R 655

Technical Report

PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA

January 1970

Sponsored by

NAVAL FACILITIES ENGINEERING COMMAND

NAVAL CIVIL ENGINEERING LABORATORY

Port Hueneme, California

PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA

Technical Report R-655

YF 38.534.006.01.003

by

Richard W. Drisko

ABSTRACT

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

INTRODUCTION

Because Naval Facilities Engineering Command field activities have difficulties and spend a great deal of time and money in maintaining steel mooring buoys, the Naval Civil Engineering Laboratory (NCEL) was assigned the task of investigating plastic mooring buoys as a means of reducing maintenance costs. Because the steel framework of the buoy is filled with foam and covered with glass-reinforced plastic skin, the only steel components of the buoy exposed to hostile marine environment are the fittings used for securing the buoy to ships and ground tackle.

The fabrication of two plastic mooring buoys is described in NCEL Technical Report R-365.[1] One buoy has an exterior shell composed of ten layers of fiberglass cloth impregnated with polyester resin; the other has an exterior shell composed of a spray-up coating of chopped fiberglass strands in polyester resin. The performance of these buoys while in service to the Fleet in San Diego Bay for a period of 3 years is described in Technical Report R-601.[2] Reference 2 also describes the fabrication of another plastic mooring buoy of improved design. The exterior shell of this buoy consists of alternate layers of fiberglass cloth and mat impregnated with polyester resin.

This report provides additional data on the condition of the first two buoys in San Diego Bay after 4 years and of the third buoy at Pearl Harbor after 1 year of service to the Fleet. It also presents cost data for purchasing and maintaining steel and plastic mooring buoys.

CONDITION OF BUOYS

San Diego Bay

After about 4 years of service to the Fleet, the two plastic mooring buoys in San Diego Bay were lifted from the water onto the deck of a floating crane for their annual inspection required by BUDOCKS Instruction 1153.4B of 9 April 1965. During the previous year these buoys had received moderate to heavy usage. The marine fouling organisms were examined and then removed with a high-pressure stream of seawater (Figure 1) so that the underlying substrate could be examined. On both buoys there was moderate to heavy fouling

Figure 1. Hosing of marine fouling from hand lay-up buoy in San Diego Bay.

similar to that on steel buoys exposed in the Bay for the same length of time. Fouling organisms included green algae (heaviest in the splash-zone), barnacles, tunicates, bryozoa, tube worms, and hydroids. The barnacles were comparatively few in number but large in size. The organisms were rather easily removed (as they are from steel buoys) by high-pressure hosing with seawater.

Hand Lay-Up Buoy. The hand lay-up buoy was still in very good condition after about 4 years of service to the Fleet. There was considerable superficial white staining by guano on the top and side (Figure 2). There was also rust streaking from the steel mooring eyes and hardware used to secure the fenders in place. The upper lateral fender, which had previously been torn loose by impact and later wired back in place, was still providing good protection. The two test patches* made on the buoy side after one-half year of service were also in good condition. Most of the reflective glass beads embedded in the buoy coating had been lost above water, but many remained below water.

* See Reference 2.

Figure 2. Hand lay-up buoy in San Diego Bay after 4 years of service. Note guano staining on side and slight displacement of upper lateral fender.

Spray-Up Buoy. The spray-up buoy (Figure 3) had continued to deteriorate slightly during the last year. The upper shoulder had numerous cracks in the outer skin from which rust was streaking (Figure 4). Guano buildup and staining were not so great as on the hand lay-up buoy. The exterior shell was cracked through to the polyurethane-foamed core in three places—one normally above the water (Figure 5) and two below (Figure 6). These cracks were over 1 foot in length, but did not permit sufficient passage of water to affect the flotation of the buoy or its service to the Fleet. The middle lateral fender, held in place by a steel cable, had also been displaced (Figure 5) by the impact of a ship. The two test patches in the side (Figure 4) were in good condition. The above superficial damage did not seem to have any effect on the utilization of the buoy.

Figure 3. Hosing of marine fouling from spray-up buoy in San Diego Bay.

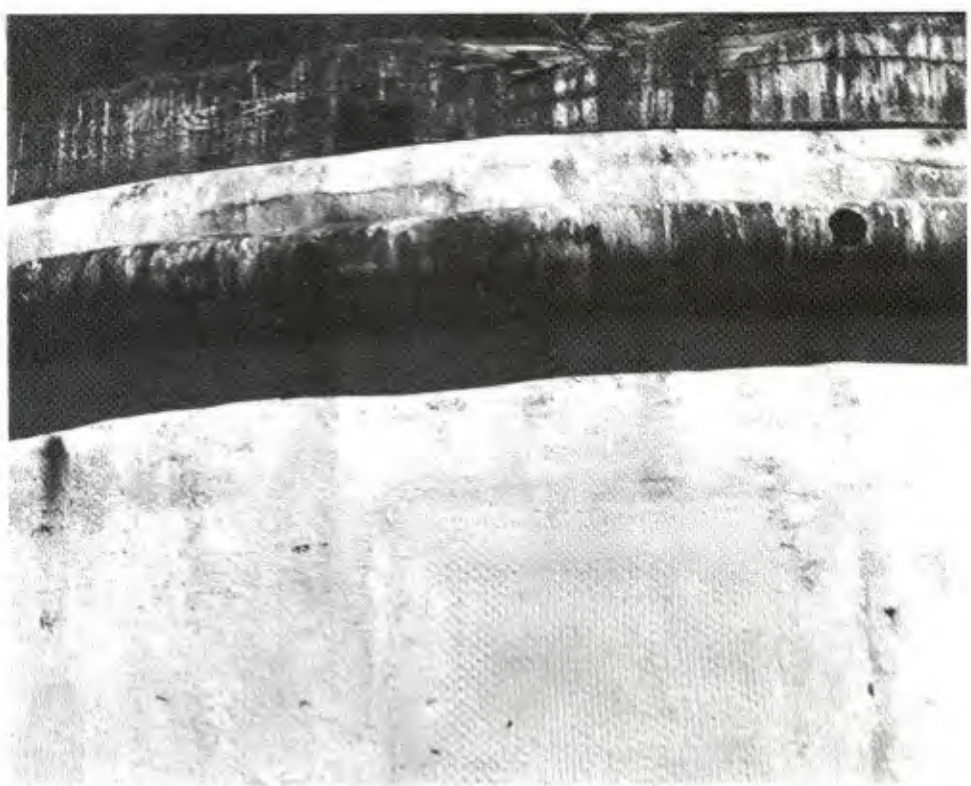

Figure 4. Upper portion of spray-up buoy in San Diego Bay after 4 years of service. Note worn upper wooden fender, deteriorated shoulder, and square at bottom center.

Figure 5. Side of spray-up buoy in San Diego Bay. Note displaced middle fender and crack in shell above it.

Figure 6. Crack in shell of spray-up buoy located below water line.

Pearl Harbor

The plastic mooring buoy with the improved design was installed by Public Works Center, Pearl Harbor as part of a bow and stern mooring for a barge in a reserve area. As such, it receives much less abuse than do the two buoys in San Diego Bay. The buoy is examined quarterly by Public Works Center personnel; it was examined by the NCEL project scientist about 1 year after installation. The buoy at that time had heavy marine fouling, but very little corrosion or other deterioration. Rust streaking from the steel mooring eye and the hardware used to secure the fenders in place was very slight. The outer skin was also relatively free of dirt and yellowing. All in all, the buoy was in excellent condition (Figure 7).

During inspection of the buoy it was brought to the author's attention that several steel mooring buoys at Pearl Harbor had been coated with alternate layers of fiberglass cloth and mat impregnated with polyester resin similar to the construction of the plastic buoy exposed at this location. Many of these buoys have had extensive yellowing of the white finish coat (Figure 8). A similar yellowing was observed on the exterior of the San Diego spray-up buoy at the time of initial installation. This yellowing appears to be related to degradation of the resin by ultraviolet light and suggests that an ultraviolet light absorber incorporated into the finish coat may be desirable.

Figure 7. Plastic buoy after 1 year of service at Pearl Harbor.

Figure 8. Steel mooring buoys at Pearl Harbor with yellowed fiberglass-reinforced polyester coating.

COST COMPARISONS FOR STEEL AND PLASTIC MOORING BUOYS

Cost data for purchasing and maintaining components of Fleet moorings are very difficult to obtain because of differences in design, number, type and frequency of use, and maintenance procedures from activity to activity.

Procurement of Buoys

The San Diego Bay plastic mooring buoys were fabricated efficiently; the contractor's cost breakdown for each buoy is shown in Table 1. The Pearl Harbor plastic mooring buoy was fabricated by a contractor who proved to be less efficient; his estimated cost was about $10,000. In all three cases, the costs included time spent on development of a fabrication procedure. Thus, a mass production of plastic mooring buoys should lower significantly the cost per buoy.

Table 1. Cost Data on Fabrication of San Diego Plastic Mooring Buoys

No.	Item	Cost ($) for—	
		Hand Lay-Up Buoy	Spray-Up Buoy
1.	Labor on materials other than plastics	1,327.58	1,327.59
2.	Labor on plastic materials	1,231.23	591.22
3.	Total labor (1 + 2)	2,558.81	1,918.81
4.	Total material	4,926.32	4,803.82
5.	Manufacturer's overhead (80% of 3)	2,047.05	1,535.05
6.	Total standard cost (3 + 4 + 5)	9,532.18	8,257.68
7.	General administration expense (20% of 3)	511.76	383.76
8.	Total burden (6 + 7)	10,043.94	8,641.44

Steel buoys currently used by NFEC field activities were built in large quantities during World War II. The surplus buoys were stored for use as required, and now these buoys have almost been exhausted. A few Mark II peg-top mooring buoys (Federal Stock Catalog No. 2050-275-7681) are still available at the Construction Battalion Center, Port Hueneme at a nominal price of $2,120 each. Before use as part of a mooring, these buoys require removal of the shop coating and recoating with a system suitable for marine exposure. Also, modification of the buoy might be necessary for a particular type of mooring operation. For example, at San Diego, the hawse pipe would be replaced with a tension bar. It is estimated that the complete fabrication of a new steel buoy ready for use in San Diego would cost between $10,000 and $12,000, a price comparable to that of a plastic buoy. Thus, the relative maintenance costs of the two types of buoys would be the determining factors in the selection of either type of buoy once the limited supply of steel buoys is exhausted.

Maintenance of Buoys

Steel Buoys. It is difficult to separate the costs associated with maintaining mooring buoys from those of maintaining the rest of the mooring since both are rehabilitated together. Cost data were assembled for removal, overhaul, and

reinstallation of four Fleet moorings by Public Works Center, San Diego. These were seven- and eight-legged moorings (BB Type) with Mark II peg-top riser-chain mooring buoys. The codes of the work center performing the various phases of the work are listed in Table 2. Sandblasting for surface preparation of metal for painting was done by Work Center 540 (General Support Shop). Both rigging and diving services fall under Work Center 540, and this number will refer to rigging service unless otherwise specified.

Table 2. Identification of Work Center Codes

Code	Work Center
210	Engineering Department; Civil Engineering Division
332	Inspection Division
525	Paint Shop
540	General Support Shop
542	Welding Shop
543	Wharf Building Shop
622	Utilities Shop
700	Transportation Department (Equipment Rental)
722	Automotive Operations
724	Heavy Equipment Operations
728	Rigging Service (also Diving Service)
772	Heavy Equipment Maintenance

Tables 3, 4, and 5 list Planning and Estimating Branch estimates for work scheduled for moorings 34, 35, 36, and 37, respectively. The actual man-hours spent to accomplish the work were considerably more than estimated. Also, labor costs have since increased by 10% and material costs by 25% (40% for lumber, Work Center 534; 20% for paint, Work Center 525; and 10% for other materials). This is tabulated in Table 6 along with corrections for actual man-hours and material costs. From this table the projected (June 1969) average removal, overhaul, and reinstallation costs for the mooring were calculated to comprise 20%, 34%, and 43%, respectively, of the total rehabilitation costs. The costs associated with the buoy comprised about

30% (an average of $2,345) and the ground tackle portion 70% (an average of $5,480). A higher percentage of costs for the ground tackle was due to high labor costs associated with sandblasting the chain prior to dip-coating. With three- and four-legged moorings the relative costs of the work should be about the same for the buoy as for the ground tackle.

It should be noted that the factors affecting maintenance costs of rehabilitating moorings at San Diego may be quite different from those at other NFEC field activities. While conditions in San Diego are severe, conditions may be appreciably worse in tropical environments. In cold areas, factors contributing to corrosion should be appreciably less. The mooring maintenance operations at Public Works Center, San Diego are considered to be quite efficient, and maintenance costs at other field activities may be appreciably greater. Only a survey of data from other locations could indicate the relative maintenance costs at activities other than Public Works Center, San Diego.

BUDOCKS Instruction 1153.4B of 9 April 1965 calls for (1) annual inspection of mooring buoys for damage, deterioration or corrosion, and physical condition of the ground tackle connected to the buoy, (2) lifting of buoys from the water every 3 years for painting and required repairs, and (3) hauling out of the water, inspecting, and rehabilitating the complete mooring assemblies every 3 years where there are adverse bottom conditions and every 5 years where there are favorable bottom conditions. Public Works Center, San Diego follows the 3-year program for both buoys and their ground tackle.

Plastic Buoys. Very few data are available on the costs of maintaining plastic buoys. After 4 years of heavy duty in San Diego Bay, there is no evidence of significant deterioration on the hand lay-up buoy that would require removal ashore for repairs in the near future. The buoy at Pearl Harbor seems to have no significant deterioration after 1 year of service, and the overall appearance is better than that of the San Diego hand lay-up buoy after a similar period of time.

CONCLUSION

NCEL studies[3] into cathodic protection of moorings indicate that it would be unnecessary to move moorings ashore for maintenance if the chains were protected from corrosion by sacrificial zinc anodes. It would seem logical to utilize in conjunction with such a system a mooring buoy that gives a longer service life between periods of necessary overhaul than that of the presently used steel buoys. A plastic mooring buoy appears to fulfill this requirement. Reinforced plastic navigational buoys have also been shown[4] to be less expensive to maintain than comparable steel buoys.

Table 3. Estimated Costs for Fleet Mooring 34

Phase of Work	Work Center	Man-Hours	Cost ($)			
			Labor	Materials	Other	Total
Removal of mooring	700	0	0	0	451	451
	722	3	20	0	0	20
	724	15	108	0	0	108
	728	108	789	0	0	789
	772	12	99	0	0	99
	total	138	1,016	0	451	1,467
Overhaul of mooring	332	10	76	0	0	76
	525	20	155	235	0	390
	540	52	349	145	0	494
	542	8	63	0	0	63
	543	60	479	248	0	727
	700	0	0	0	170	170
	724	24	173	0	0	173
	728	24	175	0	0	175
	total	198	1,470	628	170	2,268
Reinstallation of mooring	210	*	0	0	0	0
	700	0	0	0	751	751
	722	3	20	0	0	20
	724	21	151	0	0	151
	728 (divers)	63	672	0	0	672
	728 (riggers)	140	1,023	10	0	1,033
	772	17	141	0	0	141
	total	244	2,007	10	751	2,768
Total work	210	*	0	0	0	0
	332	10	76	0	0	76
	525	20	155	235	0	390
	540	52	349	145	0	494
	542	8	63	0	0	63
	543	60	479	248	0	727
	700	0	0	0	1,372	1,372
	722	6	40	0	0	40
	724	60	432	0	0	432
	728 (divers)	63	672	0	0	672
	728 (riggers)	272	1,987	10	0	1,997
	772	29	240	0	0	240
	total	580	4,493	638	1,372	6,503

* Information only

Table 4. Estimated Costs for Fleet Moorings 35 and 36

(Cost estimates for both Fleet moorings were identical.)

Phase of Work	Work Center	Man-Hours	Costs ($)			
			Labor	Materials	Other	Total
Removal of mooring	700	0	0	0	446	446
	722	4	27	0	0	27
	724	20	144	0	0	144
	728	108	789	0	0	789
	772	12	99	0	0	99
	total	144	1,059	0	446	1,505
Overhaul of mooring	332	8	61	0	0	61
	525	20	155	352	0	507
	540	56	383	163	0	546
	542	8	63	92	0	155
	543	52	415	125	0	540
	700	0	0	0	149	149
	724	24	173	0	0	173
	728	24	175	0	0	175
	total	192	1,425	732	149	2,306
Reinstallation of mooring	210	*	0	0	0	0
	700	0	0	0	964	964
	722	4	27	0	0	27
	724	24	173	0	0	173
	728 (divers)	72	768	0	0	768
	728 (riggers)	212	1,550	0	0	1,550
	772	24	199	0	0	199
	total	336	2,717	0	964	3,681
Telephone removal and installation	622 (removal)	8	63	0	0	63
	622 (installation)	8	63	216	0	279
	total	16	126	216	0	342
Total work	210	*	0	0	0	0
	332	8	61	0	0	61
	525	20	155	352	0	507
	540	56	383	163	0	546
	542	8	63	92	0	155
	543	52	415	125	0	540
	622	16	126	216	0	342
	700	0	0	0	1,559	1,559
	722	8	54	0	0	54
	724	68	490	0	0	490
	728 (divers)	344	2,514	0	0	2,514
	728 (riggers)	72	768	0	0	768
	772	36	298	0	0	298
	total	688	5,327	948	1,559	7,834

* Information only

Table 5. Estimated Costs for Fleet Mooring 37

Phase of Work	Work Center	Man-Hours	Costs ($)			
			Labor	Materials	Other	Total
Removal of mooring	700	0	0	0	445	445
	722	3	20	0	0	20
	724	15	108	0	0	108
	728	108	790	0	0	790
	772	12	99	0	0	99
	total	138	1,017	0	445	1,462
Overhaul of mooring	332	10	76	0	0	76
	525	20	155	243	0	398
	540	52	356	145	0	501
	542	8	63	0	0	63
	543	60	479	248	0	727
	700	0	0	0	138	138
	724	24	173	0	0	173
	728	24	175	0	0	175
	total	198	1,477	636	138	2,251
Reinstallation of mooring	210	*	0	0	0	0
	700	0	0	0	789	789
	722	3	20	0	0	20
	724	21	151	0	0	151
	728 (divers)	63	672	0	0	672
	728 (riggers)	140	1,023	24	0	1,047
	772	17	141	0	0	141
	total	244	2,007	24	789	2,820
Total work	210	*	0	0	0	0
	332	10	76	0	0	76
	525	20	155	243	0	398
	540	52	356	145	0	501
	542	8	63	0	0	63
	543	60	479	248	0	727
	700	0	0	0	1,372	1,372
	722	6	40	0	0	40
	724	60	432	0	0	432
	728 (divers)	63	672	0	0	672
	728 (riggers)	272	1,988	24	0	2,012
	772	29	240	0	0	240
	total	580	4,501	660	1,372	6,533

* Information only

Table 6. Calculated Actual Costs and Projected (June 1969) Costs for Moorings Maintenance

Phase of Work	Percent of Total Costs	Mooring	Actual Man-Hours	Actual Costs ($)				Projected Costs ($)		
				Labor (avg man-hours x wage)	Materials	Other	Total	10% of Labor	25% of Materials	Total
Removal	20	34	152	156 x 7.36 = 1,148	0	451	1,595	115	0	1,710
		35	158		0	446				
		36	158		0	446				
		37	152		0	445				
		Average	156		0	447				
Overhaul	34	34	218	215 x 7.43 = 1,597	750	170	2,549	160	200	2,909
		35	211		850	149				
		36	211		850	149				
		37	218		750	138				
		Average	215		800	152				
Reinstallation	43	34	268	319 x 8.14 = 2,597	15	751	3,475	260	3	3,738
		35	369		0	964				
		36	369		0	964				
		37	268		30	789				
		Average	319		11	867				
Telephones	3	34	0	9 x 7.88 = 71	0	0	206	7	34	247
		35	18		270	0				
		36	18		270	0				
		37	0		0	0				
		Average	9		135	0				
Total	100	34	638	5,413	765	1,372	7,825	542	237	8,604
		35	756		1,120	1,559				
		36	756		1,120	1,559				
		37	638		780	1,372				
		Average	697		946	1,466				

ACKNOWLEDGMENT

LT Richard F. Heine, formerly of Public Works Center, San Diego and currently senior Activity Civil Engineer at Naval Training Center, San Diego, spent considerable time gathering the data presented in Tables 2 through 6; his contribution is gratefully acknowledged.

REFERENCES

1. Naval Civil Engineering Laboratory. Technical Report R-365: Plastic mooring buoys - pt. I. Fabrication of experimental models, by R. W. Drisko and T. Roe. Port Hueneme, Calif., Mar. 1965. (AD 612055)

2.———. Technical Report R-601: Plastic mooring buoys - pt. II. Completion of test program, by R. W. Drisko. Port Hueneme, Calif., Nov. 1968. (AD 845132)

3.———. Technical Note N-975: Cathodic protection of mooring buoys and chain - pt. IV. Additional field studies with cables providing continuity, by R. W. Drisko. Port Hueneme, Calif., Aug. 1968, and earlier reports referenced therein. (AD 839338L)

4. "Reinforced plastic lighted buoys; their practical and econmical advantages," Dock and Harbour Authority, vol. 45, no. 530, Dec. 1964, pp. 259-260.

DISTRIBUTION LIST

SNDL Code	No. of Activities	Total Copies	
—	1	20	Defense Documentation Center
FKAIC	1	10	Naval Facilities Engineering Command
FKNI	13	13	NAVFAC Engineering Field Divisions
FKN5	9	9	Public Works Centers
FA25	1	1	Public Works Center
—	14	14	RDT&E Liaison Officers at NAVFAC Engineering Field Divisions and Construction Battalion Centers
—	281	281	NCEL Special Distribution List No. 5 for persons and activities interested in reports on Deterioration Control

Naval Civil Engineering Laboratory
PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA, by Richard W. Drisko

TR-655 17 p. illus January 1970 Unclassified

1. Plastic mooring buoys—Performance of I. YF 38.534.006.01.003

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

Naval Civil Engineering Laboratory
PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA, by Richard W. Drisko

TR-655 17 p. illus January 1970 Unclassified

1. Plastic mooring buoys—Performance of I. YF 38.534.006.01.003

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

Naval Civil Engineering Laboratory
PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA, by Richard W. Drisko

TR-655 17 p. illus January 1970 Unclassified

1. Plastic mooring buoys—Performance of I. YF 38.534.006.01.003

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

Naval Civil Engineering Laboratory
PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA, by Richard W. Drisko

TR-655 17 p. illus January 1970 Unclassified

1. Plastic mooring buoys—Performance of I. YF 38.534.006.01.003

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

Naval Civil Engineering Laboratory
PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA, by Richard W. Drisko

TR-655   17 p. illus   January 1970   Unclassified

1. Plastic mooring buoys—Performance of   I. YF 38.534.006.01.003

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

Naval Civil Engineering Laboratory
PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA, by Richard W. Drisko

TR-655   17 p. illus   January 1970   Unclassified

1. Plastic mooring buoys—Performance of   I. YF 38.534.006.01.003

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

Naval Civil Engineering Laboratory
PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA, by Richard W. Drisko

TR-655   17 p. illus   January 1970   Unclassified

1. Plastic mooring buoys—Performance of   I. YF 38.534.006.01.003

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

Naval Civil Engineering Laboratory
PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA, by Richard W. Drisko

TR-655   17 p. illus   January 1970   Unclassified

1. Plastic mooring buoys—Performance of   I. YF 38.534.006.01.003

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Naval Civil Engineering Laboratory Port Hueneme, Calif. 93041	Unclassified
	2b. GROUP

3. REPORT TITLE

PLASTIC MOORING BUOYS—COST AND ADDITIONAL PERFORMANCE DATA

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Not final; July 1968—July 1969

5. AUTHOR(S) *(First name, middle initial, last name)*

Richard W. Drisko

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
January 1970	17	4

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. YF 38.534.006.01.003	TR-655
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	

10. DISTRIBUTION STATEMENT

This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Naval Facilities Engineering Command Washington, D. C. 20390

13. ABSTRACT

Two plastic mooring buoys have provided good service as part of moorings for the Fleet in San Diego Bay for a period of 4 years. One buoy with a hand lay-up fiberglass-reinforced polyester shell is in appreciably better condition than the other one with a spray-up shell of fiberglass-reinforced polyester resin. A third plastic buoy with an improved design is in excellent condition after 1 year of service to the Fleet in Pearl Harbor. An analysis of the costs of purchasing and maintaining steel and plastic mooring buoys is presented. It indicates that after the present supply of World War II mooring buoys is exhausted, the Naval Facilities Engineering Command field activities should use plastic mooring buoys as replacement becomes necessary.

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

Unclassified
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Plastic mooring buoys						
Hand lay-up buoy						
Spray-up buoy						
Steel mooring buoys						
Deterioration						
Maintenance						
Cost						
Fabrication						
Fiberglass-reinforced polyester coating						
Performance						