4-1-1977

Dry Stack Storage a Promising Marina Alternative

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Marine Resource Advisory
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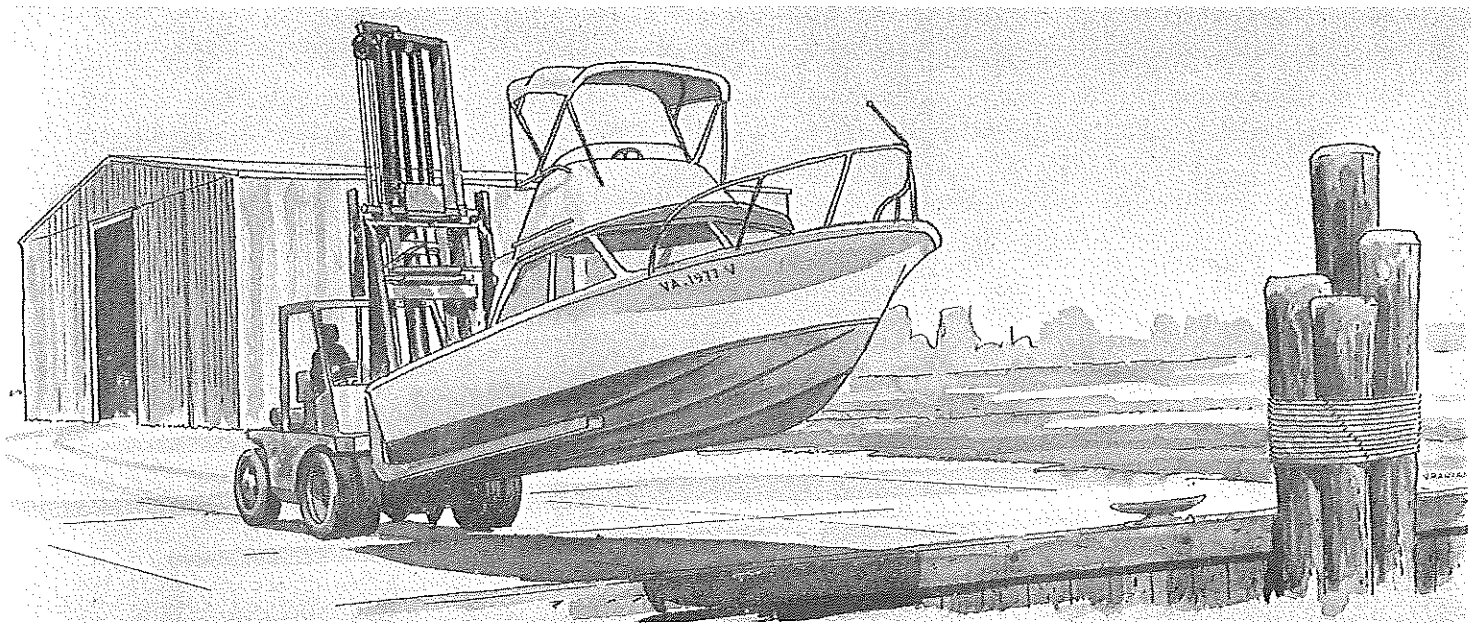
ADVISORY NO. 13 APRIL 1977



DRY STACK STORAGE--A Promising Marina Alternative

by
Jon A. Lucy, Marine Recreation Specialist

SCENARIO I

Say you're a marina operator with 50 wet slips. Business has been good and you'd like to consider doubling the size of your operation. You have some open land space at your site, but not enough water area or shoreline to put in slips for 50 more boats. You begin to look at the land next door for possibilities and start getting rough estimates on dredging and slip construction costs.

That's when problems begin to develop:

You find that the adjacent property has skyrocketed in price.

Dredging and slip construction costs have practically kept up with land prices.

Environmental and pollution considerations may not allow you to dredge and bulkhead as much frontage as you want. What's more, nearby shellfish growing grounds may prohibit significant wet slip expansion of your marina altogether.

SCENARIO II

You are knowledgeable in the area of marina design and management and, along with several business associates, recognize that the demand for boating access in your city is not being adequately met. Capital is available to establish a marina within the city, no suitable site with enough shoreline footage and water area can be found for a wet slip operation. In addition, the greatest demand for access probably lies with small and medium sized boats under 30 feet in length rather than with larger cruisers and sailboats. Can anything be done with existing land located in a confined waterfront area?

A possible solution to the problems in both situations might be dry stack storage of boats. Similar situations have prompted a number of Virginia marina operators either to expand existing facilities or establish new facilities using this "vertical" mode of operation. The idea of dry stacking boats is a lot like using apartments and multistory parking garages: when surface area becomes limited, people look to the vertical dimension to improve use efficiency.

Dry stack storage originated in Florida about 15 years ago. In the past decade it has spread to most of the popular boating areas in the United States. The system is built around a simple skeletal steel or aluminum rack structure which can be set up in multiple configurations and adjusted to accommodate boats of various lengths and widths. The maximum length boat handled is generally 25 to 26 feet, but larger boats (up to 30 feet) can be stored with proper planning and design.

Vertical dry storage also offers a variety of attractive features to the recreational boat owner. Launching and retrieval of boats are simple and efficient. Owners can call ahead at most marinas to have their boat launched by a given time, or they can go into the marina during operating hours and their boat will be launched in a matter of minutes. After launching, boats are moored at a holding dock for loading of gear and passengers.

After using his craft, the owner returns it to the holding dock and is free to leave. Marina personnel then haul the boat out of the water, wash it down and return it to the racks.

Most facilities include unlimited launchings and haul-outs in their basic storage fee. On a per-foot basis, stack storage fees generally run approximately equal to wet storage fees for open slips housing similar class boats. In addition, most stack storage operators will move boats to low racks or cradles outside the building for do-it-yourself repair and maintenance work.

Dry storage lessens the need for some types of maintenance work, such as lower unit and out-drive maintenance on motors. There is no need for anti-fouling bottoms, since the boats are in water only when they are being used. Owners report that the weather protection afforded by the system also reduces general maintenance and can increase resale value of craft.

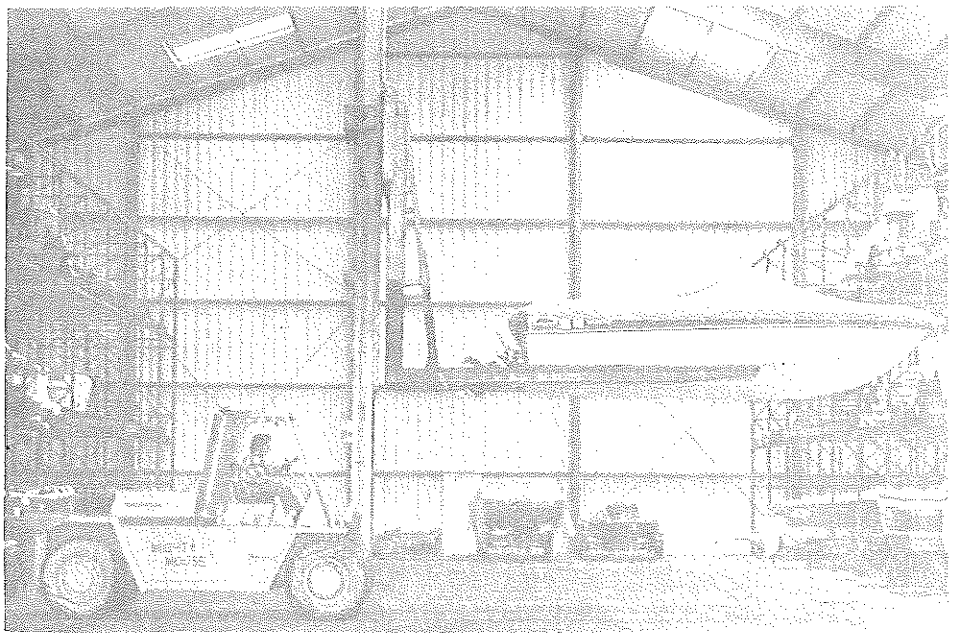
Dry storage eliminates the need for boat trailers, thus avoiding the ownership, towing and maintenance problems associated with such equipment. But the system limits use of the craft to the immediate area in which it is stored. This restriction seems to be one of the few drawbacks to dry stack storage.

Damage to boats from careless handling by lift operators has not been reported as a major problem, and reputable operators are invariably insured against such damage. Mishaps, when they occur, are generally limited to bowrails, lights and tops. A nuisance problem sometimes encountered is fuel or water dripping from upper level boats onto those below. If this persists, either work on the upper boat or the use of plastic to protect the lower boat solves the problem.

Many marinas enclose their storage racks in warehouse-type buildings for protection from the weather and for additional security from theft or vandalism. Racks also can be partially enclosed in a building which is open on one side or simply covered by a roof.

Boats are stored up to five levels high. Either forklift trucks or an overhead crane system is used to get boats from the racks to the water and back into storage. The more common forklift method uses industrial trucks specially adapted for the stack storage application. The major modifications are extended forks to support the larger loads and adjustable fork spread to accomodate different hull dimensions. Where tidal fluctuations exceed a maximum range of 7-8 feet, a fixed dockside elevator may be a necessary addition to the forklift for launching and retrieving boats. During extreme low tides, the 10-foot negative lift feature (lowering the forks below ground level) of most trucks may not be adequate.

The stacker crane, presently used in only one operation on the West Coast, features an overhead crane supported on rails above the center aisle of the rack storage building. The crane has 360-degree maneuverability and has a greater vertical range than the forklift. With both methods, boats can be taken from storage and placed in the water within 3 to 8 minutes, depending upon how far the lift must travel.



Most dry stack operations store boats in warehouse-type buildings.

Stack storage has several potential environmental advantages. It can operate with less shoreline footage and water area than required by a comparable wet slip marina, reducing dredging and bulkheading needs. Less anti-fouling paint is likely to come in contact with the environment. In comparison with wet slip operations, fewer boats are in the water at any one time. The system also reduces problems associated with waste disposal by catering

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to smaller sized boats; in addition, it all but eliminates problems associated with people staying aboard their boats overnight. For stack storage operations, these features are proving to lessen some of the difficulties generally encountered in obtaining state and federal shoreline permits for marina projects.

During the latter half of 1975, interviews were conducted with marina operators offering dry stack storage service in Maryland, Virginia and North Carolina to gain a better understanding of stack storage operations. Contacts with the 20 firms known to offer the service yielded 17 usable sets of data. Since completion of the survey, at least two new stack storage marinas have opened and two are under construction. The geographic distribution of the 17 surveyed marinas and the total number of marinas now having stack storage (shown in parenthesis) is as follows: Maryland -- 4(7), Virginia -- 9(10) and North Carolina -- 4(5). Of the marinas surveyed, all are on coastal waters except for two inland lake firms in Virginia.

Stack storage first developed in the area about ten years ago, appearing almost simultaneously in North Carolina and Maryland. By 1969, at least four firms offered the service, and there has been a dramatic increase in use of the storage method during the 1970's, particularly in Virginia.

Between 1970 and 1972, stack storage was installed at six marinas. Two of these were new marinas, designed specifically for the stack method and having only limited wet storage space available. Over the next three years, at least seven more stack facilities began operation; three of them were new stack marinas. The new stack storage marinas are successfully demonstrating their ability to use sites incapable of development as traditional wet slip marinas handling the same number of boats. Of the thirteen firms known to initiate the service during the 1970's, eight were in Virginia.

The distribution of stack storage capacity among the marinas (Table 1) points out a distinction between wet storage marinas adding stack storage to their operations and those new facilities designed as stack marinas. The combination marinas generally have stack capacities of under 150 boats, while the stack firms are characterized by capacities exceeding 150 boats. Stack capacity at combination operations is shifting upwards, as indicated by two firms in the 100-150 boat category doubling their capacities during 1975-1976. This degree of expansion will affect the future ratio of stack storage to wet storage at combination marinas, two-thirds of which presently exhibit a stack/wet boat storage ratio of 1.3 to 2.9.

The initial capacities of the combination marinas and stack marinas are also distinctive. Two thirds of the combination operations began with stack storage capacities of approximately 100 boats. Some operators recommended this figure as the minimum that should be added to a wet slip operation to justify the initial investment. Several operators started out adding much smaller stack capacities, but these individuals did most of their own work, thus holding down construction costs. Better than half of the combination marinas have expanded their stack storage capacity since first initiating the service, and approximately half plan to expand before 1980.

TABLE 1

Stack Storage Capacity	*Number of Marinas*	
	Combined Storage	*Stack Storage*
49	1	
50–99	3	
100–149	4	
150–199	1	3
200–249	2	2
250–300	1	

Four of five stack storage marinas opened with capacities of 160 to 235 boats. One operator began with slightly over 100 boats, but has since expanded his capacity to nearly 180 boats. Operators of stack storage marinas surveyed in California and Florida recommend a 200-boat capacity as the minimum initial scale of operation (Williams-Kuebelbeck and Associates, 1975).

Two stack marinas which began operations prior to 1974 have expanded their capacities. Newer facilities had not expanded at the time of the survey. Three of the five operators anticipate expanding prior to 1980. As with the combination marina operators, stack operators generally feel that future expansion should be aimed at boats greater than 20 feet in length. More demand is being placed on existing stack facilities by owners of these larger boats.

All but a few of the marinas with 80% or more of their stack capacity filled maintain a customer waiting list for stack storage. On the average, these full operations turned away 10 to 20 potential storage customers during 1974. Several operators reported having to turn away nearly three times this number of customers.

Customer utilization of stack storage naturally depends upon a number of factors characteristic of the marina and its location -- trailered boat traffic in the area, new boat sales volume, the distance by water to popular boating-fishing areas, the marina's service record, etc. While not all of the marinas surveyed sell new boats, most of those having larger stacked storage capacity are involved in boat sales. The two operations promote one another.

Of eleven marinas initiating stack storage prior to 1974, nine had at least 80% of their stack capacity filled by 1975. On the average, these nine operators indicated that nearly two full boating seasons were necessary to fill their initial capacity, which ranged from 9 to 130 boats. There were several operations that filled up in about half this time. By late in 1975, only one of four operations initiating stack storage in 1974 were filled. Location appeared to be the primary problem for the slower filling firms.

Nearly all of the operators interviewed felt that word of mouth advertising by satisfied customers was the most important factor bringing new customers into stack storage. With a few exceptions, the average annual rate of customer turnover was estimated to be 5 to 10%.

Distances traveled by customers to use stack storage facilities depends upon whether the service is located in or adjacent to major metropolitan areas. For storage facilities with at least 50% of their spaces filled, "metropolitan" operators (5 firms) estimated that 30 to 75% of their stack customers live within 10 miles of the marina and 80 to 99% within 25 miles.

Facilities located at some distance from metropolitan areas exhibit a different customer distribution pattern. Generally these "rural" marina operators (9 firms) have only 5 to 10% of their stack storage customers living within 25 miles of their marina. Most of the rural marinas primarily accommodate boat owners from urban areas located 25 to 100 miles away.

Estimates of stack stored boat usage

varied considerably for the marinas surveyed. For eleven marinas with 65% or more of their stack storage capacity filled, the average percentage of stack stored boats used on a typical fair weather weekend was 42%. Estimates ranged from 15% to 70% and were distributed as follows: Under 20% – 1 firm; 21% to 40% – 4 firms; 41% to 60% – 5 firms and 61% to 80% – 1 firm.

Most of the marina sites consist of less than 10 acres of land. Stack marinas can utilize smaller sites than combination marinas, as indicated by one operation which uses just under one acre for its storage building and launching site. However, onsite parking and yard space for repair or other activities would require a larger site. A California feasibility study for stack storage marinas (Williams-Kuebelbeck and Associates, 1975) estimated site requirements for a 200- and 400-boat facility to be 2.4 acres and 4.2 acres respectively. Respective water area requirements were estimated at 0.5 acres and 1.2 acres.

During the survey, information was not requested on parking space requirements. However, in the California study, parking spaces for normal activity were estimated at 0.35 to 0.4 spaces per boat in storage. This figure was lower than the 0.5 to 0.75 spaces per boat used for typical marinas, for two reasons: "First, the boats in dry storage are significantly smaller than the average boats in wet storage and are expected to be used by fewer people per boat; second, boats in wet slips are often used as a place for relaxation and entertainment."

Shoreline footage in use at three of the five stack marinas surveyed ranged from 300 to 400 feet, the other two operations using twice this amount. Over half of the combination marinas had 450 to 1,000 feet of waterfront footage in use, while the remainder were in the 1,500- to 3,600-foot range. If necessary, stack marinas can function using less shoreline frontage than combination marinas or comparable wet storage marinas.

Totally enclosed boat storage buildings are twice as common among the operators surveyed as partially open ones. However, some closed systems have expanded by using open storage racks alongside the main storage building. The building must be designed around the rack system and forklift(s) to be used. The width of the building, its eave height, roof pitch and door dimensions are critical. The type of forklift to be used in the operation must be included in the early design plans. The two stage mast and three stage mast lifts commonly in use have different vertical clearance requirements when lifting a boat to the same height.

The basic building design of totally enclosed rack systems involves placing the storage racks along the long walls of the building, with a 50 foot wide concrete aisle between the boats (not the racks). Building width is generally determined by a rule of thumb where the maximum overall length (including the drive projection) of any boat to be stored is multiplied by three and the length of the lift truck, excluding the forks, added (Ross, 1974). Boats are stored perpendicular to the building walls. A 100-foot-wide building is generally used where the largest boats to be stored are 25 to 26 feet long. If property limitations require an unusually narrow building, racks can be arranged at a 60^{o} angle to the building's long axis, but 15% to 20% fewer boats can be handled than with right angle storage (Ross, 1974). Three and four level storage of boats were about equally common, resulting in respective building eave heights of approximately 24 to 27 feet and 30 to 34 feet.

Natural lighting was supplemented by electric lights in some Virginia and Maryland closed systems. North Carolina's closed systems were not wired for electricity. Fiberglass skylights are used, and one operator considerably improved lighting in his building by doubling the numbers of skylights recommended to him and painting the interior of the building white.

Most closed systems included only one doorway for shuttling boats in and out of storage. Door widths ranged from 15 to 30 feet, with a door width of 25 to 30 feet most common. A wider door makes it easier for the lift operator to move boats in and out of the storage building, especially during peak periods of boat use.

Designing a rack system to fit the boating characteristics of an area requires careful planning. Both the present and future demand for boat storage must be assessed, and even the effect of the stack storage facility on the local boating market must be considered. Since these elements can be determined with only limited accuracy, an operator should build into his rack system as much flexibility as possible to let him adjust to storage demand as it develops.

Maximum flexibility is provided by racks with individual bays for each boat, and this type of design is used by the majority of operators. Bay width can vary for each tier of racks, and the height of each bay is adjustable. Within the weight capacity limits of each tier, boats of different superstructure design -- even those with flying bridges -- can be handled efficiently.

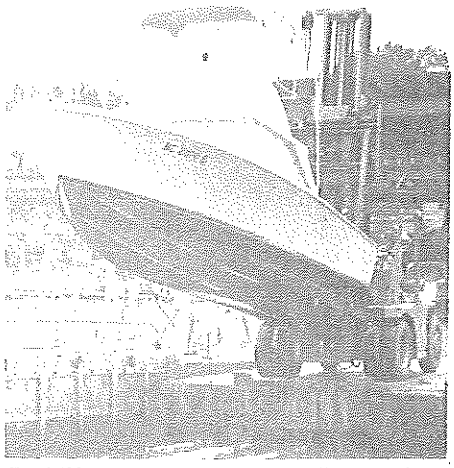
Another basic rack design observed during the survey consisted of wider individual bays in which two or three boats were stored. Requiring fewer but heavier rack members, this system also incorporates vertical flexibility. Adjustments are more difficult because of the weight involved. Also, bay width is the same for all tiers of boats, and without careful planning this can result in lost space on the bottom levels where the largest bosts are stored. Some operators have been able to squeeze in smaller boats on the lower levels to use the space, but this situation does not make best use of the stronger lower bays, since larger boats potentially bring higher bay rentals. Before settling on a rack system, potential stack storage operators should examine how others have fared with their racks and try to profit from their experience.

Support for the boats in the bays is generally accomplished with 2- x 10- inch wooden stringers, although another method of support was observed. Several operators use only the padded rack beam to support the bow of their boats while the stern is stabilized on a cradle or self-adjusting chocks. Both methods work, but stringers provide better support for the larger boats and are the preferred method.

Stringers should be adequately secured to the racks so that lateral pressure from boat hulls does not lay them over or severely bow them. They should also have as few knots as possible, to reduce the chance of cracking. Obtaining fairly clean lumber for stringers can be a problem. Larger boats are frequently supported by either heavier timbers (3" x 10" or 4" x 8") or by doubled stringers. Several operators have found that turning the stringers inward to direct their support perpendicular to the surface of the boat hull reduces some of the problems mentioned above.

A single forklift carried out all boat handling chores at most marinas. Only four operations used two, and in one case three lifts. Besides serving in a back-up capacity, a second lift can improve launching efficiency if boats are stored in more than one building, particularly if the storage areas are spread across the marina site.

Because of the scarcity of good quality used lifts, most operators purchased their lifts new. Capacities varied, but the most common lift had a manufacturer's rated capacity of 20,000 pounds (at a 24-inch



Forklift trucks are generally used to launch and retrieve boats.

load center). None of the coastal marinas used fixed dockside lifts, since the tidal amplitude in the region does not require them. Nearly two-thirds of the operators had experienced lift breakdowns at one time or another which prevented them from handling boats for short periods. The breakdowns were generally minor in nature, and occurred rarely. Hydraulic hoses and tires receive the most wear and require a good preventative maintenance effort by the operator.

A smooth running stack storage service depends upon many factors, and one of the most critical elements is the launching area. In spite of good forklift maintenance and a top-notch driver, a poorly designed boat launching area can bottleneck the operation, causing customer delays and frustrations for everyone. Multiple launching points and an adequate temporary holding area for boats are the elements required.

Most operators have at least a double launching point where two boats can be placed in the water side by side. This setup provides some leeway in clearing the launching point, giving the customer or dockhand a little more time to move a boat before another is launched. Some operations use two or more separate launching areas to improve boat movement.

Short floating docks or bulkhead space immediately adjacent to the launch point provide convenient short-term boat moorage for launching and retrieving boats. Slips or other holding areas can be available at some distance from the launch point, but the extra time required to move boats any distance can cause troublesome delays.

Operators having at least 80% of their stack capacity filled find that an in-the-water mooring capacity of 10 to 14% of their total stack capacity takes care of most traffic loads. Several operators recommend a 20% to 30% holding capacity, which would take care of potential holiday weekend problems and help when a storm sends everyone back to the marina at once, but these are not normal operating conditions.

Keeping track of boats moored in the holding area can prove to be a problem, particularly with respect to the customer who calls ahead to have his boat launched by a specific time and then shows up hours late. The recurrence of this situation has caused some operators to terminate their call-ahead service; however, most do provide it and generally encourage its use.

In the course of a weekend, boats will be returned to the marina that are going to be taken back out again later in the day or again the next morning. Rather than try to keep up with the owners who want their boat put back in storage and those who want theirs left in the holding area, one innovative operator has customers tie a card on their boat stating their wishes. By using "re-rack" and "leave overnight" cards, customers effectively communicate their needs to the lift operator without having to locate him on the premises. The system results in more freedom of movement for customers and marina personnel alike, while eliminating possible misunderstandings.

Stack storage customers come from three basic boating backgrounds -- new boat owners, trailered boat owners and wet stored boat owners. New boat owners represent 50 to 75% of the stack storage customers at 8 of the 14 marinas with 50% or more of their stack capacity filled. All but one of these eight firms sell new boats, which no doubt contributes to the dominance of such owners. On the other hand, there are two stack storage operators who sell new boats but estimated that 50% of their customers previously trailered their boats, while only 30% were new boat owners. This indicates the appeal that stack storage can have for the trailered boat owner. Nearly all operators felt that new boat owners were making up an increasing percentage of their customers. Where new boat owners did not prevail at marinas, trailered boat customers generally did. This is expected, since more boats in the under 26-foot category are trailered than stored in wet slips.

Bay rental rates are determined in a number of different ways, according to the needs of the operator and the custom of the area. Rental contracts are not used by every marina; although this is the case at nearly one-third of the operations. Those businesses using contracts are almost equally divided between annual and monthly agreements. Several operators also use quarterly contracts. Monthly rather than annual fee schedules are the rule.

Rental terms can be broadly divided into three categories for prescribed time frames: a flat fee per boat, regardless of length; a set fee per foot of boat length; and escalating fees per boat length intervals of 1-4 feet. Virginia and North Carolina operators use the flat fee system more commonly than the Maryland operators surveyed. Nearly half of the Virginia operators and three of four Maryland operators set rental rates based upon one of the other two methods.

By working through the various rate strategies and calculating fees on a per-foot of boat length per-month basis, it can be seen that rates fall within a certain range. Taking boat lengths to range from a minimum of 16 feet up to the maximum length handled by the marina, averaged monthly rates in 1975 ranged from approximately $1.25 to $2.00 per foot. Average monthly charges ranged from approximately $24 to $38. Stack storage fees in the three state area were slightly lower than in Florida where the prevailing monthly rate ranged from $1.00 to $3.00 per foot in 1975 with the most common rate being about $2.00 per foot (Williams-Kuebelbeck and Associates 1975).

Construction costs for stack storage and wet slip storage facilities appear to be in the same general range, based on a cost per boat (or slip) basis. The California stack storage feasibility study (Williams-Kuebelbeck and Associates, 1975) stated this conclusion for the West Coast. It was felt that no significant saving per slip could be gained with stack storage if it were constructed in an existing harbor or marina. However, some savings might be realized if a comparable size wet slip facility required a fair amount of dredging and breakwater construction.

Based upon 1975 estimated costs for the basic components of a stack storage system, costs per boat ranged from about $1,200 to $1,300 for a facility with a 160-boat capacity. This estimate only includes the cost of a closed building on a concrete pad, a new 22,500–24,000 pound forklift, adjustable racks and stringers, a concrete apron and bulkhead launching point, and floating utility docks for temporary boat moorage. Not included are the costs of the land, possible dredging, extensive bulkheading and paved parking areas.

Costs can be reduced, depending upon how much work marina personnel can do themselves. If a used forklift is available,

savings can be realized, at least initially. However, it is important to remember that it does not save money to cut corners on basic items, particularly the racks and concrete work. If anything, an operator should tend to build some overkill into these elements, since problems with them later could prove costly.

While stack storage is not a cure-all for all the problems faced by the marina industry and the boat owner looking for access to the waterways, it does provide an opportunity for improving use efficiency of certain coastal areas. It may well be the only realistic method for significant expansion of many existing marinas. In the coastal urban environment, stack storage has opened up a new niche for boating and expanded badly needed access opportunities for urban boat owners. Because of the vital role marinas play in much of boating, a part of boating's future may be linked to the successful application of the stack storage concept.

If you would like more information, consult the following articles or contact Jon Lucy, Department of Advisory Services, Virginia Institute of Marine Science, Gloucester Point, VA 23062, (804) 642-2111.

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