# Bainbridge Island Shoreline Master Program Regulations for Buoys and Recreational Floats

Regulations -- Mooring Buoys and Recreational Floats -General

1. Mooring buoys and recreational floats shall be prohibited in the Aquatic Conservancy environment. Mooring buoys and floats for recreational use shall be permitted in the Aquatic environment offshore from Conservancy, Rural, Semi-rural, and Urban environments and shall be prohibited offshore from the Natural environment. Mooring buoys for commercial use shall be permitted only as conditional uses offshore from the Urban environment.

2. Buoys shall not interfere with navigation, shall be visible in daylight one hundred (100) yards away, and shall have reflectors for night visibility.

3. If a buoy is located offshore of the extreme low tide line, the owner shall obtain a lease for the bed of navigable waters from Department of Natural Resources. [WAC 332-30-122 (1)(ii) or its successor].

4. Buoys shall lie between the waterfront property side lot lines extended beyond the shoreline, except those on Department of Natural Resources tidelands. Vessels moored to the buoys shall not swing across the extended side lot lines. Where the configuration of the waterfront lot precludes these requirements, a mooring buoy owner shall file with the City a written statement from the affected, adjacent, waterfront property owners agreeing to the buoy placement.

5. Mooring buoys shall be installed at least twenty (20) yards from other permitted piers, docks, floats, or buoys so as not to interfere with or obstruct existing piers, docks, floats, or buoys.

6. Owners of waterfront property are permitted to install one (1) mooring buoy per waterfront lot, except that where the waterfront lot is owned in community, the City may permit upon the owners' application, additional mooring buoys with the total not more than one (1) per owner in the community. [WAC 332-30-122 (1)(ii) or its successor].

7. Buoys shall be located offshore no farther than the Construction Limit Line in Eagle Harbor, and elsewhere not more than two hundred (200) feet beyond extreme low tide, the -3 fathom depth contour (-18 feet at mean low water), or the line of navigation, whichever is closest to shore. [WAC 332-30-148(2) or its successor].

8. The owners or lessees of waterfront property zoned for commercial or industrial use may install mooring buoys for commercial vessels, subject to obtaining a Shoreline conditional use permit from the City for each mooring buoy.

10. A contractor doing waterfront work involving floating equipment may place a temporary mooring buoy convenient to the work site, provided it is the responsibility of the contractor to ensure that all necessary permits are obtained

from all agencies with jurisdiction.

11. Recreational floats shall be located as close to shore as possible. They shall be located no farther than the following limits:
    a. In Eagle Harbor, the construction limit line.
    b. Elsewhere, the distance necessary to obtain a depth of four (4) feet of water as measured at extreme low tide at the landward end of the float, or the line of navigation, whichever is closer to shore.

12. Recreational floats must be built so that the deck surface is one (1) foot above the water's surface and shall have reflectors for night visibility.

13. Single-property-owner recreational floats shall not exceed eight (8) feet by (8) feet.

14. All recreational floats shall include stops which serve to keep the floats off the bottom of tidelands at low tide.

7/19/01

**WDFW MARINE MOORING BUOY DESIGN CRITERIA**

1. General:
All mooring buoys that will be located in water with a depth of less than -30 feet (MLLW = 0.00) shall meet the following design criteria:

a. The line between the anchor and surface float shall not exceed the water depth as measured at extreme high tide plus a maximum of 20% additional line for scope.

b. The buoy system shall include a subsurface float designed to keep the line between the anchor and surface buoy from contacting the bottom during low tide cycles. The subsurface float shall be located off the bottom a distance equal to 1/3 the line length as defined above in item a.

2. Eelgrass, Kelp and Macroalgae Habitat:

a. No Vegetation Survey

If a mooring buoy will be located in water with a depth of less than -30 feet (MLLW = 0.00) and a preliminary level marine vegetation survey conducted by a qualified diver/biologist to verify the absence of marine vegetation at the buoy site is not submitted to WDFW, then the mooring buoy system shall include an embedment style anchor in order to avoid potential impacts to vegetation associated with surface anchor designs.

b. Vegetation Survey

If the mooring buoy will be located in water with a depth of less than -30 feet (MLLW = 0.00) and a preliminary level marine vegetation survey is conducted by a qualified diver/biologist then the following criterial apply:

1. If the preliminary level marine vegetation survey verifies the absence of vegetation at the buoy site and the survey report is submitted to WDFW, then the mooring buoy system may use either an embedment style anchor or a surface style anchor.

2. If the preliminary level marine vegetation survey verifies the presence of vegetation at the buoy site then the mooring buoy system shall include an embedment style anchor in order to avoid potential impacts to eelgrass associated with surface anchor designs.

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## RCW 79.105.430
# Private recreational docks — Mooring buoys.

(1) The abutting residential owner to state-owned shorelands, tidelands, or related beds of navigable waters, other than harbor areas, may install and maintain without charge a dock on the areas if used exclusively for private recreational purposes and the area is not subject to prior rights, including any rights of upland, tideland, or shoreland owners as provided in RCW 79.125.400, 79.125.460, 79.125.410, and 79.130.010. The dock cannot be sold or leased separately from the upland residence. The dock cannot be used to moor boats for commercial or residential use. This permission is subject to applicable local, state, and federal rules and regulations governing location, design, construction, size, and length of the dock. Nothing in this subsection (1) prevents the abutting owner from obtaining a lease if otherwise provided by law.

(2) The abutting residential owner to state-owned shorelands, tidelands, or related beds of navigable waters, other than harbor areas, may install and maintain a mooring buoy without charge if the boat that is moored to the buoy is used for private recreational purposes, the area is not subject to prior rights, including any rights of upland, tideland, or shoreland owners as provided in RCW 79.125.400, 79.125.460, 79.125.410, and 79.130.010, and the buoy will not obstruct the use of mooring buoys previously authorized by the department.

(a) The buoy must be located as near to the upland residence as practical, consistent with applicable rules and regulations and the provisions of this section. The buoy must be located, or relocated if necessary, to accommodate the use of lawfully installed and maintained buoys.

(b) If two or more residential owners, who otherwise qualify for free use under the provisions of this section, are in dispute over assertion of rights to install and maintain a mooring buoy in the same location, they may seek formal settlement through adjudication in superior court for the county in which the buoy site is located. In the adjudication, preference must be given to the residential owner that first installed and continually maintained and used a buoy on that site, if it meets all applicable rules, regulations, and provisions of this section, and then to the owner of the residential property nearest the site. Nothing in this section requires the department to mediate or otherwise resolve disputes between residential owners over the use of the same site for a mooring buoy.

(c) The buoy cannot be sold or leased separately from the abutting residential property. The buoy cannot be used to moor boats for commercial or residential use, nor to moor boats over sixty feet in length.

(d) If the department determines that it is necessary for secure moorage, the abutting residential owner may install and maintain a second mooring buoy, under the same provisions as the first, the use of which is limited to a second mooring line to the boat moored at the first buoy.

(e) The permission granted in this subsection (2) is subject to applicable local, state, and federal rules and regulations governing location, design, installation, maintenance, and operation of the mooring buoy, anchoring system, and moored boat. Nothing in this subsection (2) prevents a boat owner from obtaining a lease if otherwise provided by law. This subsection (2) also applies to areas that have been designated by the commissioner or the fish and wildlife commission as aquatic reserves.

(3) This permission to install and maintain a recreational dock or mooring buoy may be revoked by the department, or the department may direct the owner of a recreational dock or mooring buoy to relocate their dock or buoy, if the department makes a finding of public necessity to protect waterward access, ingress rights of other landowners, public health or safety, or public resources. Circumstances prompting a finding of public necessity may include, but are not limited to, the dock, buoy, anchoring system, or boat posing a hazard or obstruction to navigation or fishing, contributing to degradation of aquatic habitat, or contributing to decertification of shellfish beds otherwise suitable for commercial or recreational harvest. The revocation may be appealed as provided for under RCW 79.105.160.

(4) Nothing in this section authorizes a boat owner to abandon a vessel at a recreational dock, mooring buoy, or elsewhere.

[2005 c 155 § 106; 2002 c 304 § 1; 2001 c 277 § 1; 1989 c 175 § 170; 1983 2nd ex.s. c 2 § 2. Formerly RCW 79.90.105.]

**Notes:**

**Effective date -- 1989 c 175:** See note following RCW 34.05.010.

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**WAC 352-66-100** No Washington State Register filings since 2003

# Mooring (anchor) buoys.

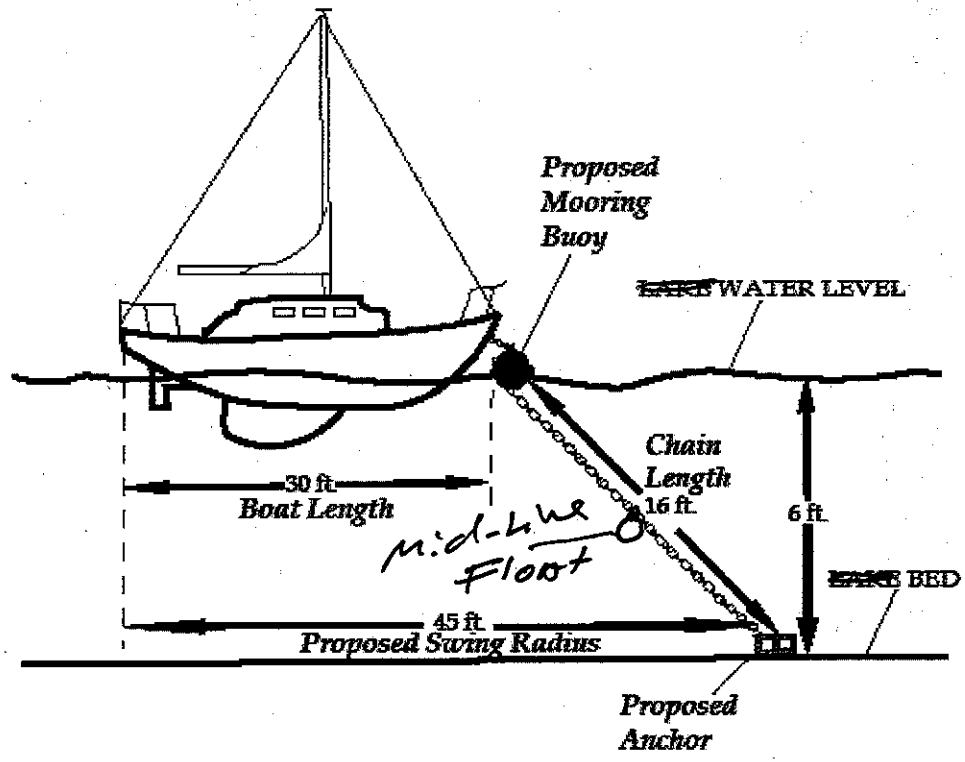
(1) Mooring buoys for private aids to navigation shall be colored white and shall have a horizontal blue band around the circumference of the buoy centered midway between the top of the buoy and the water line.

(2) A lighted mooring buoy shall normally display a slow flashing white light. When its location in a waterway is such that it constitutes an obstruction to a vessel operated during hours of darkness, it shall display a quick flashing white light.

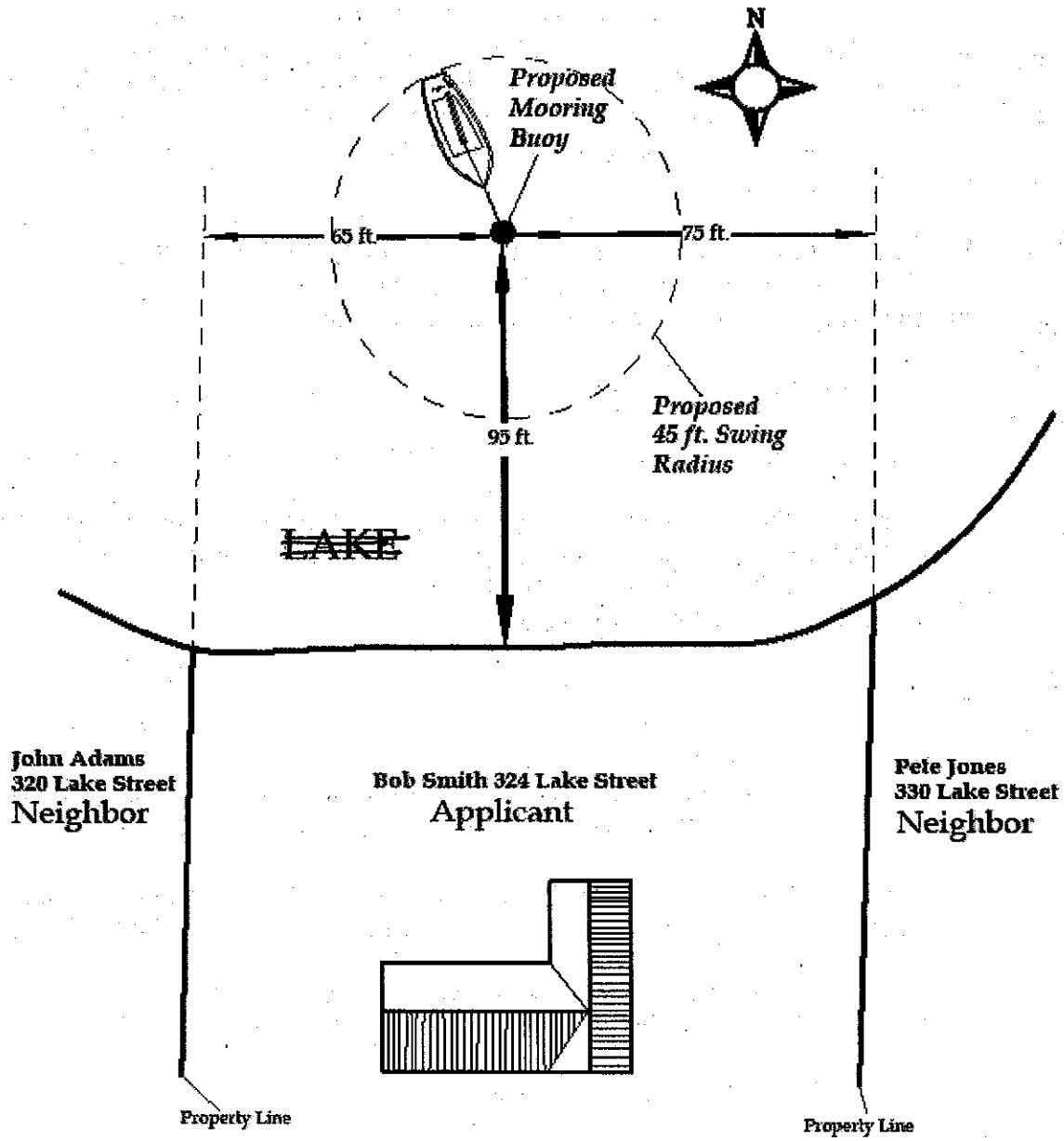
(3) A mooring buoy shall bear ownership identification provided that the manner and placement of the identification does not detract from the meaning intended to be conveyed by the color scheme or identification letter when assigned.

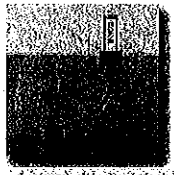
[Statutory Authority: RCW 43.51.040. 90-07-051, § 352-66-100, filed 3/19/90, effective 4/19/90.]

# Sample Cross-Section
# Mooring Buoy



# Sample Site Plan
# Mooring Buoy





Moorings & Complete Systems

Concrete Anchors

Dor-Mor Anchors

Helix Anchors

## Helix Anchors

Helix anchors are already popular as permanent moorings for boats, floating docks, and fish cages. They are now becoming popular for buoy moorings in those cases where there is a significant chance of or known problem with the buoy being dragged. Pound for pound, helix anchors have higher holding powers than almost any other type of anchor available.

Watermark offers helix anchors that can be installed by a diver without requiring hydraulic-power tools. These anchors are ideal for small boats and large buoys, and are very cost effective.

Helix anchors are ideal when:

- A permanent, non-dragging anchor is desired for a boat, floating dock, or buoy
- The bottom consists of relatively firm sand for 5 ft or more in depth
- The water depth is shallow enough for a diver to work safely
- Diver services are readily available
- A low-cost anchor is desired

Conversely, these anchors are not well suited:

- For rocky bottoms
- For those moorings that need to be frequently moved or inspected
- When diver services are cost prohibitive

See information on our Concrete and Dor-Mor Anchors, and please contact us for more information about helical anchor applications and installation.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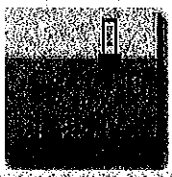


Moorings & Complete Systems

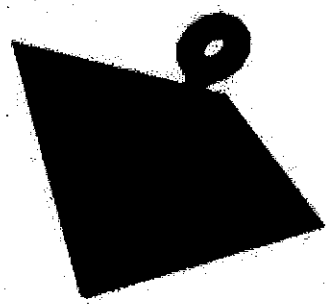
Concrete Anchors

Dor-Mor Anchors

Helix Anchors

## Dor-Mor Anchors

The Dor-Mor anchor is a patented, pyramidal-shaped anchor that is designed to penetrate the bottom and prevent dragging. The one-piece cast iron anchor is used to moor boats, large and small buoys, docks, oceanographic equipment, containment booms, nets, aquaculture pens, and much more. These anchors have proven so effective that the US Coast Guard is replacing their concrete sinkers with Dor-Mors!



Dor-Mor anchors are most appropriate for:

- Moving water sites such as rivers and coastal areas
- Where the moorings will be frequently moved
- Mooring *scopes* of 3:1

Here is how the Dor-Mor anchor compares to two other popular types of anchors in a 3:1 *scope* mooring

- Approximately 10 times the holding power of a concrete anchor of similar weight
- Approximately 2 times the holding power of a mushroom anchor of similar weight

Here are some of the design attributes that make the Dor-Mor anchor work so well:

- Cast Iron design loses only 14% of its weight in water vs. 45% for concrete
- Large surface area of the pyramid shape has a high suction effect when dragged
- Chain wrap is minimized by the short shank design (as opposed to the long shank of mushroom anchors)
- The large diameter size is designed to accommodate the proper sized shackle for the mooring weight

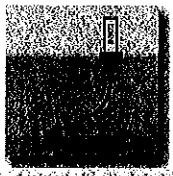
The Dor-Mor anchor is available in sizes ranging from 15 lbs to 4,000 lbs. For our Watermark buoys we make the following recommendations:

| | Lake Mooring | Slow River | Fast River/Coastal Area |
|---|---|---|---|
| WNS-1060 | 15 lbs | NA | NA |
| WNS-6000 | 15 lbs | 15 lbs | 35 lbs |
| WNS-7000 | 35 lbs | 35 lbs | 70 lbs |

Dor-Mor anchors may not be the best option when:

- Using extremely short scopes (<2:1)
- The bottom is very rocky
- Concrete anchors are sufficient for applications in small lakes or ponds

If you need to deploy a mooring where a Dor-Mor anchor is not suited, check out Concrete and Helical Anchors, or contact us for more assistance.



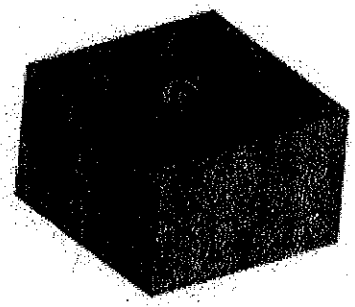


**Concrete Anchors**

**Dor-Mor Anchors**

**Helix Anchors**

## Concrete Anchors



For many applications, simple concrete anchors are the most cost-effective option. They are most appropriate for applications:

- In still water such as lakes
- Where the buoy and mooring will be in place year-round
- Where the bottom is very rocky, preventing the use of other types of anchors
- For mooring scopes less than 2
- When heavy moorings can be set with ease (crane barge, etc...)

Watermark offers prefabricated anchors with 3/8" stainless steel mooring eyes in 70, 150, and 250 lb sizes. Larger sizes available.

If you need to deploy a mooring where a concrete anchor is not suited, see the Dor-Mor and Helix Anchors.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# Foundation Findings

## Report #20 Mooring Anchors

### Looking Below the Bottom Line

In the aftermath of recent devastating hurricanes, the wreckage left in numerous harbors has pointed to a "weak link" in preventing storm damage - moorings.

Pictures of boats – moorings still attached - flung up on beaches , docks and atop other boats remain vividly etched in our memories. The thousands of boat owners whose vessels were damaged or destroyed by those disasters live in fear of another destructive storm.

In an attempt to reduce the extent of storm-related damage in the future, the BOAT/U.S. Foundation for Boating Safety along with Massachusetts Institute of Technology (MIT) Sea Grant College Program, and Cruising World magazine, conducted tests earlier this year to examine relative merits of old and new anchoring technologies.

We tested five types of mooring anchors in Rhode Island's Newport and nearby Jamestown harbors by pulling on them with a 65-foot tugboat powered by two 450 horsepower engines capable of generating up to 14,000 pounds of pull.

Our team measured force exerted upon two traditional anchor types, concrete blocks and mushrooms; the pyramid-shaped Dor-Mor, and two "embedment" anchors, a helical screw and the Manta Ray. (See Figure 9.)

We will present the test outcomes and then examine some mooring anchor attributes that contributed to those results.

### THE DOR-MOR

We first tested a 650-pound version of the cast iron Dor-Mor, which is available in 10 sizes from 35 pounds to 2,000 pounds. This anchor is shaped like an inverted, squat pyramid with a short, large-eyed shank extending from the center. The Dor-Mor we tested had been in place for one year and our BOAT/U.S. Foundation diver found it was completely buried in mud.

Water depth was about 18 feet, creating a scope of slightly less than 3: 1. Two strain gauges were tied into the rode package - one an analog mechanical type, and one digital, which fed data to the lap-top computer. The tugboat began to pull and according to both measuring devices, the Dor-Mor broke out at approximately 4,500 pounds of pressure. Computer data indicates the anchor may have tried to reseat itself several times as it was pulled along the bottom between breakout and shut down of the engines.

### HELICAL SCREW ANCHOR

Next we tested a helical unit that had been placed in about 20 feet of water, using a special hydraulic torque motor. The anchor consisted of a 15-foot long,

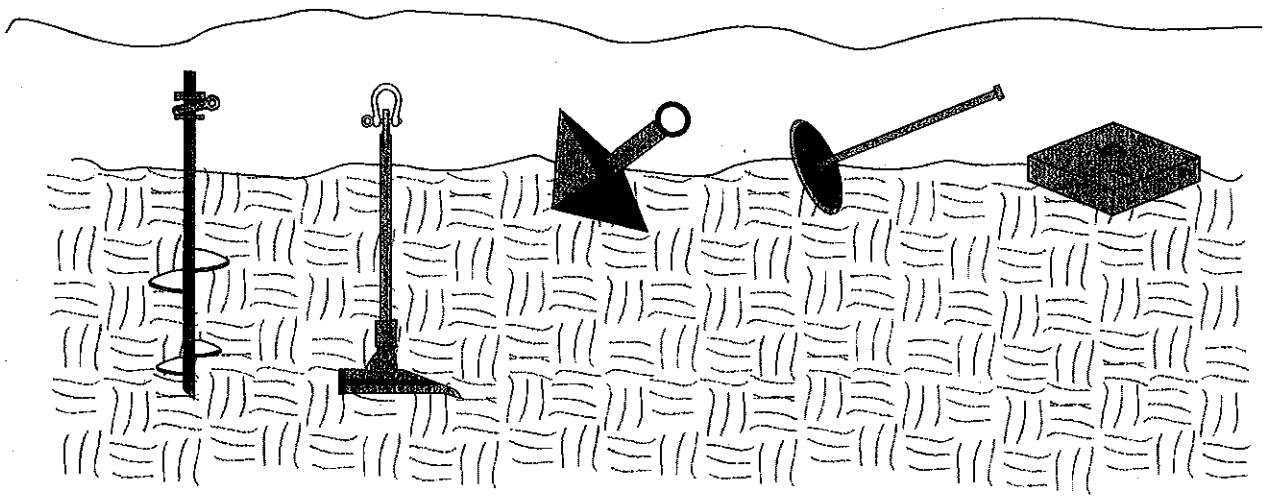

Figure 9

galvanized, steel shaft, screwed into the harbor floor with three 14-inch round helical plates in an area of very deep mud.

It was connected through the two strain gauges and attached to the tug at approximately a 4:1 scope.

The tug began its pull, increasing power until the mechanical strain gauge showed 12,000 pounds of pressure. Suddenly, the gauges hurled through the air and slammed into the transom several yards away. Some element of the system had given way, causing it to break apart.

The aftermath of the incident revealed a damaged and frayed steel cable, a warped and broken connecting shackle, and a shattered analog strain gauge, lying in pieces where it had landed on the fantail. The digital unit was beyond repair.

Fortunately, we were able to continue our tests using a backup digital gauge, brought along in anticipation on just such a failure.

### THE MANTA RAY

Next, we attached the tug - digital strain gauge in line - to the galvanized cast iron Manta -Ray. It had been driven into an area of solid shale in about 19 feet of water, creating a scope of about 4: 1.

The Manta Ray's spade-shaped head is attached by a swivel joint to a shaft that varies in length according to how deeply it must be driven to hold in different soil types. It is set by a hydraulic "load locker," which toggles the manta-like projection into a position perpendicular to the shaft and locks it into place below the harbor bottom. The load locker can set an anchor with holding power up to 45,000 pounds, depending on the bottom composition.

We had the skipper increase engine revolutions per minute until the computer tallied 7,500 pounds, then backed off the throttle and removed the gauge to insure its availability for the remainder of the tests. We again increased engine power to the 1,700 rpm it had taken to break down our initial setup. As with the helical system, the Manta Ray didn't budge when the tug's twin screws reached that power level.

## Conventional Mooring Anchors

The next anchor to be tested, a mushroom type lying in about 15 feet of water, was not very well dug into the mud. Optimally, the mushroom "cap" and the shank to which it is attached are fully buried. But, as so often happens, this one was only about half covered, with the shank lying in line with the area's prevailing winds.

It took a "quick tap" of the tug's throttle, generating about 1,200 pounds of pull, to break out the 500-pound mushroom, despite the normally acceptable 3-1/2:1 scope.

In our last two tests, it took only about 800 pounds of pull in 14 feet of water to pull out a 2,000 pound concrete block, and about 4,000 pounds of pull to dislodge a pair, of 4,000 pound cement blocks connected by chain in 35 feet of water. Both moorings had 3:1 -scopes.

Now we can examine how the various anchors differ and why they interact as they do with different marine environments.

## Weight-Dependent Anchors

The first deadweight mooring used by a man was probably a submerged rock with a length of vine tied around it to keep a dugout canoe or raft from drifting away. Today, many types of mooring systems are available, meeting boat owners' needs as dictated by bottom conditions, weather patterns, and wallets.

Concrete blocks, chunks of granite, railroad wheels or engine blocks make up the simplest category of anchor, and all have one thing in common - their holding power comes mostly from dead weight, with some help from suction, especially in soft mud and silt.

Dead weights weigh less when underwater than on land. Cement blocks lose 45%, while granite loses 36%, iron loses 14%, and steel 13% when submerged.

Mushroom anchors also, are best suited for use in muddy or silty environments, but not in coarse sand, hard mud or clay, or rocky conditions. The mushroom's upended "cap" works into the underwater subsoil and the "stem" - to which ground tackle is attached protrudes from the bottom. When all but the tip of the shaft is buried, mushrooms are said to have holding power 10 times their weight. But partially buried mushrooms may hold only at a rate double to their weight. When hurricane-force winds blow a mushroom anchored mooring from a direction opposite that of the prevailing winds, the force of the storm can uproot the shaft by flipping it over, neutralizing most of the anchor's holding power.

To ensure that mushrooms are properly seated, compressed air is sometimes "jetted" downward into the bottom, creating a hole that later fills in around and above the anchor. But generally a boat is used to circle the newly placed mushroom, keeping the rode taut so that it works the anchor partially into the bottom.

The Dor-Mor because it offers less leverage when

the-prevailing wind reverses its direction, is probably less likely to be uprooted-than the mushroom. And, as our test seemed to indicate, it may have better gripping power after being dislodged because of its sharp edges and pointed construction. It is best suited to muddy or silty bottom environments like the mushroom. Also, the Dor-Mor's thicker eyelet may not rust out as quickly as those on the mushroom or block.

## Embedment Anchors

Helical Screw Anchors were introduced as screw pilings for lighthouses in 1838. The technology has been used continuously since, most recently in the construction industry for retaining walls, offshore pipelines, and pole guy wires.

Holding power for helical anchors, just as with the Manta Ray, is dependent oh the composition of the harbor bottom where they are placed. They don't do well in rock bottoms, and the number of helixes employed differs with soil type - from loose silt to highly cohesive clay -just as wood screws with different threads are used to achieve optimum results in different woods like pine or oak. One underwater helical anchor installer claims the mooring will withstand "more that 25,000 pounds of straight upward pull" when properly set into the bottom.

Manta Ray, like the helix, has been used in traditional construction applications and to anchor embankments, sea walls, and artificial reefs. Its holding capacity varies from 8,000 pound to 25,000-plus pounds in soil ranging from loose sand and silt to very dense sand and hardpan, according to the manufacturer. Manta Ray can be used in harbor bottoms ranging from solid bedrock, which has to be predrilled, to very loose sand, saturated silt, and swamp, where two or three anchors are tied together.

Unlike weight-dependent anchors, embedment types' holding power appears not to be affected by the angle from which they are pulled. Therefore, the strength of other mooring system components, like the hardware, rode, and pennant, dictate the amount of scope required.

But we should not overlook the beneficial effects of scope, with its uniform curve, or catenary, to absorb storm surge or other sudden stress.

## Costs

The manufacturers of both helical and Manta Ray mooring anchors say their products offer greater holding power than is offered by conventional moorings. And some insurance companies offer lower rates for approved mooring systems.

A helical mooring anchor with double helixes and mooring adapter is about $550. Installation runs about $250, with a $60 per hour surcharge for any installation taking more than an hour. Total cost, installed, would probably run $800 to $860 for a single unit, with prices for multiple installations being negotiable.

Manta Ray anchor and seven-foot-long rod combination, adequate for recreational boats in most soil types, costs $130. Typically, a professional diver with the proper gear would charge a minimum of about $1,000 per day, during which time he could put eight to 12 Manta Ray units into place. A single anchor, including placement, should run about $1,150 to $1,200, with a sharp decrease in per unit price for the multiple installations.

Equipment, installation, and maintenance costs would be virtually the same for any recreational boat, ranging from a 19-foot sloop to a 50-foot power cruiser with a tuna tower.

The cost of inspections to check for deterioration of underwater anchor sections protruding from the bottom should also be figured into overall expense of a system. Visual inspections, much like those made on conventional mooring systems, may be necessary. And, since both types require professional installation, they might also require specialized personnel with torque motors or load lockers to "proof load" and perhaps reset them if they should loosen.

A 300-pound mushroom anchor retails for about $500; a 500 pounder costs about $800. Transport and placement of a mushroom within a harbor would probably run about $150 to $200, according to one New England harbor master. And installation at a location remote from a commercial harbor or boat yard, for instance near a private waterfront property, could become quite expensive, based on time and transportation costs, he said.

A 500-pound Dor-Mor sells for $600 and would be subject to the same transportation charges as a large mushroom.

Concrete blocks, though cheaper, could be subject to higher transportation and installation costs because of their weight.

## Some Conclusions

Our tests seem to indicate both the helical and Manta Ray mooring anchors may offer at least a partial solution to one of the most basic mooring problems -