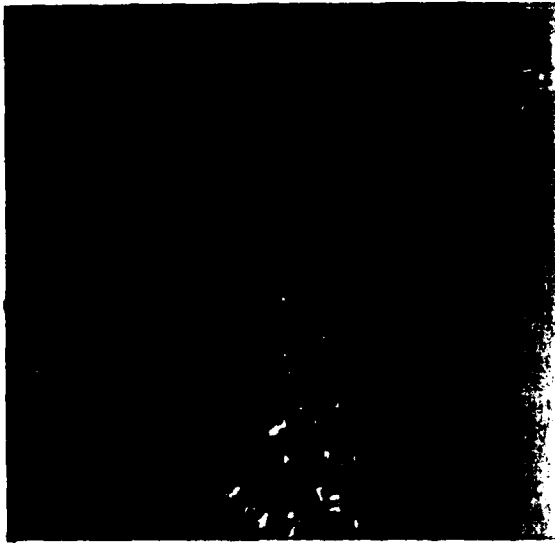


LOOKING NORTH

OVERALL VIEW OF PIER Q, MAMOHILLA BAY



BENT 11



BENT 12



HOUR-GLASSING OF PILES; PIER Q

BENT 16 - BATTER PILE
FIGURE 27

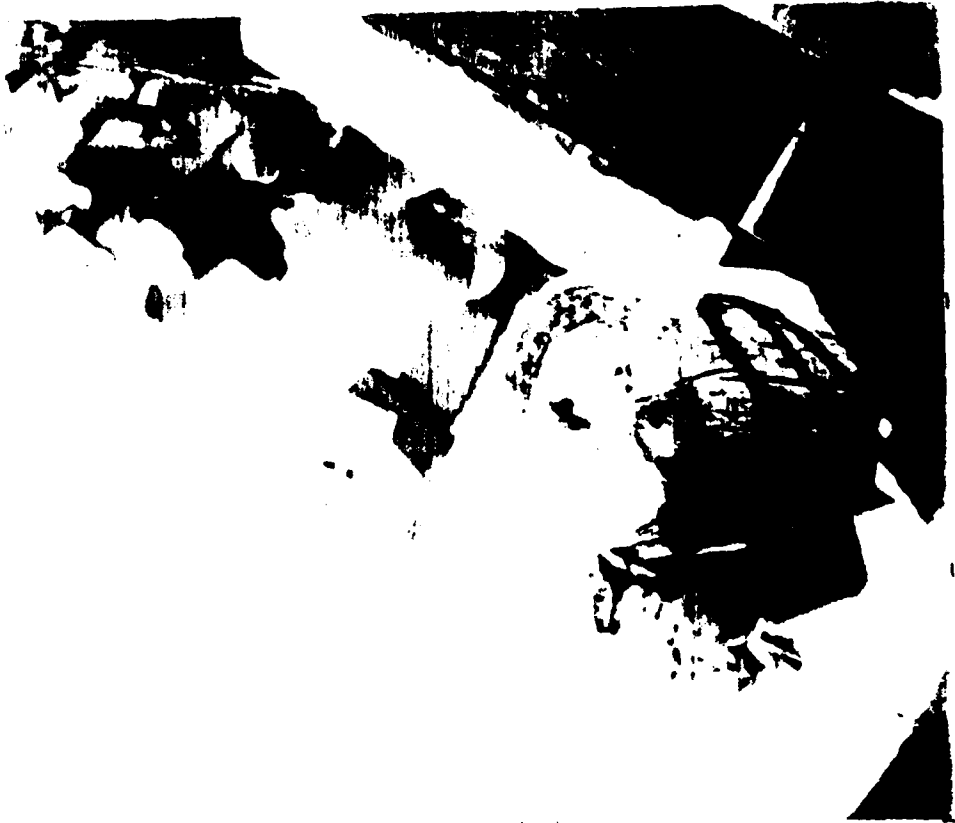
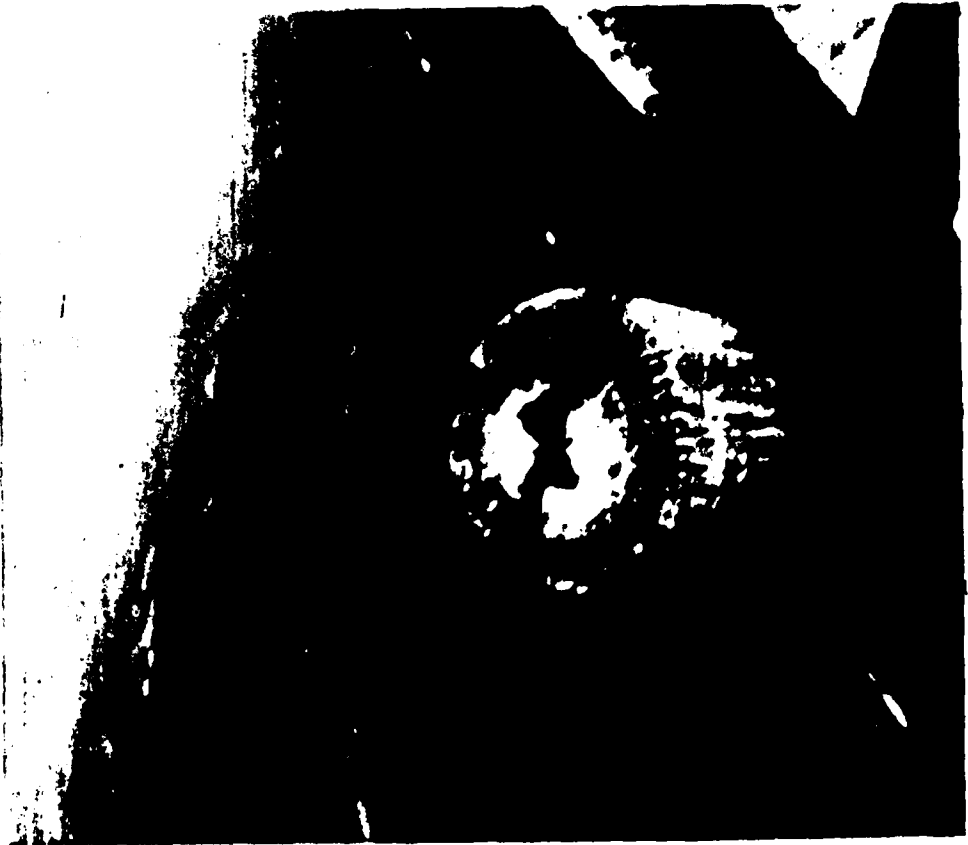
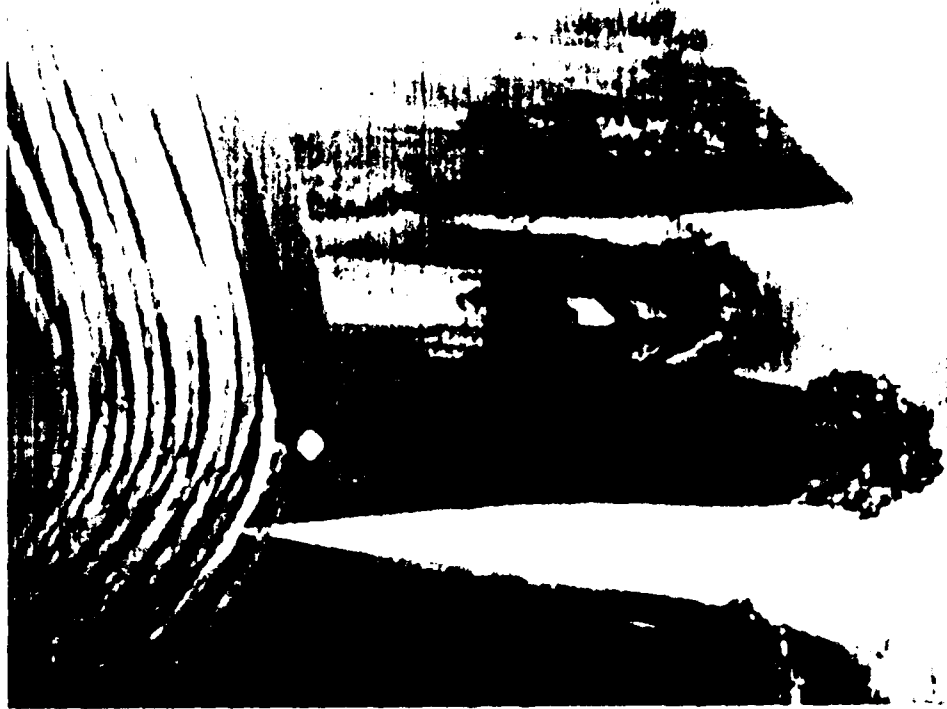


FIGURE 28



FUNGUS ROT OF FENDER PILES; PIER Q



DEGRADATION OF DOLPHIN PILES: LIMNORIA ATTACK; PIER Q

FIGURE 23

PIER C (CHARLIE)

DESCRIPTION

Pier C is an open-type pier 370 feet long and 34 feet wide. The concrete cap and deck structure is supported by twenty-five bents with four bearing piles and two batter piles per bent. The piles are pre-cast, reinforced concrete piles approximately sixteen inches square as shown in Figure 30.

INSPECTION RESULTS

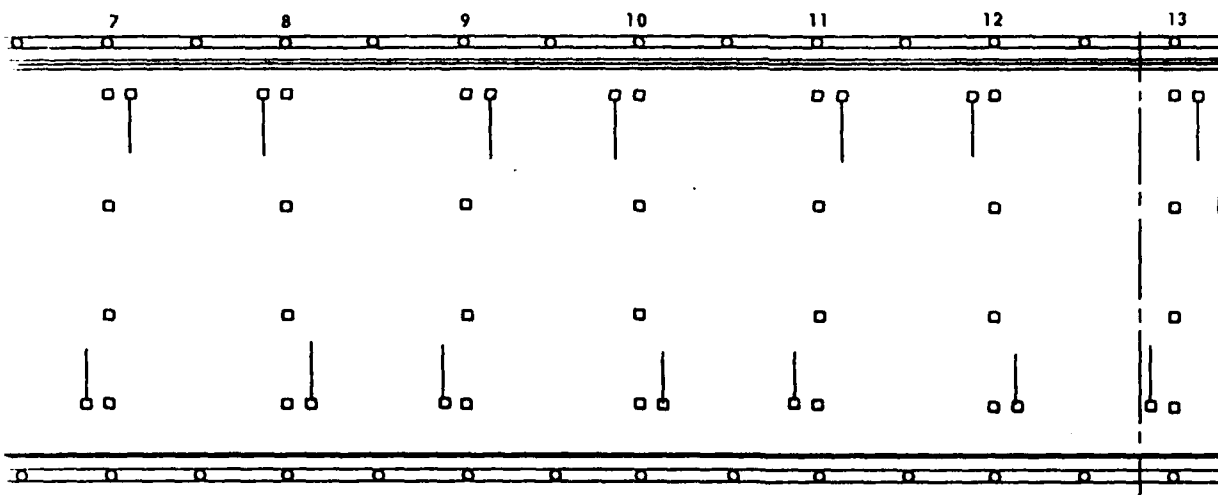
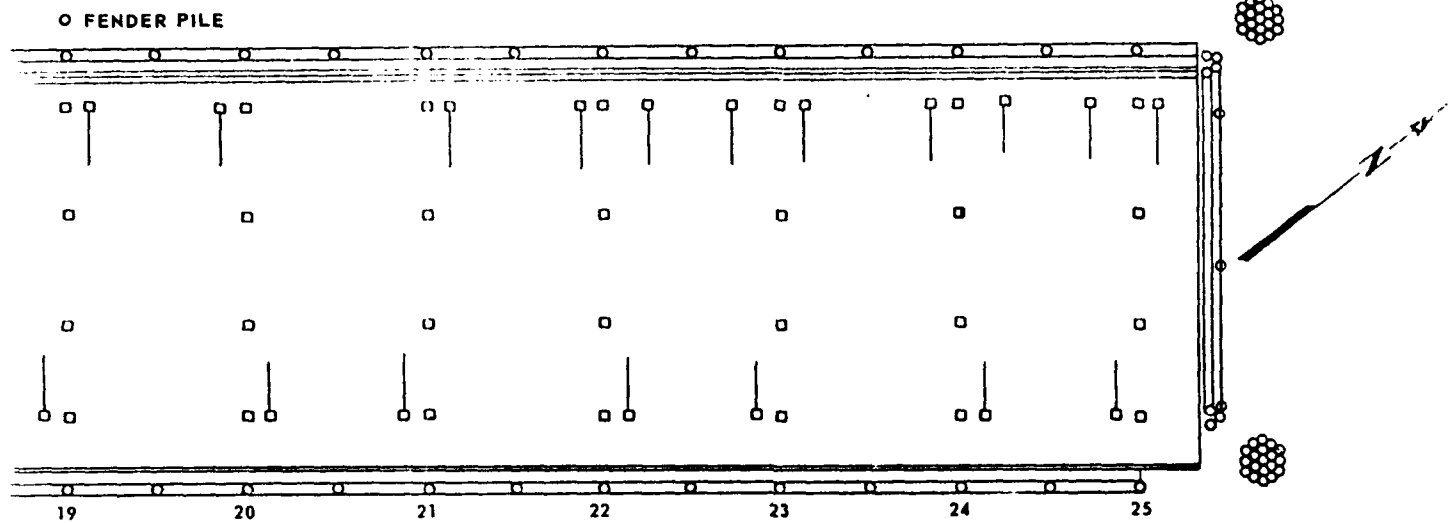
Where the piles or portions of caps and stringers have been repaired, the concrete sections have an increased cross-section. The underwater inspection revealed that there was some bleeding from seawater penetration to interior reinforcing steel in Bents 1, 7, and 9. Between Bents 17 and 18 the deck girder is cracked and some spalling is evident throughout the structure. The concrete over the steel fender piles is removed by the combined action of corrosion and the flexing of the fender pile. The sheet piling that surrounds the area adjacent to the end of Pier C is severely deteriorated at the top and bottom, and portions of the underwater sections are missing. Sufficient fill behind the sheet piling has been removed to cause visible sinking at the fill surface.

- o Figure 31: Deterioration of top portions of sheet piling and soil subsidence.
- o Figure 32: Spalling of concrete at fender tie-rod connection.
- o Figure 33: Spalling concrete cover of fender piles.

These areas of deterioration may be identified by reference to the pier cross-section shown in Figure 33A.

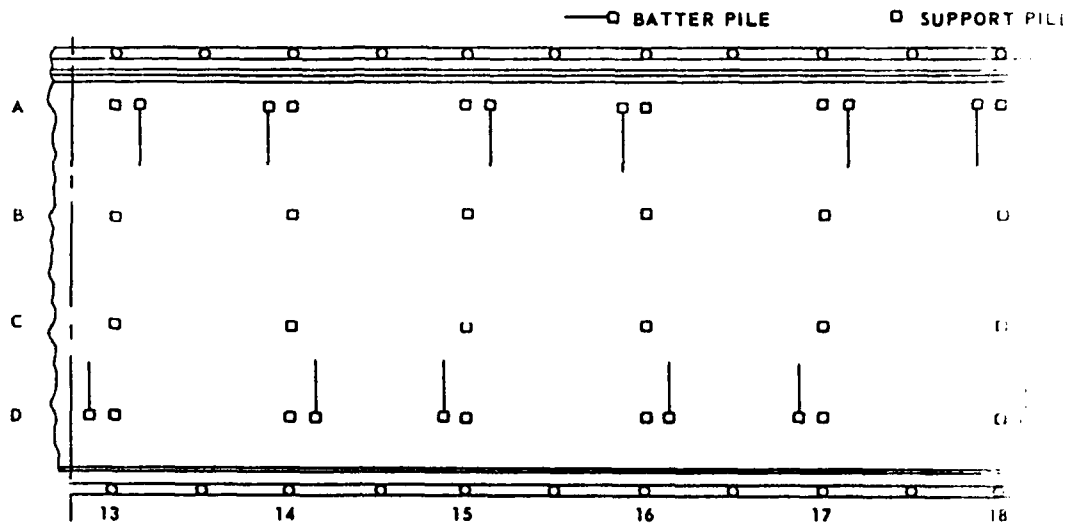
CONCLUSIONS AND RECOMMENDATIONS

Future utilization of Pier C will depend on the effective repair of the deteriorated portions of the structural portions of the pier. It is recommended that:

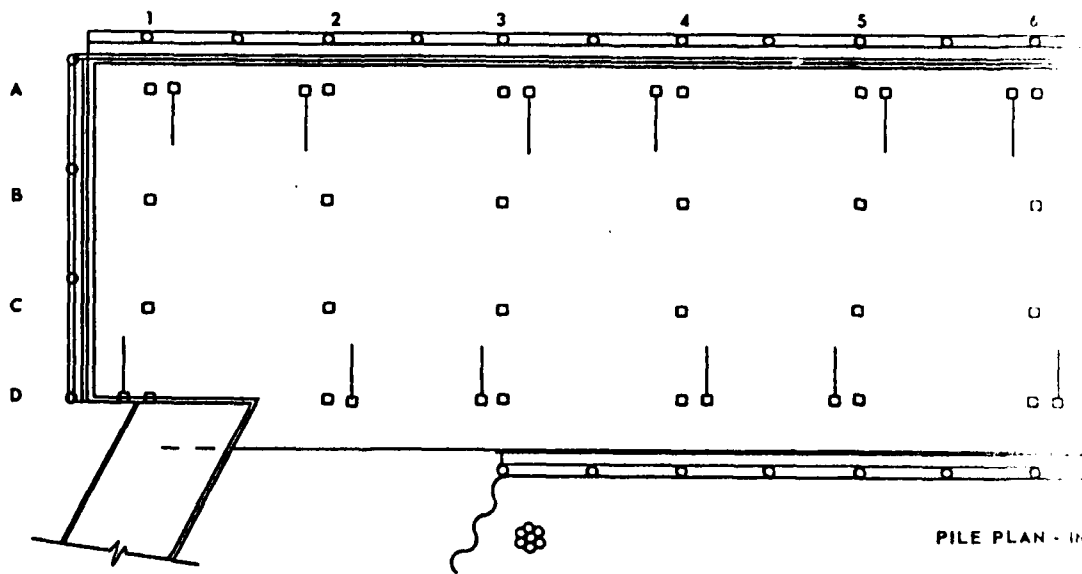


PIER C (CHARLIE) - U.S. NAVAL STATION - GUANTANAMO BAY
INSPECTION PLAN

FIGURE 1



PILE PLAN - EXTERIOR



PILE PLAN - INTERIOR

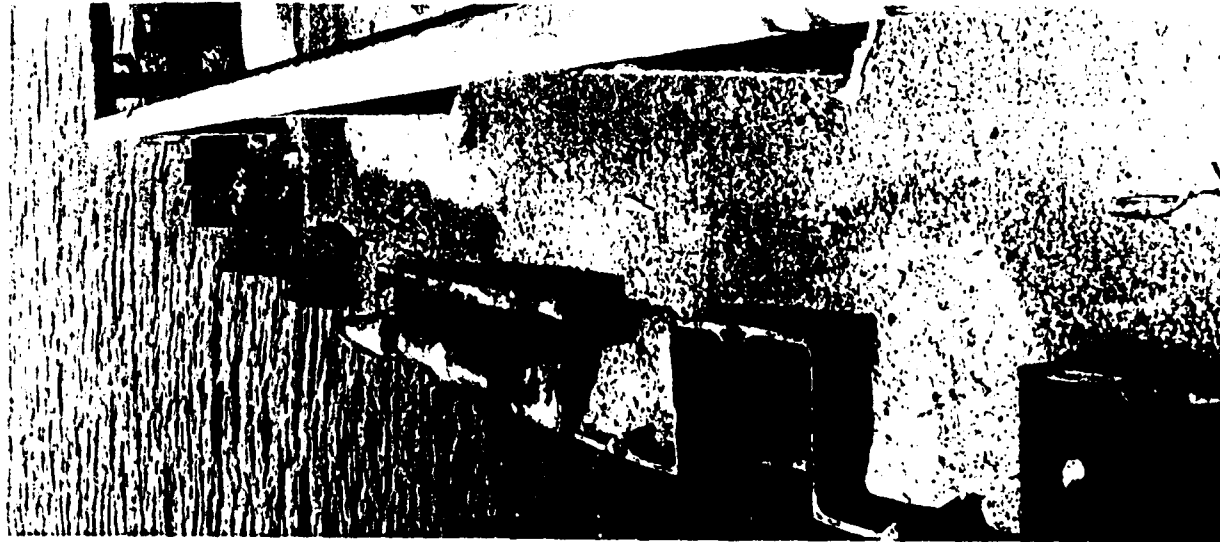
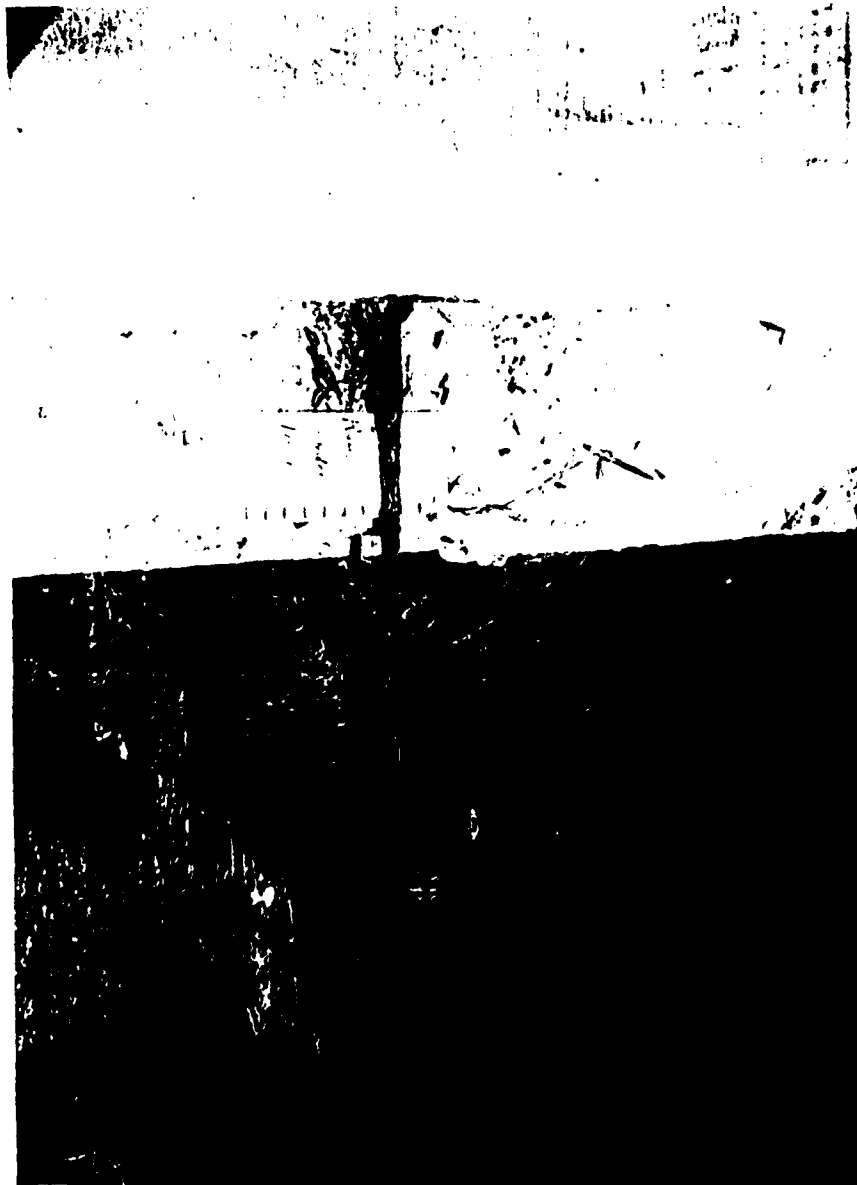


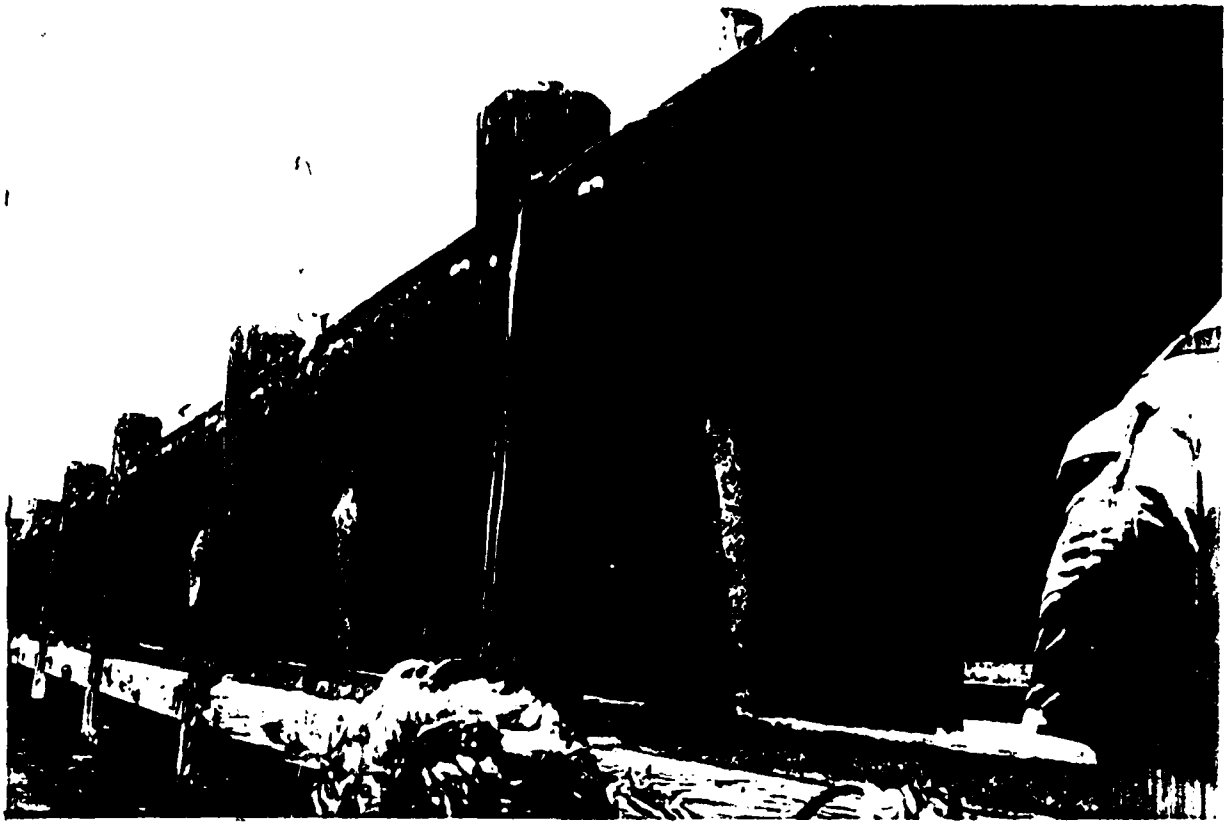
FIGURE 31

DETERIORATION OF SHEET PILING AND SOIL SUBSIDENCE, PIER C



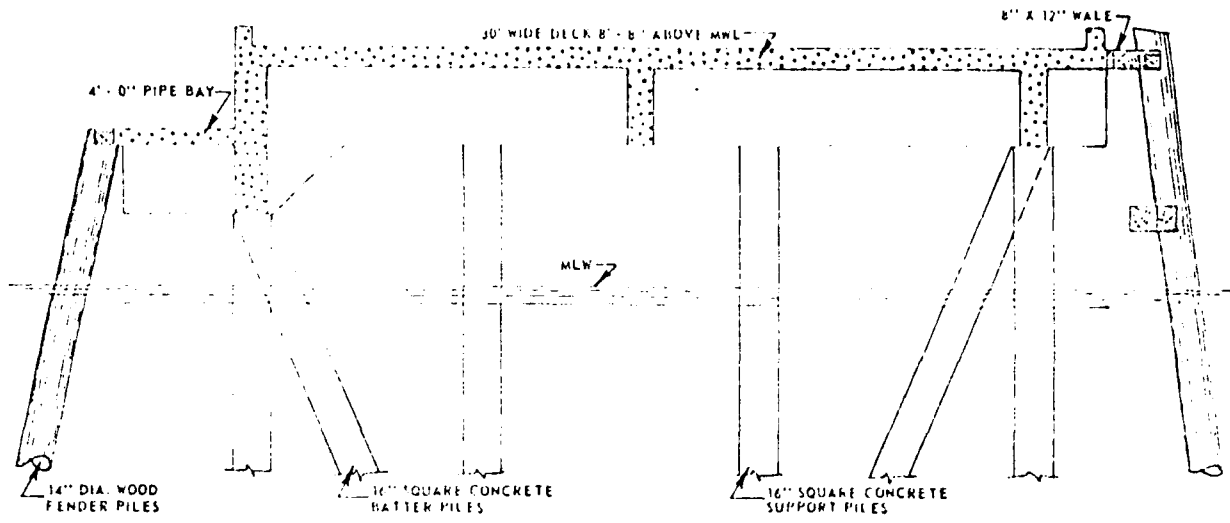
SPALLING OF CONCRETE AT FENDER TIE-ROD CONNECTION;
PIER C

FIGURE 32



SPALLING CONCRETE COVER OF FENDER PILES; PIER C

FIGURE 39



CROSS SECTION OF PIER CHARLIE

FIGURE 33A

- o The sheet piling be repaired to prevent further soil subsidence.
- o Repairs of spalling concrete, cracked girder, and areas of *bleeding* concrete be repaired to halt further deterioration of the structure.

MISCELLANEOUS FACILITIES

MOORING BB-1

Mooring BB-1 consists of two sheet pile caissons located approximately 300 feet apart. Between the two caissons, a concrete deck, 32 feet wide, is supported by approximately 20 bents with four bearing piles and two batter piles per bent. The batter and bearing piles consist of steel H-piles that are protected by a wooden fender pile, wales, and chocks, Figure 34. Deterioration of the H-piles and sheet piles is minimal and limnoria attack is beginning to show on the wooden sections of the mooring.

PIER A, WHARF B, WHARF T

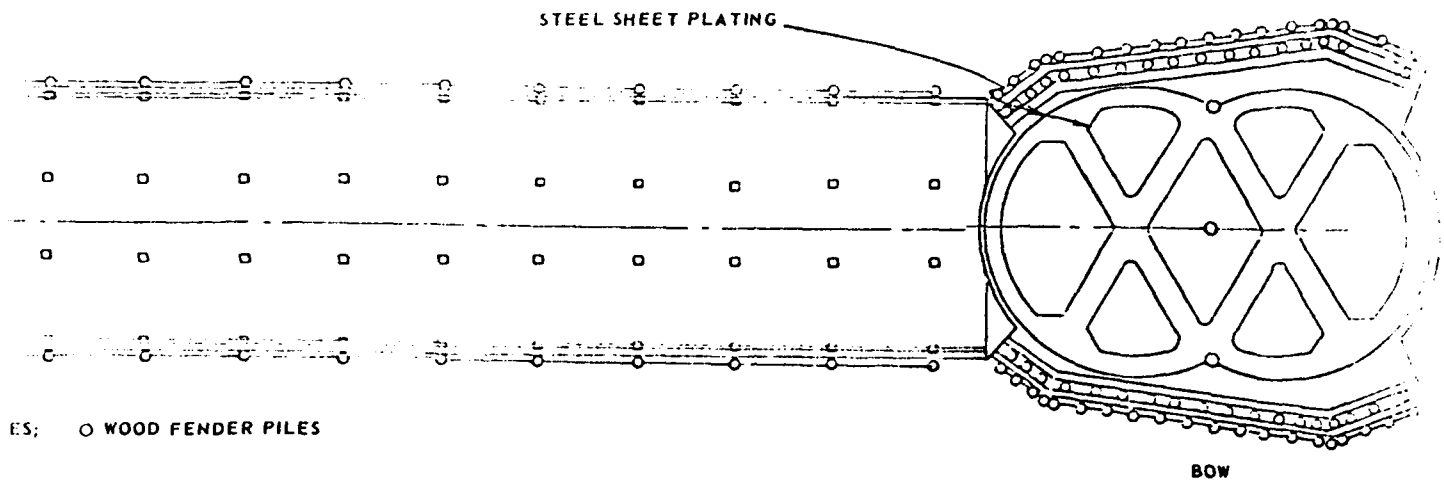
The underwater portions of Pier A, Wharf B, and Wharf T showed no significant deterioration. These waterfront structures appear to have been recently repaired and are in good condition.

QUAYWALL DETERIORATION

At several locations between Carinso Point and Radio Point, the quaywalls have been completely undermined because the supporting fill has been washed away. Extreme examples are shown, as follows:

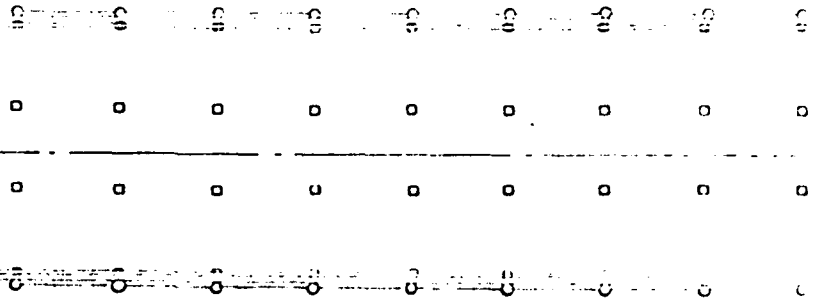
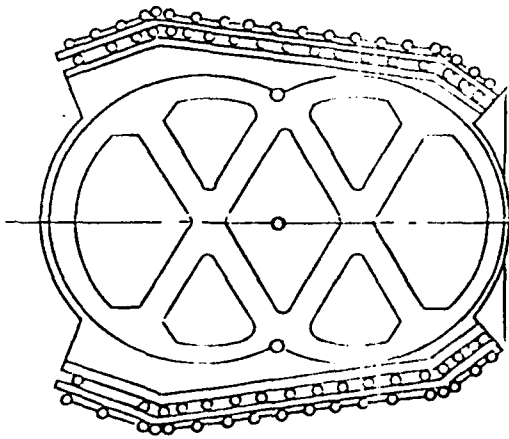
- o Figure 35: Quaywall between Pier V and L
- o Figure 36: Cement slabs behind quaywall between Piers C and D.

These quaywalls cannot protect the fill that supports the cement slabs, asphalt surface, etc., and should be repaired if the area behind these walls is to be utilized.



MOORING BB-1 - U. S. NAVAL STATION - GUANTANAMO BAY
INSPECTION PLAN

FIGURE 34



STERN

CODE: □ STEEL H-BEAM 50



QUAYWALL BETWEEN PIER V AND L

FIGURE 35



CEMENT SLABS BEHIND QUAYWALL BETWEEN PIER D AND C

FIGURE 36

GENERAL CONCLUSIONS AND RECOMMENDATIONS

WATERFRONT FACILITY INSPECTION RECORDS

For effective utilization of waterfront facilities inspection, precise records of the past, present, and anticipated future condition of each structure should be maintained. All photographs, slides, and sketches should have a small sign designating the pier or wharf location along the pier or wharf, and depth or vertical position. Other designations which accurately describe the location of all waterfront structures should be established by the facility and maintained in all records. As a minimum, the following data should be assembled:

- o Up-to-date simple schematics that disclose the location of each pile, quaywall section, surface condition, etc.
- o The location, type, and severity of any deterioration that is located in all inspections.
- o Photographs which document the type of deterioration, the progression of the deterioration, and the repair of each pile, quaywall section, or fender system.
- o Official as-built drawings including drawings utilized for repair and new construction.
- o Specifications for repair of waterfront facilities.

The availability of these data will enable the facility to schedule maintenance, repair, and inspection so as to ensure maximum utilization of a waterfront facility with minimum cost and effort.

FUTURE INSPECTIONS AND REPAIRS

On the basis of the underwater inspection of the waterfront structures at Guantanamo Bay, Cuba, the following conclusions are reached:

- o Underwater inspections should be performed by divers on a regularly scheduled basis in order to verify or locate structural deterioration and to identify maintenance requirements in a timely and cost-effective manner.

- o Repairs to underwater structures should be designed for the environment and installed under effective quality control to verify compliance with specified application procedures.

GENERAL RECOMMENDATIONS

Specific recommendations have previously been provided for each structure inspected. The following general recommendations apply to all of the utilized waterfront facilities:

- o Detailed underwater inspections should be scheduled for all facilities in order to establish the extent of underwater damage and deterioration, the requirements for repairs, or the need to de-rate the facilities for damage control or safety reasons.
- o Repairs to the waterfront facilities should be scheduled, as needed, to prevent further degradation of facilities and to avoid safety problems.
- o Procedures or warnings concerning constraints on the docking at piers and wharves should be provided to all vessels utilizing the facilities in order to prevent inadvertent *mechanical damage*.
- o Utilization of piers or fenders which have been damaged should be minimized until repairs have been completed. Docking which impacts directly onto the piling should not be allowed; and temporary fendering or camels should be provided where permanent fenders have been destroyed and are awaiting repairs.
- o A minimum of three and one-half inches of appropriately mixed concrete or grout should be applied to cover any reinforcing bar or mesh in any repairs or pier deck beams, pile caps, or pile protective covers.
- o With respect to Pier L, utilization should be reduced. As recommended in reference 7, an engineering inspection and repairability assessment should be undertaken immediately to establish repair requirements and interim de-rating criteria. (These recommendations were implemented and the results are reported in reference 8.)

REFERENCES

- (1) CNO LTR SER 44/391983 of 29 Mar 1979
- (2) NAVSTA GTMO LTR 11000 SER 1281 undated (approximately early Dec. 1978)
- (3) COMBLANT MSG 0:1931Z Jun 79
- (4) UCT ONE MSG 081805Z Jun 79
- (5) UCT ONE MSG 081803Z Jun 79
- (6) Unpublished data; "Pier Inspections at the Naval Station, Guantanamo Bay, Cuba" by LT R. H. Mayer, AOIC ONE, Little Creek, Va. 1976
- (7) "Point Paper on the Preliminary Underwater Survey of Pier L at Guantanamo Bay, Cuba" by Jack E. Baber, dated July 1979
- (8) "Report and Recommendations; Underwater Damage Assessment, Pier Lima, Naval Station, Guantanamo Bay, Cuba" by Wiswell, Inc., Southport, Connecticut, dated 29 August 1979

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