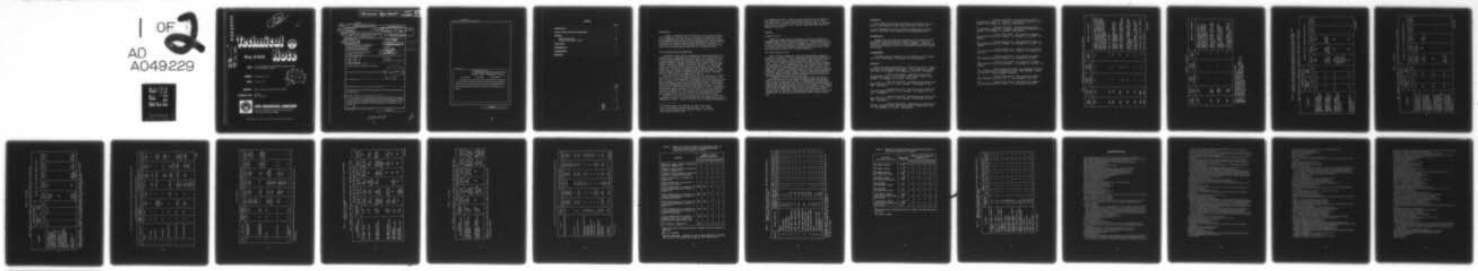
AD-A049 229 CIVIL ENGINEERING LAB (NAVY) PORT HUENEME CALIF F/G 13/13
1977 INSPECTION OF EXPERIMENTAL MARINE PILING AT PEARL HARBOR, --ETC(U)
NOV 77 T ROE

UNCLASSIFIED CEL-TN-1505 NL

1 OF 2
AD A049229



END
DATE FILMED
3-78
DDC

CONT


OF
9229

12

Technical Note

CEL

TN no. N-1505

title: 1977 INSPECTION OF EXPERIMENTAL MARINE PILING AT PEARL HARBOR, HAWAII

author: Thorndyke Roe, Jr.

date: November 1977

sponsor: Naval Facilities Engineering Command

program nos: 61152N;
DNL Z-R000-147

CIVIL ENGINEERING LABORATORY
NAVAL CONSTRUCTION BATTALION CENTER
Port Hueneme, California 93043

Preceding Page BLANK - NOT FILMED

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: TN-1505	2. GOVT ACCESSION NO.: DN244075
3. RECIPIENT'S CATALOG NUMBER: Technical note	
4. TITLE (and Subtitle): 1977 INSPECTION OF EXPERIMENTAL MARINE PILING AT PEARL HARBOR, HAWAII	5. TYPE OF REPORT & PERIOD COVERED: Not Final; Apr 1976—Apr 1977
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(S): Thorndyke Roe, Jr.	8. CONTRACT OR GRANT NUMBER(s): 16 ZR000 01; 17 ZR4126
9. PERFORMING ORGANIZATION NAME AND ADDRESS: CIVIL ENGINEERING LABORATORY, Naval Construction Battalion Center, Port Hueneme, California 93043	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 61152N; DNL Z-R000147
11. CONTROLLING OFFICE NAME AND ADDRESS: Naval Facilities Engineering Command, Alexandria, Virginia 22332	12. REPORT DATE: November 1977
	13. NUMBER OF PAGES: 23
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): 12 29p.	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

DDC RECEIVED JAN 31 1978 F

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Pile structures, marine borers, marine borer prevention, wood preservatives, biodeterioration, and intertidal zone.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The cooperative-, CEL-, and CEL/Industry-treated piles at Pearl Harbor were inspected by a diver in April 1977. The remaining cooperative-treated piles are performing satisfactorily as are many CEL- and CEL/Industry-treated piles. These piles were impregnated with either creosote containing a toxic additive, a solution containing two toxic compounds, or a dual treatment.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

391 111

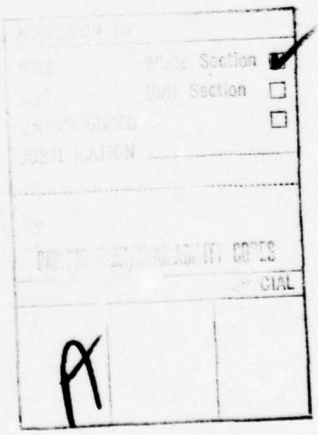
Library Card

Civil Engineering Laboratory
1977 INSPECTION OF EXPERIMENTAL MARINE PILING AT PEARL HARBOR, HAWAII, by Thorndyke Roe, Jr.
TN-1505 23 pp November 1977 Unclassified

1. Pile structures 2. Marine borers I. DNL Z-R000-147

The cooperative-, CEL-, and CEL/Industry-treated piles at Pearl Harbor were inspected by a diver in April 1977. The remaining cooperative-treated piles are performing satisfactorily as are many CEL- and CEL/Industry-treated piles. These piles were impregnated with either creosote containing a toxic additive, a solution containing two toxic compounds, or a dual treatment.

CONTENTS



INTRODUCTION

In order to determine the effectiveness of any proposed preservative treatment for wood piling, it is necessary to expose full-sized piles impregnated with that treatment in marine borer invested waters. To decrease the time required to obtain meaningful data without imposing any artificial conditions upon the evaluation method, exposures are carried out in tropical locations where marine borers and the rate of their attack are much greater than they are in temperate waters.

PILING INSTALLATIONS AND INSPECTIONS

From 1963 to 1976, the Civil Engineering Laboratory monitored two installations of experimentally treated piles. One installation [1] at Coco Solo Annex, Rodman Naval Station, Canal Zone, consisted of piles treated and supplied by the Cooperative Marine Piling Committee, an informal committee composed of representatives from the wood treating industry, The Forest Products Laboratory, and the W. F. Clapp Laboratories. Monitoring of these piles was discontinued after the 1976 inspection. The second installation [2-6] at Waipio Peninsula, Pearl Harbor, Hawaii, consists of Cooperative Marine Piling Committee piles plus four groups of CEL- and CEL/Industry-treated piles. The piles driven at Pearl Harbor are summarized in Table 1.

From the initial inspection through the 1974 inspection, the piles exposed at both sites were inspected visually from the surface of the water [7-14]. One interruption in the exposure at Pearl Harbor occurred when, in August 1972, 120 of the experimental piles were accidentally pulled and brought ashore by Harbor Cleanup Unit HCU-1. Those removed were 42 of the Cooperative Marine Piling Committee piles and the CEL piles driven in 1963 and the 78 CEL piles driven in 1965. An inspection revealed that many of these piles were either lost or were broken and could not be identified. Thus, only 51 of the original 120 piles removed were redriven: four of the 1963 piles (two Cooperative Marine Piling Committee and two CEL), and 47 of the 1965 CEL piles [13].

Because of the difficulties encountered in trying to observe submerged pile surfaces, it was decided that the 1975 inspections would be conducted by a diver. CEL let a contract to the Al Hanson Diving Service*

---

*Mr. Hanson has been the inspector of wood piles for the Port of Los Angeles for more than 25 years. Mrs. Hanson, who is both a licensed diver and diver tender, acts as his tender and records his data.

to accomplish this work. Similar contracts were let for the 1976 and 1977 inspections. Mr. Hanson reports the percentage loss of cross-sectional area of each pile caused by borer attack as well as the extent and location of the attack [15]. Splits, checks and other defects or damage are also noted.

FINDINGS

Cooperative Piles

Ammoniacal copper arsenite followed by creosote in Douglas fir, chromated copper arsenate followed by creosote in southern yellow pine, 70-30 creosote-coal tar solution in Douglas fir, 70-30 creosote-coal tar solution in southern yellow pine, and 70-30 creosote-coal tar solution in southern yellow pine followed by sheathing with cupro-nickel alloy have sustained no attack after 14 years of exposure.

CEL and CEL/Industry Piles

After 13 years of exposure, only piles treated with a moderate retention of creosote (17.4 pcf) containing 1% tributyltin oxide and 1% dieldrin are unattacked. Piles treated with a high retention of creosote (28.6 pcf) containing 5% chlordane have attack in the 0 to 1% range. After 12 years of exposure none of the creosote-free treatments are unattacked, but two (5% chlordane plus 1% tributyltin oxide and 5% chlordane plus 2% tributyltin oxide) only have attack in the 0 to 1% range. After 11 years of exposure, none of the piles driven in 1966 are unattacked. However, piles treated with basic zinc sulfate followed by tributyltin oxide, ammoniacal copper arsenite followed by tributyltin oxide, and ammoniacal cooper arsenite followed by 70-30 creosote-coal tar solution have attack in the 0 to 1% range.

In summary, 50 of the 69 (72%) CEL/Industry piles treated with creosote or solutions of toxic agents in creosote have been attacked after 13 years of exposure; 23 of the 35 (66%) single and combination creosote-free treated piles and 9 of the 12 (75%) creosote-plus-additive treated piles have been attacked after 12 yars of exposure; 34 of the 48 (71%) single and combination (dual-treated) creosote-free treated piles and 3 of the 12 (25%) piles treated with a high retention of 70-30 creosote-coal tar solution or with ammoniacal copper arsenite plus 70-30 creosote-coal tar solution have been attacked after 11 years of exposure.

CONCLUSIONS

1. Piles treated with creosote containing a toxic additive are, in general, performing better than those treated with creosote only.

2. Piles impregnated (1) with a solution containing two toxic compounds, or (2) with a dual treatment are performing equally well.

RECOMMENDATION

Because several preservative treatments of wood piling are still giving good protection in the Pearl Harbor exposure, it is not yet possible to identify the best two or three treatments. Therefore, the annual diver inspections, which can be performed at small cost, should be continued.

ACKNOWLEDGMENT

The author wishes to thank Mr. D. Kim, Maintenance Control Department, Public Works Center, Pearl Harbor, for his assistance.

REFERENCES

1. Naval Civil Engineering Laboratory. Technical Note N-473: Cooperative marine piling investigation, Phase 1 – Pile driving at Coco Solo, Canal Zone, by H. Hochman. Port Hueneme, CA Apr 1963. (AD 405914)

2. _____. Technical Note N-503: Cooperative marine piling investigation: Phase 2 – Pile driving at Pearl Harbor, Hawaii, by H. Hochman. Port Hueneme, CA, Jul 1963. (AD 417175)

3. _____. Technical Note N-672: Experimental wood piling treatments FY-64, by T. Roe, Jr., and H. Hochman. Port Hueneme, CA Dec 1964. (AD 456491)

4. _____. Technical Note N-677: Driving of piles treated with creosote containing additives, by H. Hochman. Port Hueneme, CA, Dec 1964. (AD 458071)

5. _____. Technical Note N-736: Experimental wood piling treatments FY-65, by T. Roe, Jr., and H. Hochman. Port Hueneme, CA Aug 1965. (AD 468687)

6. _____. Technical Note N-898: Experimental wood preservative systems. Treatment; FY 66, Driving, FY 67, by H. Hochman and T. Roe, Jr., Port Hueneme, CA Jun 1967. (AD 816825L)

7. _____. Technical Note N-879: Cooperative marine piling investigation - Phase III - Inspection after four years exposure, by H. Hochman. Port Hueneme, CA, Mar 1967. (AD 811337L)

8. _____. Technical Note N-957: Cooperative marine piling investigation - Phase IIIA - Inspection after five years exposure, by H. Hochman. Port Hueneme, CA, Apr 1968. (AD 831178L)

9. _____. Technical Note N-1048: 1969 inspection of experimental marine piling, by H. Hochman. Port Hueneme, CA Sep 1969. (AD 859356)

10. _____. Technical Note N-1116: 1970 inspection of experimental marine piling, by H. Hochman. Port Hueneme, CA Jul 1970. (AD 873228L)

11. _____. Technical Report R-757: Evaluation of pile preservatives at Coco Solo and Pearl Harbor, by H. Hochman. Port Hueneme, CA, Feb 1972.

12. _____. Technical Note N-1253: 1972 inspection of experimental marine piling, by H. Hochman. Port Hueneme, CA, Dec 1972.

13. _____. Technical Note N-1298: 1973 inspection of experimental marine piling, by Harry Hochman. Port Hueneme, CA, Jul 1973 (AD 767636)

14. _____. Contract Report CR 74.009: The inspection and evaluation of experimentally treated wood piling, by Harry Hochman. Oxnard, CA, Jun 1974. (Contract N68305-74-C-0010)

15. _____. Technical Note N-1418: 1975 inspection of experimental marine piling, by T. Roe, Jr. Port Hueneme, CA, Dec 1975.

16. _____. Technical Note N-1466: 1976 inspection of experimental marine piling, by T. Roe, Jr. Port Hueneme, CA, Dec 1976.

Table 1. Experimentally Treated Piles Driven at Pearl Harbor

Year Driven	Source of Piles	Number of Treatments	Piles per Treatment	Total Piles	Summary of Treatments
1963	Coop	10	6	60	Inorganic salt followed by creosote (double treatment); 70-30 creosote-coal tar solution; phenylmercuric; oleate dissolved in 70-30 creosote-coal tar solution; 70-30 creosote-followed by sheathing with 90:10 cupro-nickel alloy
1963	CEL	1	6	6	Type III creosote
1964	CEL	9	6	54	Creosote solutions of specific organic compounds and/or metal organic compounds
1964	OWPC	1 1 1	4 5 6	15	Creosote solutions of specific organic and metal organic compounds
1965	CEL	13	6	78	Solutions of specific organic and metal organic compounds in xylene or creosote
1966	CEL	2	6	12	Double treatment: Copper sulfate followed by tributyltin oxide
1966	BCCWP	1	6	6	Chromated copper arsenate (Type B)
1966	AZLS	3	6	6	Basic zinc sulfate

continued

Table 1. Continued

Year Driven	Source of Piles	Number of Treatments	Piles per Treatment	Total Piles	Summary of Treatments
1966	AZLS	3	6	18	Ammoniacal copper arsenite; 70-30 creosote-coal tar solution; double treatment: ammoniacal copper arsenite followed by 70-30 creosote-coal tar solution
1966	AZLS/ CEL	1	6	6	Double treatment: basic zinc sulfate followed by tributyltin oxide
1966	BCCWP/ CEL	1	6	6	Double treatment: chromated copper arsenate (Type B) followed by tributyltin oxide
1966	JHB/ CEL	1	6	6	Double treatment: ammoniacal copper arsenite followed by tributyltin oxide

[a]Coop = Cooperative Marine Piling Committee.
CEL = Civil Engineering Laboratory.
OWPC = Osmose Wood Preserving Company of America.
BCCWP = British Columbia Clean Wood Preservers, Ltd.
AZLS = American Zinc, Lead, and Smelting Co.
JHB = J. H. Baxter and Co.

Table 2. Results of 1977 Inspection of Cooperative Piles at Pearl Harbor, Plus One Set of Piles Treated With Creosote by CEL (installed in 1963)

(Mart = Martesia; Lim = Limnoria; Ter = Teredo; ML = Mud Line; TA = Tide Area)

Treatment	Retentions (lb/ft^3)				Percent Loss of Cross-Sectional Area for -				
	Cooperative Assay		CEL Assay						
	Oil	Salt	Oil	Salt	Piling No. 1	Piling No. 2	Piling No. 3	Piling No. 4	Piling No. 5
Ammoniacal copper arsenite followed by creosote in Douglas fir	16.2	6.9	9.7	–	0%	0%	0%		
Chromated copper arsenate followed by creosote in Douglas fir	8.4	2.7	2.7	–	10%: TA to ML, Lim,Mart	26%: TA,Ter, Mart,Lim	2%: ML, dormant		
Chromated copper arsenate followed by creosote in southern yellow pine	23.2	2.7	17.3	–	0%: Pile has been hit and is broken 4 ft from ML	0%	0%		
70-30 creosote-coal tar solution in Douglas fir	15.3	–	11.1	–	0%	0%	0%		

continued

Table 2. continued

(Mart = Martesia; Lim = Limnoria; Ter = Teredo; ML = Mud Line; TA = Tide Area)

Treatment	Retentions (lb/ft^3)				Percent Loss of Cross-Sectional Area for -				
	Cooperative Assay		CEL Assay						
	Oil	Salt	Oil	Salt	Piling No. 1	Piling No. 2	Piling No. 3	Piling No. 4	Piling No. 5
70-30 creosote-coal tar solution in southern yellow pine	17.7	–	13.5	–	8%; TA, Lim,Mart	2%: TA, TA,Lim			
70-30 creosote-coal tar solution containing 1% phenylmercuric oleate[a] in Douglas fir	20.7	–	18.5	–	9%: TA,Lim	0%	1%: TA,Lim		
70-30 creosote-coal tar solution containing 1% phenylmercuric oleate[a] in southern yellow pine	24.1	–	18.5	–	0%				
70-30 creosote-coal tar solution containing 5% phenylmercuric oleate[a] in Douglas fir	13.0	–	10.0	–	2%: TA, Mart,Lim				

continued

Table 2. continued

(Mart = Martesia; Lim = Limnoria; Ter = Teredo; ML = Mud Line; TA = Tide Area)

Treatment	Retentions (lb/ft^3)				Percent Loss of Cross-Sectional Area for -				
	Cooperative Assay		CEL Assay						
	Oil	Salt	Oil	Salt	Piling No. 1	Piling No. 2	Piling No. 3	Piling No. 4	Piling No. 5
70-30 creosote-coal tar solution containing 5% phenylmercuric oleate[a] in southern yellow pine	27.5	–	22.1	–	9%: TA to ML, Lim	0%			
70-30 creosote-coal tar solution in southern yellow pine followed by sheathing with cupro-nickel alloy					0%				
CEL creosote in Douglas fir					3%: TA to ML, Mart,Lim	0%	4%: TA, Lim,Mart (dead)	2%: TA,Lim	4%: TA, Lim,Mart

[a]Nominal percentages. Analyses of core borings showed that considerably less than the nominal percentage got into the wood. No individual retention figures were reported [1].

Table 3. Results of 1977 Inspection of CEL- and Industry-Treated Piles at Pearl Harbor (installed in 1964)

(Lim = Limnoria; Mart = Martesia; Ter = Teredo; TA = Tide Area; ML = Mud Line)

Group[a]	Creosote Additive	Creosote Retention (lb/ft^3)	Additive Retention (lb/ft^3)	Percent Loss of Cross-Sectional Area for –					
				Piling No. 1	Piling No. 2	Piling No. 3	Piling No. 4	Piling No. 5	Piling No. 6
1	None	32.9	0.00	3%: TA,Lim	2%: TA,Lim	1-2%: TA	4%: high TA, Lim	3%: high TA, Lim	3%: TA hole, Lim
2	5% chlordane	28.6	1.4	0%	0%	1%: TA,Lim	1%: TA,Lim	0%	0%
3	2.5% chlordane	28.5	0.7	1%: slight etching, 1 Mart in knothole	0%	2%: TA,Lim,Mart	3%: TA,Lim,Mart	0%	0-1%: TA, 2 small Mart hole
4	1.25% chlordane	26.3	0.3	0%	0%	0%	2%: high TA, Lim	0-1%: TA	3%: TA, slight split, Lim
5	30% copper naphthenate	8.3	0.27[b]	0%	4%: TA,Lim	3%: TA,Lim,Mart	4%: TA to ML, Mart,Lim	4%: TA to 3%: ML,Lim,Mart	0%
6	15% copper naphthenate	9.4	0.15[b]	7%: TA,Lim,Mart	0%	38%: TA,Lim,Mart 4%: ML,Lim	2%: TA,Lim,Mart	12%: TA,Lim,Mart	65%: TA, tapers to 6%: ML,Lim,Mart
7	7.5% copper naphthenate	10.9	0.09[b]	86%: TA,Lim	0%	45%: 15 in. high TA 3-4%: 12 in. below 2%: ML,Lim	3%: TA,Lim	4%: TA,Lim 2%: ML,Lim	2-3%: TA,Lim,Mart

continued

Table 3. Continued

Group[a]	Creosote Additive	Creosote Retention (lb/ft^3)	Additive Retention (lb/ft^3)	Percent Loss of Cross-Sectional Area for –					
				Piling No. 1	Piling No. 2	Piling No. 3	Piling No. 4	Piling No. 5	Piling No. 6
8	14% copper naphthenate 1% tributyltin oxide	14.8	0.23[b] 0.15	15%: TA, 9 in. hole. Pile split. 5-3%: -12 in. to ML,Mart	7%: TA,Lim, Mart,Ter	2%: TA,Lim, Mart	17%: TA,Lim, Mart, few Ter	88%: TA,Lim,Mart	36%: TA, tapers to 4%: ML,Lim,Mart
9	7% copper naphthenate 0.5% tributyltin oxide	8.6	0.07[b] 0.08	1%: TA	6-7%: TA,Lim,Mart	1%: Lim	3%: TA,Lim	58%: TA, tapers to 2%: ML,Lim,Mart	18%: TA,Lim,Mart; some small Mart to ML
10	None	18.6	0.00	24%: TA, tapers to 12%: ML,Mart,Lim	26%: TA, tapers to 3%: ML,Lim, few Mart	47%: 20 in. TA, Lim, few Mart 65%: ML,Lim	25%: TA through ML,Lim,Mart		
11	1% tributyltin oxide	13.9	0.14	11%: TA,Lim	46%: TA,Lim,Mart 5%: ML,Lim	18%: TA,Lim, very few Mart 5%: ML,Lim	78%: TA, tapers to 4%: ML,Lim	38%: TA	
12	1% tributyltin oxide 1% dieldrin	17.4	0.18 0.18	0%	0%	0%	0%	0%	0%

[a] Treatment groups 1 through 9 had six Douglas fir piles each; there were four pine piles in group 10, five in group 11, and six in group 12.

[b] As metallic copper.

Table 4. Results of 1977 Inspection of CEL-Treated Piles at Pearl Harbor (installed in 1965)[a]

(Lim = Limnoria; Mart = Martesia; Ter = Teredo; TA = Tide Area; ML = Mud Line)

Treatment (Solutions in Xylene)	Retention (lb/ft^3)	Percent Loss of Cross-Sectional Area for -					
		Piling No. 1	Piling No. 2	Piling No. 3	Piling No. 4	Piling No. 5	Piling No. 6
4% copper oxinate	0.87[b]	1%: TA, Lim,Mart	1%: TA,Lim	1%: TA,Lim	4%: TA, Mart,Lim	3%: TA, Mart,Lim	0%
2% copper oxinate	0.49[b]	1%: TA,Lim	3%: TA,Lim	13%: TA,Mart, Lim,Ter	0%	3%: TA,Lim	1%: TA,Lim
2% copper oxinate 2% tributyltin oxide	0.25[b] 0.25	8%: TA, Lim,Mart 12%: ML,Lim	8%: TA,ML, Lim,Mart	3%: TA,Lim	2%: TA,Mart 3%: ML,Lim	6%: TA tapers to 5%: ML,Mart, Lim	5%: TA, Lim,Mart
3% copper oxinate 1% Victoria green base	0.69[b] 0.26	2%: TA,Lim	4%: TA, Mart,Lim		0%	1%: TA,Lim	4%: TA,Lim
5% chlordane 1% tributyltin oxide	1.3 0.27	1%: TA,Lim	0%	0-1%: TA,Mart	0%	0%	0%
5% chlordane 2% tributyltin oxide	1.5 0.62	0%	1%: TA,Mart (dead)	0%	0%	0%	0%

continued

Table 4. continued

(Lim = Limnoria; Mart = Martesia; Ter = Teredo; TA = Tide Area; ML = Mud Line)

Treatment (Solutions in Xylene)	Retention (lb/ft^3)	Percent Loss of Cross-Sectional Area for -					
		Piling No. 1	Piling No. 2	Piling No. 3	Piling No. 4	Piling No. 5	Piling No. 6
1.5% copper oxinate 0.5% Victoria green base 50% creosote	0.27[b] 0.09 9.2	4%: ML,Lim	10%: TA to ML,Lim, Mart,Ter	5%: TA,Lim	5%: TA to ML, Mart,Lim	5%: TA, Mart,Lim 3%: ML, Mart,Lim	7%: TA to 15%: ML,Lim, Mart
0.75% copper oxinate 0.25% Victoria green base 75% creosote	0.25[b] 0.08 24.7	0%	3%: TA, split,Lim 2%: ML,Lim	0%	0%	2%: TA,Lim 3%: ML,Lim	8%: TA, Mart,Lim tapers to 4%: ML,Lim

[a]These piles were accidentally pulled in August 1972 and redriven in May 1973.

[b]As metallic copper.

Table 5. Results of 1977 Inspection of CEL- and Industry-Treated Piles at Pearl Harbor (installed in 1966)

Treatment	Retention (lb/ft^3)	Percent Loss of Cross-Sectional Area for –					
		Piling No. 1	Piling No. 2	Piling No. 3	Piling No. 4	Piling No. 5	Piling No. 6
Chromated copper arsenate, Type B	0.50	100%: TA,Lim,Ter 85%: ML,Lim,Ter	100%: top of pile missing 40%: ML,Lim,Mart	5%: TA,Mart,Lim	100%: TA,Lim 60%: ML,Lim	96%: TA,Lim 6%: low TA, Lim 26%: ML,Lim	3%: TA,Mart 1%: ML,Mart
Basic zinc sulfate	2.77	2%: TA,Mart	0%	2%: TA,Mart	0-1%: TA,Lim	3%: TA,Mart	2%: TA,Mart
Ammoniacal copper arsenite	0.51	1%: TA,Mart	2%: TA,Lim,Mart	2%: TA,Lim 4%: ML,Lim	2%: TA,Mart	3%: TA,Lim	3%: TA,Mart
Chromated copper arsenate, Type B Tributyltin oxide	0.50 0.13	0%	0%	4%: TA,Lim	1%: TA,Lim	0%	2%: TA,Lim
Basic zinc sulfate Tributyltin oxide	2.66 0.09	0%	0%	0%	0%	0%	0-1%: TA,Lim
Ammoniacal copper arsenite Tributyltin oxide	0.51 0.11	0%	0%	0%	0%	0%	1%: TA,Lim
70-30 creosote-coal tar	31.7	0%	9%: TA,Lim,Mart	0%	0%	3%: TA,Lim	0%
Ammoniacal copper arsenite 70-30 creosote-coal tar	0.51 19.6	0%	1%: TA	0%	0%	0%	0%
Copper sulfate Tributyltin oxide	0.06[a] 0.19	11%: TA,Lim,Mart	6%: TA,Lim	4%: TA,Lim 2%: ML,Lim	3%: TA,Lim	2%: TA,Lim	5%: TA,Lim
Copper sulfate Tributyltin oxide	0.03[a] 0.20	5%: TA,Lim	5%: TA,Lim	3%: TA,Lim,Mart	92%: high TA, Lim	1%: TA	70%: high TA, split 2%: ML

[a] As metallic copper.

Table 6. Summary of Inspection Results on Cooperative Piles at Pearl Harbor, Plus One Set of Piles Treated With Creosote by CEL (installed in 1963)[a]

Treatment	Number of Piles Reported Attacked in -				
	1973	1974	1975	1976	1977
Ammoniacal copper arsenite followed by creosote in Douglas fir	0	0	0	0	0
Chromated copper arsenate followed by creosote in Douglas fir	2	0	1	3	3
Chromated copper arsenate followed by creosote in southern yellow pine	0	0	0	0	0
70-30 creosote-coal tar solution in Douglas fir	1	0	0	0	0
70-30 creosote-coal tar solution in southern yellow pine	2	0	0	2	2
70-30 creosote-coal tar solution containing 1% phenylmercuric oleate[c] in Douglas fir	NR[b]	NR	0	2	2
70-30 creosote-coal tar solution containing 1% phenylmercuric oleate[c] in southern yellow pine	NR	NR	0	0	0
70-30 creosote-coal tar solution containing 5% phenylmercuric oleate[c] in Douglas fir	NR	NR	0	0	1
70-30 creosote-coal tar solution containing 5% phenylmercuric oleate[c] in southern yellow pine	NR	NR	1	1	1
70-30 creosote-coal tar solution in southern yellow pine followed by sheathing with cupro-nickel alloy	NR	NR	0	0	0
CEL creosote in Douglas fir	NR	3	1	3	4

[a]These piles were accidentally pulled in August 1972 and redriven in May 1973.

[b]NR = not reported.

[c]Nominal percentages. Analyses of core borings showed that considerably less than the nominal percentage got into the wood [11].

Table 7. Summary of Inspection Results on CEL- and Industry-Treated Piles at Pearl Harbor (installed in 1964)

Group[a]	Creosote Additive	Creosote Retention (lb/ft^3)	Additive Retention (lb/ft^3)	Number of Piles Reported Attacked in -						
				1971	1972	1973	1974	1975	1976	1977
1	None	32.9	0	1	1	1	0	4	5	6
2	5% chlordane	28.6	1.4	0	2	1	0	1	0	2
3	2.5% chlordane	28.5	0.7	0	1	2	0	2	2	4
4	1.25% chlordane	26.3	0.3	0	2	0	0	3	2	3
5	30% copper naphthenate	8.3	0.27b	0	2	1	0	2	4	4
6	15% copper naphthenate	9.4	0.15b	2	3	3	0	4	4	5
7	7.5% copper naphthenate	10.9	0.09b	1	2	2	1	3	5	5
8	14% copper naphthenate 1% tributyltin oxide	14.8	0.23b 0.15	1	2	5	0	5	5	6
9	7% copper naphthenate 0.5% tributyltin oxide	8.6	0.07b 0.08	0	2	2	0	4	4	6
10	None	18.6	0	0	1	4	3	4	4	4
11	1% tributyltin oxide	13.9	0.14	0	1	4	2	5	5	5
12	1% tributyltin oxide 1% dieldrin	17.4	0.18 0.18	0	0	0	0	0	0	0

[a]Treatment groups 1 through 9 had six Douglas fir piles each; there were four pine piles in group 10, five in group 11 and six in group 12.

[b]As metallic copper.

Table 8. Summary of Inspection Results on CEL-Treated Piles at Pearl Harbor (installed in 1965)[a]

Treatment (Solutions in Xylene)	Retention (lb/ft^3)	Number of Piles Reported Attacked in -				
		1973	1974	1975	1976	1977
4% copper oxinate	0.87[b]	0	2	1	3	5
2% copper oxinate	0.49[b]	4	2	2	3	5
2% copper oxinate 2% tributyltin oxide	0.25[b] 0.25	4	0	0	4	6
3% copper oxinate 1% Victoria green base	0.69[b] 0.26	3	2	1	2	4
5% chlordane 1% tributyltin oxide	1.3 0.27	0	2	0	0	2
5% chlordane 2% tributyltin oxide	1.5 0.62	0	2	1	1	1
1.5% copper oxinate 0.5% Victoria green base 50% creosote	0.27[b] 0.09 9.2	6	4	4	6	6
0.75% copper oxinate 0.25% Victoria green base 75% creosote	0.25[b] 0.08 24.7	4	4	1	3	3

[a]These piles were accidentally pulled in August 1972 and redriven in May 1973.

[b]As metallic copper.

Table 9. Summary of Inspection Results on CEL- and Industry-Treated Piles at Pearl Harbor (installed in 1966)

Treatment	Retention (lb/ft^3)	Number of Piles Reported Attacked in -						
		1971	1972	1973	1974	1975	1976	1977
Chromated copper arsenate, Type B	0.50	3	3	3	5	4	6	6
Basic zinc sulfate	2.77	0	0	3	2	0	2	5
Ammoniacal copper arsenite	0.51	0	0	3	2	1	4	6
Chromated copper arsenate, Type B Tributyltin oxide	0.50 0.13	0	0	0	2	1	2	3
Basic zinc sulfate Tributyltin oxide	2.66 0.09	0	0	0	1	0	0	1
Ammoniacal copper arsenite Tributyltin oxide	0.51 0.11	0	0	0	0	0	0	1
70-30 creosote-coal tar	31.7	0	0	0	1	1	1	2
Ammoniacal copper arsenite 70-30 creosote-coal tar	0.51 19.6	1	0	1	0	0	0	1
Copper sulfate Tributyltin oxide	0.06[a] 0.19	2	4	3	1	2	5	6
Copper sulfate Tributyltin oxide	0.03[a] 0.20	0	1	0	2	3	5	6

[a]As metallic copper.

DISTRIBUTION LIST

AFB CESCH, Wright-Patterson; MAC/DET (Col. P. Thompson) Scott, IL; Stinfo Library, Offutt NE
ARMY BMDSC-RE (H. McClellan) Huntsville AL; DAEN-MCE-D Washington DC; HQ-DAEN-FEB-P (Mr. Price)
ARMY COASTAL ENGR RSCH CEN Fort Belvoir VA; R. Jachowski, Fort Belvoir VA
ARMY CORPS OF ENGINEERS MRD-Eng. Div., Omaha NE; Seattle Dist. Library, Seattle WA
ARMY ENG DIV HNDED-CS, Huntsville AL
ARMY ENG WATERWAYS EXP STA Library, Vicksburg MS
ARMY ENGR DIST. Library, Portland OR
ARMY ENVIRON. HYGIENE AGCY Water Qual Div (Doner), Aberdeen Prov Ground, MD
ARMY MATERIALS & MECHANICS RESEARCH CENTER Dr. Lenoe, Watertown MA
ARMY-PLASTEC Picatinny Arsenal (A M Anzalone, SMUPA-FR-M-D) Dover NJ
ASST SECRETARY OF THE NAVY Spec. Assist Energy (P. Waterman), Washington DC
BUREAU OF RECLAMATION Code 1512 (C. Selander) Denver CO
CINCLANT Civil Engr. Supp. Plans. Ofr Norfolk, VA
CINCPAC Fac Engrng Div (J44) Makalapa, HI
CNM NMAT 08T246 (Dieterle) Wash, DC
CNO Code NOP-964, Washington DC
COMFLEACT, OKINAWA Commander, Kadena Okinawa; PWO, Kadena, Okinawa
COMOCEANSYSPAC SCE, Pearl Harbor HI
DEFENSE DOCUMENTATION CTR Alexandria, VA
DTNSRDC Code 4121 (R. Rivers), Annapolis, MD
ENERGY R&D ADMIN. Dr. Cohen
GSA Fed. Sup. Serv. (FMBP), Washington DC
HQFORTRPS 2nd FSCG, (Caudillo) Camp Lejeune, NC
KWAJALEIN MISRAN BMDSC-RKL-C
MARINE CORPS BASE Camp Pendleton CA 92055; Code 43-260, Camp Lejeune NC; M & R Division, Camp Lejeune NC; PWO, Camp S. D. Butler, Kawasaki Japan
MARINE CORPS DIST 9, Code 043, Overland Park KS
MARINE CORPS HQS Code LFF-2, Washington DC
MCAS Facil. Engr. Div. Cherry Point NC; CO, Kaneohe Bay HI; Code PWE, Kaneohe Bay HI; Code S4, Quantico VA; J. Taylor, Iwakuni Japan; PWD, Dir. Maint. Control Div., Iwakuni Japan; PWO Kaneohe Bay HI
MCRD PWO, San Diego Ca
NAF PWO, Atsugi Japan
NAS Asst C/S CE Corpus Christi, TX; CO, Guantanamo Bay Cuba; Code 114, Alameda CA; Code 183 (Fac. Plan BR MGR); Code 18700, Brunswick ME; Code 18U (ENS P.J. Hickey), Corpus Christi TX; Code 8E, Patuxent Riv., MD; Dir. Maint. Control Div., Key West FL; Dir. Util. Div., Bermuda; ENS Buchholz, Pensacola, FL; PW (J. Maguire), Corpus Christi TX; PWD Maint. Div., New Orleans, Belle Chasse LA; PWD, Maintenance Control Dir., Bermuda; PWO Belle Chasse, LA; PWO Key West FL; PWO, Dallas TX; PWO, Glenview IL; PWO,, Moffett Field CA; SCE Lant Fleet Norfolk, VA; SCE Norfolk, VA
NATL RESEARCH COUNCIL Naval Studies Board, Washington DC
NATPARACHUTETESTRAN PW Engr, El Centro CA
NAVACT PWO, London UK
NAVACTDET PWO, Holy Lock UK
NAVAEROSPREGMEDCEN SCE, Pensacola FL
NAVAL FACILITY PWO, Barbados; PWO, Cape Hatteras, Buxton NC; PWO, Centerville Bch, Ferndale CA
NAVCOASTSYSLAB Code 423 (D. Good), Panama City FL; Code 715 (J. Mittleman) Panama City, FL; Library Panama City, FL
NAVCOMMAREAMSTRSTA PWO, Norfolk VA; PWO, Wahiawa HI; SCE Unit 1 Naples Italy
NAVCOMMSTA Code 401 Nea Makri, Greece; PWO, Adak AK; PWO, Exmouth, Australia
NAVCONSTRACEN CO (CDR C.L. Neugent), Port Hueneme, CA
NAVEDTRAPRODEVCEN Tech. Library
NAVFAC PWO, Lewes DE
NAVFACENGCOM Code 043 Alexandria, VA; Code 044 Alexandria, VA; Code 0451 Alexandria, VA; Code 0453 (D. Potter) Alexandria, VA; Code 0454B Alexandria, Va; Code 04B3 Alexandria, VA; Code 04B5 Alexandria, VA; Code 101 Alexandria, VA; Code 1023 (M. Carr) Alexandria, VA; Code 1023 (T. Stevens) Alexandria, VA; Code 104

Alexandria, VA; Code 2014 (Mr. Taam), Pearl Harbor HI; Morrison Yap, Caroline Is.; PC-22 (E. Spencer) Alexandria, VA; PL-2 Ponce P.R. Alexandria, VA

NAVFACENGCOM - CHES DIV. Code 101 Wash, DC; Code 402 (R. Morony) Wash, DC; Code 405 Wash, DC; Code FPO-1 (Ottsen) Wash, DC; Code FPO-1C2 Wash, DC; Code FPO-1SP (Dr. Lewis) Wash, DC; Code FPO-IP12 (Mr. Scola), Washington DC; Contracts, ROICC, Annapolis MD

NAVFACENGCOM - LANT DIV.; Code 10A, Norfolk VA; Eur. BR Deputy Dir, Naples Italy; RDT&ELO 09P2, Norfolk VA

NAVFACENGCOM - NORTH DIV. AROICC, Brooklyn NY; Code 09P (LCDR A.J. Stewart); Code 1028, RDT&ELO, Philadelphia PA; Code 111 (Castranovo) Philadelphia, PA; Code 114 (A. Rhoads); Design Div. (R. Masino), Philadelphia PA; ROICC, Contracts, Crane IN

NAVFACENGCOM - PAC DIV. Code 09DG (Donovan), Pearl Harbor, HI; Code 402, RDT&E, Pearl Harbor HI; Commander, Pearl Harbor, HI

NAVFACENGCOM - SOUTH DIV. Code 90, RDT&ELO, Charleston SC; Dir., New Orleans LA

NAVFACENGCOM - WEST DIV. 102; Code 04B; RDT&ELO Code 2011 San Bruno, CA

NAVFACENGCOM CONTRACT AROICC, Point Mugu CA; Code 05, TRIDENT, Bremerton WA; Dir, Eng. Div., Exmouth, Australia; Eng Div dir, Southwest Pac, Manila, PI; OICC, Southwest Pac, Manila, PI; OICC/ROICC, Balboa Canal Zone; ROICC (Ervin) Puget Sound Naval Shipyard, Bremerton, WA; ROICC (LCDR J.G. Leech), Subic Bay, R.P.; ROICC LANT DIV., Norfolk VA; ROICC Off Point Mugu, CA; ROICC, Diego Garcia Island; ROICC, Keflavik, Iceland; ROICC, Pacific, San Bruno CA

NAVHOSP LT R. Elsbernd, Puerto Rico

NAVNUPWRU MUSE DET Code NPU80 (ENS W. Morrison), Port Hueneme CA

NAVOCEANO Code 1600 Bay St. Louis, MS; Code 3432 (J. DePalma), Bay St. Louis MS

NAVOCEANSYSCEN Code 52 (H. Talkington) San Diego CA; Code 6565 (Tech. Lib.), San Diego CA; Code 7511 (PWO) San Diego, CA

NAVPETOFF Code 30, Alexandria VA

NAVPHIBASE CO, ACB 2 Norfolk, VA; Code S3T, Norfolk VA; Harbor Clearance Unit Two, Little Creek, VA; OIC, UCT ONE Norfolk, Va

NAVREGMEDCEN PWO Newport RI; SCE (D. Kaye)

NAVSCOLCECOFF C35 Port Hueneme, CA; C44A (R. Chittenden), Port Hueneme CA; CO, Code C44A Port Hueneme, CA

NAVSEASYSCOM Code OOC (LT R. MacDougal), Washington DC

NAVSEC Code 715 (J. Quirk) Panama City, FL

NAVSHIPREPFAC Library, Guam; SCE Subic Bay

NAVSHIPYD CO Marine Barracks, Norfolk, Portsmouth VA; Code 202.4, Long Beach CA; Code 202.5 (Library) Puget Sound, Bremerton WA; Code 380, (Woodroff) Norfolk, Portsmouth, VA; Code 400, Puget Sound; Code 404 (LT J. Riccio), Norfolk, Portsmouth VA; Code 410, Mare Is., Vallejo CA; Code 440 Portsmouth NH; Code 440, Norfolk; Code 440, Puget Sound, Bremerton WA; Code 440.4, Charleston SC; Code 450, Charleston SC; L.D. Vivian; Library, Portsmouth NH; PWD (Code 400), Philadelphia PA; PWD (LT N.B. Hall), Long Beach CA; PWO, Mare Is.; PWO, Puget Sound; SCE, Pearl Harbor HI

NAVSTA CO Naval Station, Mayport FL; CO Roosevelt Roads P.R. Puerto Rico; Engr. Dir., Rota Spain; Maint. Cont. Div., Guantanamo Bay Cuba; Maint. Div. Dir/Code 531, Rodman Canal Zone; PWD (LTJG P.M. Motodlenich), Puerto Rico; PWD/Engr. Div, Puerto Rico; PWO Midway Island; PWO, Guantanamo Bay Cuba; PWO, Keflavik Iceland; PWO, Mayport FL; PWO, Puerto Rico; ROICC, Rota Spain; SCE, Guam; SCE, San Diego CA; SCE, Subic Bay, R.P.

NAVSUBASE LTJG D.W. Peck, Groton, CT; SCE, Pearl Harbor HI

NAVSUPPACT CO, Seattle WA; Code 413, Seattle WA; LTJG McGarrah, Vallejo CA

NAVSURFWPNCEN PWO, White Oak, Silver Spring, MD

NAVTECHTRACEN SCE, Pensacola FL

NAVWPNCEN Code 2636 (W. Bonner), China Lake CA

NAVWPNSTA ENS G.A. Lowry, Fallbrook CA; Maint. Control Dir., Yorktown VA; PW Office (Code 09C1) Yorktown, VA

NAVWPNSUPPCEN Code 09 (Boennighausen) Crane IN

NAVXDIVINGU LT A.M. Parisi, Panama City FL

NCBU 405 OIC, San Diego, CA

WPNSTA EARLE Code 092, Colts Neck NJ

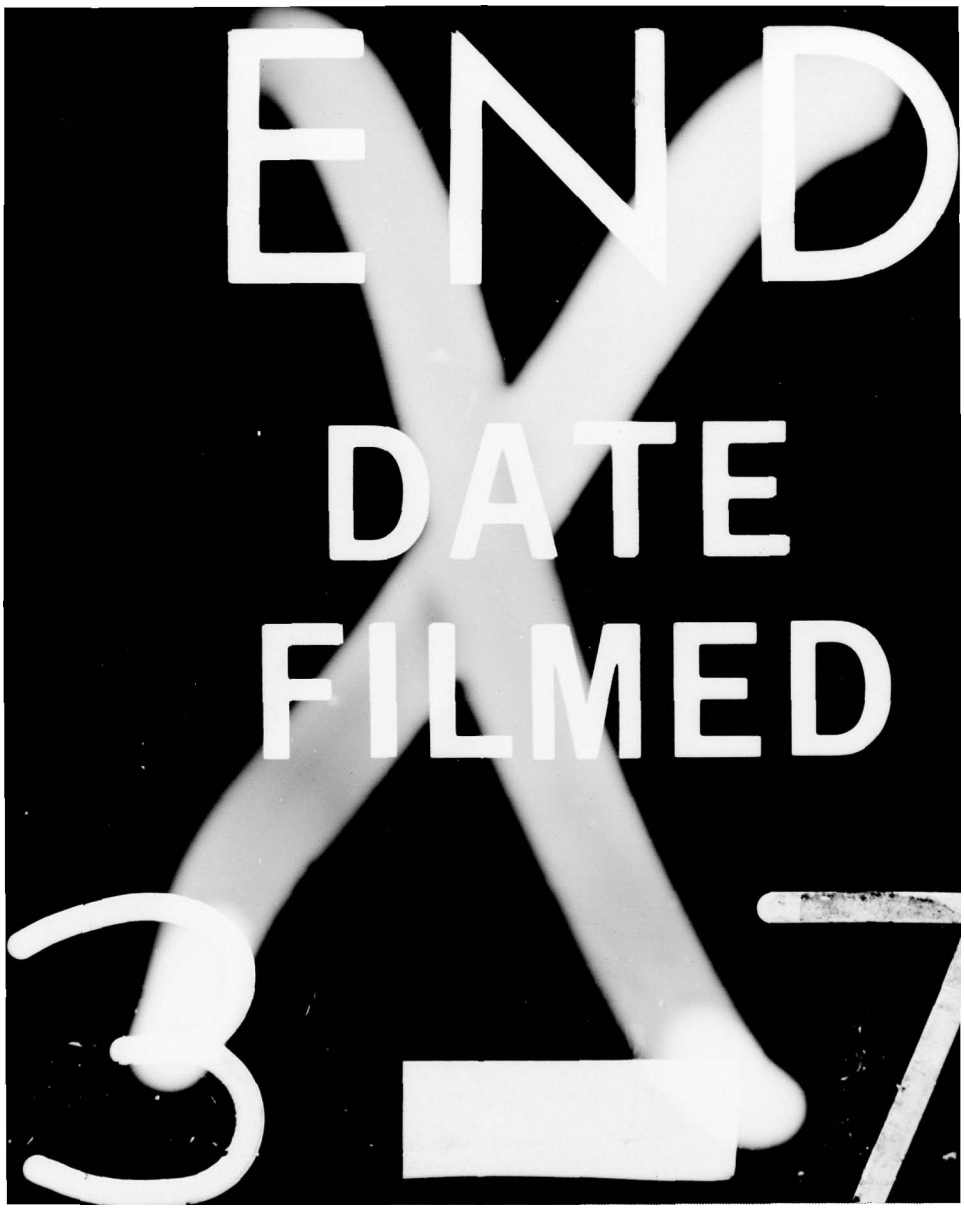
NCBC CEL (CAPT N. W. Petersen), Port Hueneme, CA; CEL AOIC Port Hueneme CA; Code 10 Davisville, RI; PWO (Code 80) Port Hueneme, CA; PWO, Davisville RI

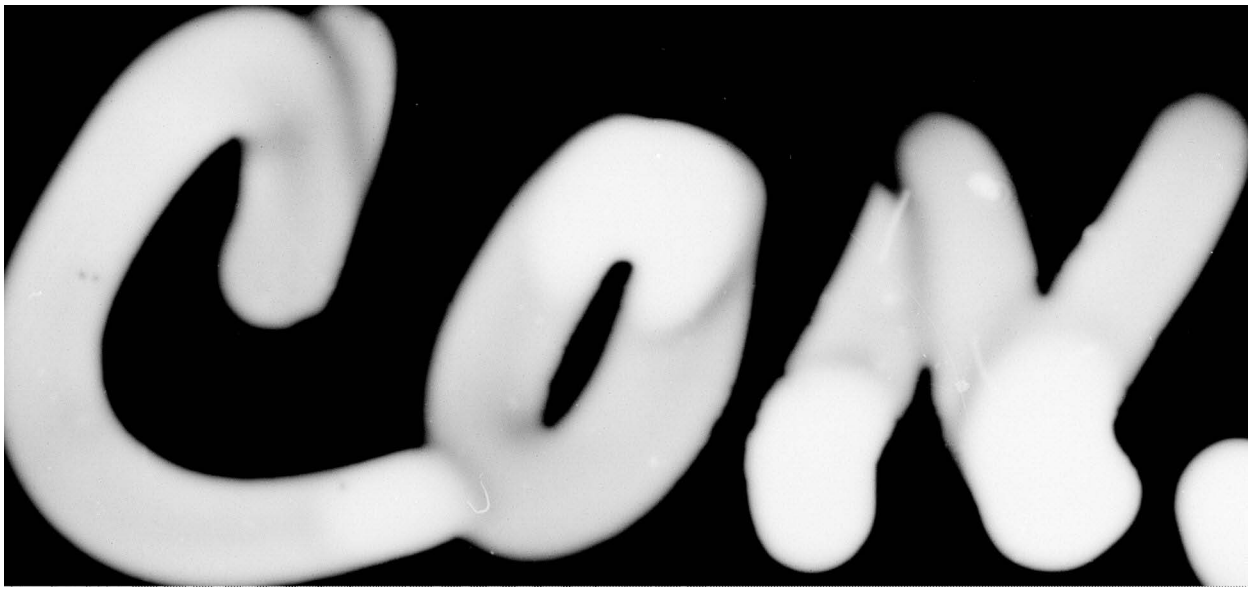
NCR 20, Commander

NMCB 133 (ENS T.W. Nielsen); 5, Operations Dept.; Forty, CO; THREE, Operations Off.
NRL Code 8441 (R.A. Skop), Washington DC
NROTCU Univ Colorado (LT D R Burns), Boulder CO
NSC Code 54.1 (Wynne), Norfolk VA
NSD SCE, Subic Bay, R.P.
NTC Code 54 (ENS P. G. Jackel), Orlando FL; SCE Great Lakes, IL
NUSC Code 131 New London, CT; Code EA123 (R.S. Munn), New London CT; Code TA131 (G. De la Cruz), New London CT
OCEANSYSLANT LT A.R. Giancola, Norfolk VA
NORDA Code 440 (Ocean Rsch, off) Bay St. Louis, Ms
ONR Code 700F Arlington VA; Dr. A. Laufer, Pasadena CA
PMTC Pat. Counsel, Point Mugu CA
PWC ENS J.E. Surash, Pearl Harbor HI; CO Norfolk, VA; CO, Great Lakes IL; Code 116 (LTJG. A. Eckhart) Great Lakes, IL; Code 120, Oakland CA; Code 120C (Library) San Diego, CA; Code 128, Guam; Code 200, Great Lakes IL; Code 200, Guam; Code 200, Oakland CA; Code 220 Oakland, CA; Code 220.1, Norfolk VA; Code 30C (Boettcher) San Diego, CA; Code 40 (C. Kolton) Pensacola, FL; Code 505A (H. Wheeler); Code 680, San Diego CA; Library, Subic Bay, R.P.; OIC CBU-405, San Diego CA; XO Oakland, CA
SPCC Code 122B, Mechanicsburg, PA
UCT TWO OIC, Port Hueneme CA
U.S. MERCHANT MARINE ACADEMY Kings Point, NY (Reprint Custodian)
US DEPT OF AGRIC Forest Products Lab. (R. DeGroot), Madison WI
US GEOLOGICAL SURVEY Off. Marine Geology, Mailstop 915, Reston VA
USCG (G-ECV/61) (Burkhart) Washington, DC; G-EOE-4/61 (T. Dowd), Washington DC
USCG ACADEMY LT N. Stramandi, New London CT
USCG R&D CENTER Tech. Dir. Groton, CT
USNA Ocean Sys. Eng Dept (Dr. Monney) Annapolis, MD; PWD Engr. Div. (C. Bradford) Annapolis MD; PWO Annapolis MD
CALIF. DEPT OF NAVIGATION & OCEAN DEV. Sacramento, CA (G. Armstrong)
CITY OF CERRITOS Cerritos CA (J. Adams)
DAMES & MOORE LIBRARY LOS ANGELES, CA
DUKE UNIV MEDICAL CENTER B. Muga, Durham NC
FLORIDA ATLANTIC UNIVERSITY BOCA RATON, FL (MC ALLISTER); Boca Raton FL (Ocean Engr Dept., C. Lin)
FLORIDA ATLANTIC UNIVERSITY Boca Raton FL (W. Tessin)
INSTITUTE OF MARINE SCIENCES Morehead City NC (Director)
VIRGINIA INST. OF MARINE SCI. Gloucester Point VA (Library)
LEHIGH UNIVERSITY BETHLEHEM, PA (MARINE GEOTECHNICAL LAB., RICHARDS); Bethlehem PA (Linderman Lib. No.30, Flecksteiner)
LIBRARY OF CONGRESS WASHINGTON, DC (SCIENCES & TECH DIV)
MAINE MARITIME ACADEMY (Wyman) Castine ME; CASTINE, ME (LIBRARY)
MICHIGAN TECHNOLOGICAL UNIVERSITY Houghton, MI (Haas)
MIT Cambridge MA; Cambridge MA (Rm 10-500, Tech. Reports, Engr. Lib.)
NATL ACADEMY OF ENG. ALEXANDRIA, VA (SEARLE, JR.)
NY CITY COMMUNITY COLLEGE BROOKLYN, NY (LIBRARY)
OREGON STATE UNIVERSITY (CE Dept Grace) Corvallis, OR; Corvalis OR (School of Oceanography)
PURDUE UNIVERSITY Lafayette, IN (Altschaeffl); Lafayette, IN (CE Engr. Lib)
SOUTHWEST RSCH INST R. DeHart, San Antonio TX
STANFORD UNIVERSITY STANFORD, CA (DOUGLAS)
TEXAS A&M UNIVERSITY COLLEGE STATION, TX (CE DEPT); College TX (CE Dept, Herbich)
UNIVERSITY OF CALIFORNIA BERKELEY, CA (CE DEPT, GERWICK); BERKELEY, CA (OFF. BUS. AND FINANCE, SAUNDERS); Berkeley CA (B. Bresler); M. Duncan, Berkeley CA
UNIVERSITY OF DELAWARE Newark, DE (Dept of Civil Engineering, Chesson)
UNIVERSITY OF HAWAII HONOLULU, HI (SCIENCE AND TECH. DIV.)
UNIVERSITY OF ILLINOIS Metz Ref Rm, Urbana IL; URBANA, IL (DAVISSON); URBANA, IL (LIBRARY); URBANA, IL (NEWARK)
UNIVERSITY OF MASSACHUSETTS (Heronemus), Amherst MA CE Dept
UNIVERSITY OF MICHIGAN Ann Arbor MI (Richart)
UNIVERSITY OF NEBRASKA-LINCOLN Lincoln, NE (Ross Ice Shelf Proj.)

UNIVERSITY OF PENNSYLVANIA PHILADELPHIA, PA (SCHOOL OF ENGR & APPLIED SCIENCE, ROLL)
UNIVERSITY OF TEXAS Inst. Marine Sci (Library), Port Arkansas TX
UNIVERSITY OF TEXAS AT AUSTIN AUSTIN, TX (THOMPSON); Austin, TX (Breen)
UNIVERSITY OF WASHINGTON SEATTLE, WA (OCEAN ENG RSCH LAB, GRAY); Seattle WA (E. Linger)
UNIVERSITY OF WISCONSIN Milwaukee WI (Ctr of Great Lakes Studies)
URS RESEARCH CO. LIBRARY SAN MATEO, CA
ALFRED A. YEE & ASSOC. Honolulu HI
ARVID GRANT OLYMPIA, WA
ATLANTIC RICHFIELD CO. DALLAS, TX (SMITH)
AUSTRALIA Dept. PW (A. Hicks), Melbourne
BECHTEL CORP. SAN FRANCISCO, CA (PHELPS)
BELGIUM HAECON, N.V., Gent
BETHLEHEM STEEL CO. BETHLEHEM, PA (STEELE)
BROWN & ROOT Houston TX (D. Ward)
CANADA Mem Univ Newfoundland (Chari), St Johns; Surveyor, Nenninger & Chenevert Inc., Montreal
DILLINGHAM PRECAST F. McHale, Honolulu HI
DRAVO CORP Pittsburgh PA (Giannino); Pittsburgh PA (Wright)
NORWAY DET NORSKE VERITAS (Library), Oslo
FRANCE Dr. Dutertre, Boulogne; L. Pliskin, Paris
GEOTECHNICAL ENGINEERS INC. Winchester, MA (Paulding)
GLIDDEN CO. STRONGSVILLE, OH (RSCH LIB)
HALEY & ALDRICH, INC. Cambridge MA (Aldrich, Jr.)
ITALY M. Caironi, Milan; Sergio Tattoni Milano; Torino (F. Levi)
KOREA Korea Rsch Inst. Ship & Ocean (B. Choi), Seoul
LAMONT-DOHERTY GEOLOGICAL OBSERV. Palisades NY (Selwyn)
LOCKHEED MISSILES & SPACE CO. INC. Mgr Naval Arch & Mar Eng Sunnyvale, CA; Sunnyvale CA (Rynewicz); Sunnyvale, CA (Phillips)
MARATHON OIL CO Houston TX (C. Seay)
MOBIL PIPE LINE CO. DALLAS, TX MGR OF ENGR (NOACK)
MUESER, RUTLEDGE, WENTWORTH AND JOHNSTON NEW YORK (RICHARDS)
NEW ZEALAND New Zealand Concrete Research Assoc. (Librarian), Porirua
NEWPORT NEWS SHIPBLDG & DRYDOCK CO. Newport News VA (Tech. Lib.)
NORWAY I. Foss, Oslo; J. Creed, Ski; Norwegian Tech Univ (Brandtzaeg), Trondheim
OCEAN RESOURCE ENG. INC. HOUSTON, TX (ANDERSON)
OFFSHORE DEVELOPMENT ENG. INC. BERKELEY, CA
PACIFIC MARINE TECHNOLOGY LONG BEACH, CA (WAGNER)
PORTLAND CEMENT ASSOC. SKOKIE, IL (CORELY); SKOKIE, IL (KLIEGER); Skokie IL (Rsch & Dev Lab, Lib.)
PUERTO RICO Puerto Rico (Rsch Lib.), Mayaquez P R
RAYMOND INTERNATIONAL INC. CHERRY HILL, NJ (SOILTECH DEPT)
RIVERSIDE CEMENT CO Riverside CA (W. Smith)
SCHUPACK ASSOC SO. NORWALK, CT (SCHUPACK)
SEAFOOD LABORATORY MOREHEAD CITY, NC (LIBRARY)
SEATECH CORP. MIAMI, FL (PERONI)
SHELL OIL CO. HOUSTON, TX (MARSHALL); Houston TX (R. de Castongrene)
SOUTH AMERICA N. Nouel, Valencia, Venezuela
SWEDEN VBB (Library), Stockholm
TIDEWATER CONSTR. CO Norfolk VA (Fowler)
UNITED KINGDOM Cement & Concrete Assoc (G. Somerville) Wexham Springs, Slou; Cement & Concrete Assoc. (Library), Wexham Springs, Slough; Cement & Concrete Assoc. (Lit. Ex), Bucks; D. New, G. Maunsell & Partners, London; Taylor, Woodrow Constr (014P), Southall, Middlesex; Taylor, Woodrow Constr (Stubbs), Southall, Middlesex
WISS, JANNEY, ELSTNER, & ASSOC Northbrook, IL (J. Hanson)
WM CLAPP LABS - BATTELLE DUXBURY, MA (LIBRARY); Duxbury, MA (Richards)
WOODWARD-CLYDE CONSULTANTS PLYMOUTH MEETING PA (CROSS, III)
ANTON TEDESKO Bronxville NY
BRAHTZ La Jolla, CA
BULLOCK La Canada

R.F. BESIER Old Saybrook CT
R.Q. PALMER Kaitua, HI
SMITH Gulfport, MS
T.W. MERMEL Washington DC

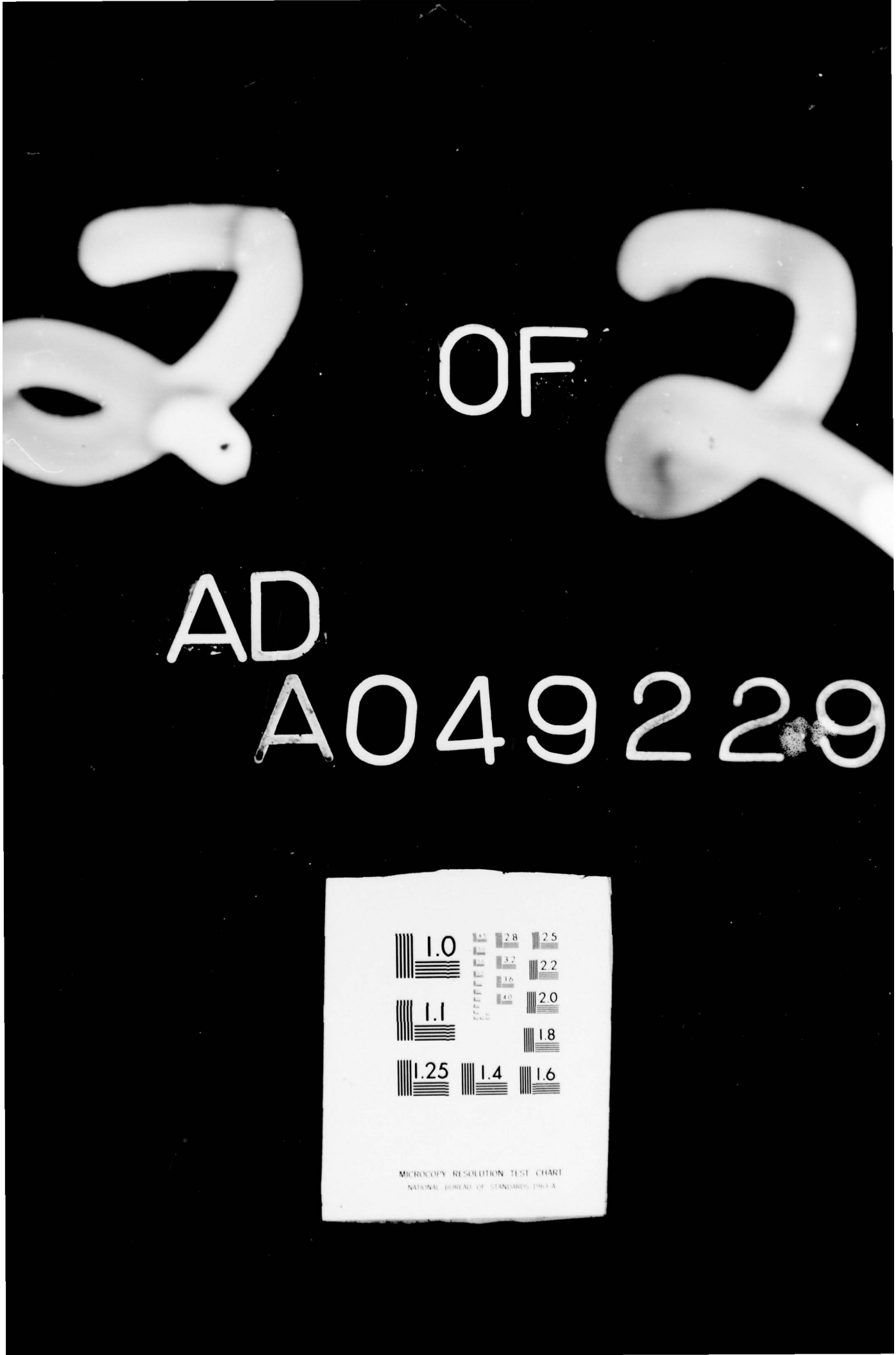

END
DATE
FILMED


Cox.

AD-A049 229 CIVIL ENGINEERING LAB (NAVY) PORT HUENEME CALIF F/G 13/13
1977 INSPECTION OF EXPERIMENTAL MARINE PILING AT PEARL HARBOR, --ETC(U)
NOV 77 T ROE
UNCLASSIFIED CEL-TN-1505 NL

2 OF 2
AD A049230

END
DATE FILMED
9-79
DDC


2 OF 2
AD
A049229

SUPPLEMENTARY

INFORMATION

CIVIL ENGINEERING LABORATORY
NAVAL CONSTRUCTION BATTALION CENTER
PORT HUENEME, CA 93043

IN REPLY REFER TO
L08/PDT/jw
DNL Z-R000-147
DNL Z-R000-01-147
Serial 278
21 February 1979

From: Officer in Charge
To: Distribution

Subj: Errata Sheet for Technical Note N-1505, "1977 Inspection of Experimental Marine Piling at Pearl Harbor, Hawaii," by Thorndyke Roe Jr.; and for Technical Note N-1538, "1978 Inspection of Experimental Marine Piling at Pearl Harbor, Hawaii," by Thorndyke Roe, Jr.

1. Please make the following pen and ink corrections:

AD-A049 229

N-1505, Page 6: 2nd column, 1st entry should be JHB vice AZLS
Page 7: 3rd column, 1st entry should be 0.9 vice 6.9

~~N-1538, Page 6: 2nd column, 2nd entry should be JHB vice AZLS~~
~~Page 7: 3rd column, 1st entry should be 0.9 vice 6.9~~

Peter D. Triem

PETER D. TRIEM
By direction