C1. Dimensional Criteria

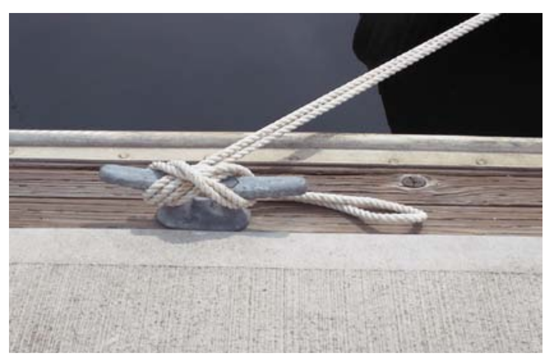
C1.1 Fingerfloats

Table C-1
Minimum Fingerfloat Width

Fingerfloats	
Minimum Width	**Length Range**
5.0 ft	all accessible fingerfloats
2.5 ft	below 20 ft
3.0 ft	20 ft & over
4.0 ft	36 ft & over
5.0 ft	60 ft & over
6.0 ft	80 ft & over
8.0 ft	120 ft & over

View of Fingerfloat Clear Width Including Walers

C1.1.2 Minimum fingerfloat width dimensions are considered to be "clear" widths. Cleats or rings along the top edge of a fingerfloat, and hoses and power cords connected to utility pedestals, should not be considered to be reductions of the clear width of fingerfloats. However, ***hoses and power cords shall not be allowed to lay across an accessible fingerfloat***.



Fingerfloat Cleat Attached to Inside Waler

C1.1.3 The clear width will often include the thickness of walers along the sides of fingerfloats. In some dock structures the widths of single or double walers can add 3 to 7 inches of width to each side of a fingerfloat, amounting to an additional overall width of 6 to 14 inches. The fingerfloat waler width must be considered in designing the actual clear width of a berth. If ignored or overlooked, it can result in reduction of the clear width of the berth. This is even more critical on single berths since walers are on both sides of the berth.

Double Waler Fingerfloat

C1.1.4 These guidelines do not specifically address berth lengths over 80 feet. However, Table C-1 shows recommended widths for berths up to 120 ft to address the growing demand for larger berths in some coastal marinas. Special attention must be paid to boat length, beam and draft.

C1.2 Main Walkways

C1.2.1 Minimum Widths

Table C-2
Minimum Main Walkway Width

Main Walkways	
Minimum Width	**Length Range**
6.0 ft	below 300 ft
8.0 ft	300 ft & over
See C1.2.2.1 regarding uniform widths of long main walkways.	

Main Walkway - Fingerfloats Both Sides

C1.2.1.1 Width dimensions are generally considered to be "clear" widths. Piles, light standards, telephone and fire call boxes, etc. along the edge should not be considered violations of the clear width criteria.

C1.2.1.1.1 ***Intermittent width reductions shall be kept to a minimum on accessible route walkways, and encroachment into the clear width by any part of berthed boats shall not be allowed***.

C1.2.1.2 When designing a new or altered marina, the minimum width criteria must be applied in conjunction with design criteria for fairway widths, berth lengths and the inventory of berth sizes being planned. Otherwise, discontinuities of both fairway and dock alignments will result.

C1.2.2 Main Walkways – Maximum Length C

700 feet is a practical maximum length of a main walkway.

C1.2.2.1 The clear width of a main walkway should be of uniform width throughout its length. Otherwise, problems will occur with regard to utilities and the clean orderly alignment of fingerfloats and fairways.

Long Uniform-Width Main Walkway

C1.3 Marginal Walkways

C1.3.1 Minimum Widths C

Table C-3
Minimum Marginal Walkway Widths

Marginal Walkways		
Minimum Width	**Length Range**	**Qualifying Criteria**
6.0 ft	up to 300 ft	when connected to main walkways that **do** have dedicated gangways
8.0 ft	over 300 ft	when connected to main walkways that **do not** have dedicated gangways
10.0 ft	over 600 ft	
12.0 ft	over 800 ft	

C1.3.1.1 As length increases, width must increase in consideration of:

- increased pedestrian traffic and maintenance activities;
- movement of supplies, equipment and gear;
- larger utility lines and pull boxes;
- lighting needs; and
- emergency access for rescue and law enforcement personnel.

C1.3.2 Marginal Walkways – Maximum Lengths C

C1.3.2.1 1,000 feet is a practical maximum length in consideration of:

- walking distances between berths, parking areas and restrooms;
- hauling supplies, equipment and gear to and from a boat;
- utility line size increases because of long walkway lengths;
- potential voltage losses in electrical circuits;
- possible need for additional transformers; and
- more utility lines, fittings and equipment dead loads on docks.

C2. Loading

C2.1 Dead Load (DL)

Dead Load on a Dock:
Electrical Transformer Cabinet

C2.1.1 The total dead load of a floating dock system is the combination of concentrated and uniformly distributed weights of all framing, decking, nuts, bolts, washers, connectors, flotation pontoons, and all permanently attached equipment such as pipes, lines, pumps, utilities, fuel facilities, sewage systems, fire suppression systems, gangways, lighting, storage boxes, utility cabinets, etc. The determination of total dead loads should also include the estimated weight of items that will be stored in storage boxes, and the weight of the fluids in various utility lines and related equipment.

C2.1.2 Care must be taken in locating various dead load elements to insure that flat and reasonably level deck surfaces are maintained throughout the service life of the dock system. Overloaded storage boxes or large diameter water lines on only one side of a dock can alter the freeboard and deck slopes.

C2.1.3 ***Cross slopes under dead load only shall not exceed 2% (1:50) on docks that are part of an accessible route.*** C

C2.1.4 The dead weight of lumber and wood timbers utilized in a floating dock system should be assumed to weigh not less than 35 lbs. per cubic foot at specified moisture contents following pressure treatment.

C2.2 Uniform Live Load (ULL)
25 pounds per sq ft minimum

C2.2.1 25#/ft^2 is a guideline that is time tested and can be relied upon to be reasonable in its application. Floating docks in marinas should meet all freeboard and deck slope guidelines under the minimum ULL. C

C2.2.1.1 There may be circumstances in which the application of a 25#/ft^2 ULL is actually in conflict with practical dock design and construction considerations under unique local conditions. C

C2.2.2 Snow and ice loads will be part of the ULL in certain locations. Sustained snow loads and ice buildup can exceed 25#/ft^2, depending on water content. These loads can linger for weeks or months unless the docks are cleared or warmer weather returns. It is prudent to check with local authorities for required or recommended design snow and ice loadings. C

C2.2.3 ULL of 40#/ft^2 may be necessary for design purposes in marina locations where floating dock systems are subjected to regular and repeated high volumes of pedestrian traffic and the movement of goods, materials, supplies, cargo, etc. Special events such as boat shows where queuing for shuttles, ferries, etc., may call for the higher ULL on impacted marinas. C

High Volume Pedestrian Traffic

C2.3 Live Point Load (LPL)
400 pounds minimum

C2.3.1 Floating docks in marinas are to meet all freeboard and deck slope requirements under a minimum LPL of 400#, applied at any point on the deck not closer than 12" from any edge. This realistically addresses the center of gravity of the general array of heavy objects that are likely to be rolled over the surface of, or temporarily placed upon a marina dock. A typical LPL might be an outboard engine, stacked boxes of supplies for a cruise, or an adult person in a heavy-duty battery-powered wheelchair. The 400# LPL will cover the majority of typical temporary loads that are likely to occur on a marina dock.

C2.3.2 Where the application of a heavier LPL is anticipated, especially along an accessible route, design loads require careful attention with regard to freeboard and cross slopes. C

C2.3.3 ***Where applied along an accessible route, the minimum 400# LPL shall be applied concurrently with the minimum 25#/ft ^{2} ULL to insure that maximum cross slopes are not exceeded.***

C2.4 Lateral Loads (WinL, CL, WavL, IL)
Lateral loads on a dock system may result from winds, currents, waves, and impacts. Such loads may be imparted to docks, boats tied up to docks, or both concurrently. Such loadings may be influenced by seasonal factors that may dictate that two or more types of lateral loads be applied concurrently.

C2.4.1 <u>Wind loads</u> (WinL) on the projected vertical surfaces of docks and berthed boats should be not less than 15#/ft^2, applied above the water surface. If established wind data at specific locations dictates, a higher unit WinL may be necessary. C

C2.4.2 <u>Current loads</u> (CL) should be calculated on the basis of the maximum currents, flood flows, tidal flows, and/or other site-specific lateral (horizontal) moving water loadings that can be anticipated at a given marina site. The determination of current loads must include consideration of reversals of flow with changing tides, eddies in rivers, and anomalies that can occur in complex water systems where a failed levee event can cause a temporary reversal of direction of flow in a river or slough.

C2.4.3 Wave loads (WavL) should be calculated on the basis of the maximum wave that can be expected to occur within a marina basin, caused by the highest significant wave impinging on the protective works of the marina basin; or the maximum wind wave that can set up within the marina basin, whichever is greater.

C2.4.4 Impact loads (IL) to both floating docks and berthed boats are primarily caused by vessels of varying sizes underway within a marina. Such impact events usually occur in main channels and fairways. The determination of impact loads is based on the length and weight of the impacting boat, its angle of impact, and its velocity at impact. C

C2.5 Environmental Loads

C2.5.1 Waterway debris loadings on marina dock systems may occur because of unique local conditions. River based marinas are subject to flood events that bring large quantities of limbs, branches, logs, trees, root balls, propane tanks, travel trailers, abandoned boats, swept away docks, piles and other large debris that pile up against a marina and its berthed boats.

Upstream Debris Deflection Boom

C2.5.1.1 The location and magnitude of potential waterway debris loading is virtually impossible to accurately anticipate and calculate. However, prudent marina designers should investigate the history of a waterway upon which a marina is being planned, interview personnel and owners of existing nearby marinas, and make diligent efforts to discover and quantify the loadings that may occur. Based on this data and information, estimated design loads can be developed to design and construct a marina that will likely withstand such environmental loadings. The final design in a river may very well include an upstream debris boom to deflect floating debris and encourage it to pass around a marina rather than through it.

C2.5.1.2 River based marinas near low bridges are special cases, including marinas upstream or downstream from a bridge. A low bridge is one that can be impacted by anything in the river at high water. The C definition of “near” cannot be identified in terms of feet or miles, but must be determined by the character of the river itself, including bends, tangents, forks, stream flows, velocities, levee characteristics and the presence of other physical features that influence where quantities of debris would likely flow during a flood event.


River Marina Viewed From Low Bridge

C2.5.2 Wildlife loading can occur in marinas, involving ducks, geese, sea lions, harbor seals and other natural residents that live in and near the water. When such a condition occurs with wildlife, it can cause partial or total shutdown of a marina. Along the coast where certain marine animals are protected by federal law, and enforced by NOAA Fisheries, it may be very difficult or illegal to remove wildlife from docks and boats for certain periods of time. When such events occur in a marina, solutions can usually be worked out cooperatively with personnel from federal, state and local environmental authorities. **C**


Sea Lions in Boats


Sea Lions on Docks

C3. Freeboard

C3.1 Under DL only: **C**

Minimum Freeboard	14 inches
Maximum Freeboard	24 inches

C3.2 Under DL + ULL: **C**

Minimum Freeboard	10 inches

C3.3 Under DL + LPL: **C**

Minimum Freeboard	10 inches

C4. Maximum Slopes

C

C4.1 Under DL only, and DL + ULL:

Maximum Cross Slope
¼ inch per foot, not to exceed 1 inch maximum

Maximum Longitudinal Slope
$^1/_8$ inch per foot, not to exceed 1 inch in 10 feet

C4.2 Under DL + LPL:

Maximum Cross Slope
½ inch per foot (4%), not to exceed 2 inches maximum

Maximum Longitudinal Slope
¼ inch per foot, not to exceed 2 inches in 10 feet

C4.3 On Accessible Routes, Under DL only, DL + ULL, or DL + LPL:

Maximum Cross Slope
Shall not exceed 1:50 (2%)

Maximum Longitudinal Slope
Note: The maximum allowable longitudinal slopes in C4.1 and C4.2 are well below the 1:20 (5%) slope that defines a "ramp". Marina walkways are typically very flat in slope, and consequently provide excellent accessibility with regard to maximum longitudinal slopes.

C4.4 ***The ULL and LPL shall be applied concurrently along accessible routes in order to insure that maximum cross slopes are not exceeded.*** The maximum allowable cross slope on a accessible route is 1:50 (2%). This requirement applies to gangways, marginal walkways, main walkways, fingerfloats, courtesy landing docks, fuel docks, sewage pumpout station docks, and any other floating structures that are part of an accessible route in a marina. All of these components link together to provide the accessible route that serves all marina primary function areas.

C5. Material Considerations

C

C5.1 In selecting materials for berthing systems, keep the following in mind:

- corrosion resistance
- impact resistance
- strength of materials
- minimum thickness
- ultraviolet resistance
- cost
- flexibility
- ease of maintenance
- vandalism
- availability
- pleasing appearance
- past performance
- decking texture / traction
- local code requirements
- weight
- color
- dissimilar metal galvanic corrosion
- thermal expansion and contraction

C6. Pontoons

C6.1 Pontoons in floating marina berthing systems are the components that provide the flotation capacity to support all loads that may occur during the service life of a marina. The heavier the combined loadings, the greater the required pontoon capacity to maintain required freeboard, cross slopes, etc. C

C6.2 Marina pontoons are typically manufactured from concrete, polyethylene plastic, fiberglass, aluminum and steel. Pontoon material selection must include consideration of environmental influences, the nature of the berthing frame system, pontoon flotation characteristics, availability and cost. Environmental influences include salt water, fresh water, currents, waves, tides, flooding, wind, storms, extreme temperatures, ultraviolet exposure, impacts, and potential seismic activity.

C6.3 Pontoons must be selected and designed to be compatible with the dock frame regarding fastening details, ease of repair and/or replacement if necessary, flexibility/stiffness, and performance. C

C6.4 Most pontoons used in marinas consist of an outer pontoon shell of concrete, plastic or metal. ***Hollow marina pontoons shall be filled with new expanded foam*** to insure continued flotation if the shells leak, as they most probably will. Pontoon foam can be polystyrene or polyurethane, but should be either (1) expanded and formed inside the pontoon shell; or (2) manufactured in large monolithic blocks such that the foam fits tightly inside the pontoon shells with a minimum of air gaps. In the case of concrete pontoons, the concrete is cast around a pre-manufactured foam core. In the cases of closed-vessel roto-cast polyethylene and fiberglass pontoons, the foam must be expanded inside the completed pontoons in precisely determined quantities. Too little foam will be ineffective if the pontoon leaks. Too much foam and the pontoon will be destroyed from the internal pressure from the expanding foam. The filling of pontoon shells with used foam debris and left over pieces is unacceptable.

Roto-Cast Polyethylene Foam-Filled Pontoon

Dock Sections with Polyethylene Pontoons

C6.5 Exposed foam pontoons will not be approved for use on marina projects.

Pontoons made exclusively with polystyrene or polyurethane foam, without protective shells, are subject to the dissolving effects of hydrocarbons such as gasoline and oil. Obviously, such exposed foam pontoons should never be used near fuel docks. Also, exposed foam is subject to mechanical wear from debris in the water, and damage from gnawing animals such as muskrats and other salt seeking rodents. The foam inside pontoon shells is the only insurance against a marina sinking. The foam must be protected.

C6.6 Where polyethylene pontoons are used, it is recommended that the following guidelines be used in the specifications: C

- Method: Roto-Cast
- Material: Linear Low Polyethylene
- Nominal Wall Thickness: 0.150 inches
- Color: Black

C6.7 Where concrete pontoons are used, the walls, bottom and top act as a closed pontoon shell and a structural frame. They are very rigid, heavy, and provide excellent docks in relatively quiet marina basins. They probably should not be considered for marinas in open water locations subject to wave heights over 12-14 inches unless designed and built to also act as a wave attenuator. C

Rectangular Pontoon Loading Curve
Based on a 1 ft^3 Pontoon, 12"x12" by 12" Long

C6.8 The loading characteristics of a pontoon are dictated by the vertical cross section. Both rectangular and circular pontoons are used for flotation.

C6.8.1 <u>Rectangular pontoons</u> with essentially vertical side walls, load in a linear straight-line fashion. As each increment of applied load sinks a pontoon deeper into the water, the pontoon responds with a proportionally increasing pontoon buoyant uplift.

Circular Pontoon Loading Curve
Based on a 1 ft^3 Pontoon,13.54" Diameter by 12" Long

C6.8.2 Circular pontoons load in a non-linear fashion. As each increment of applied load sinks a circular pontoon deeper into the water, the lower half of the diameter responds with a disproportionally greater buoyant uplift, and the upper half responds with disproportionally lesser buoyant uplift.

C7. Decking

Decking is the element in a marina berthing system that is probably most important to boaters. They don't much care what kind of pontoons are used or how big utility conduits are. But the decking is something they walk on, sit on, roll their carts over, sweep, hose off, and either love or hate depending on how it functions.

C7.1 Decking can be attached to a structural frame, or it can be part of the structural frame as in the case of cast concrete floats. Decking used in marinas includes various types of wood, pressure treated or untreated; recycled plastic lumber products; metal extrusions; fiberglass; and concrete. **C**

C7.2 Marina decking should be oriented so the "grain" runs across the primary direction of travel. Decking grain includes broom and brush finishes on concrete docks; gaps between lumber decking; and ridges, serrations, knurling marks and other traction enhancing elements imparted to extruded metal and plastic decking.

C7.2.1 ***The decking on an accessible route shall not have gaps wider than ½ inch, and the gaps must be perpendicular to the path of travel to the maximum extent possible.*** **C**

C7.2.2 Changes in decking level up to ¼ inch maximum shall be permitted to be vertical. Changes in level between ¼ inch and ½ inch maximum shall be beveled with a slope not steeper than 1:2.

C7.2.2.1 ***Where a change in level greater than ½ inch cannot be avoided, it shall be ramped at a slope not to exceed 1:12, with smooth transitions at the top and bottom of the ramp.***

C7.3 Lumber (wood) decking should be oriented laterally, across the width of a dock, and never longitudinally, along the length of a dock. This applies to marginal walkways, main walkways, fingerfloats, and gangways as well. Torsional twisting will gradually break the fasteners on the butt ends of longitudinal decking, allowing opposing corners to raise up and cause tripping hazards. Lateral decking is perpendicular to the torsional axis and is essentially neutral to the torsional effects. **C**

C8. Moorings

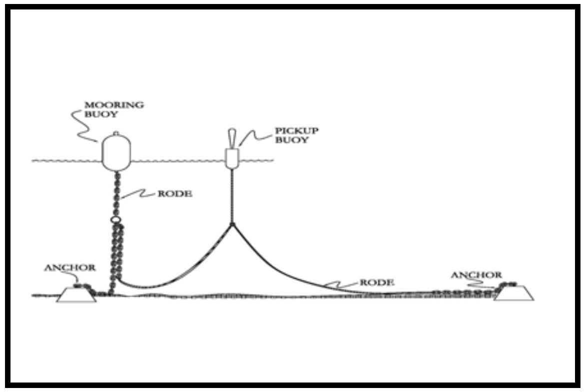
C8.1 The use of moorings is an alternative to berthing in certain circumstances, and may be used in lieu of or in conjunction with berthing. Mooring considerations include the wave climate; wind exposure; water depth; bottom conditions; ease of maintenance; management of the moorings; proximity to docks, berthing, channels and commercial shipping lanes; and environmental permit requirements.

C8.2 Moorings for recreational boats typically consist of buoys, chains or lines, and anchors connected together as a mooring system. The chain or line that connects a buoy to an anchor has historically been referred to as a **rode** which is an archaic past participle of the word **ride**. A boat tied to a mooring or an anchor can **ride** out a storm on a **rode**. Current terminology for moorings frequently refers to buoys, rodes and anchors.

C8.3 Recreational boat moorings typically consist of one of two types:

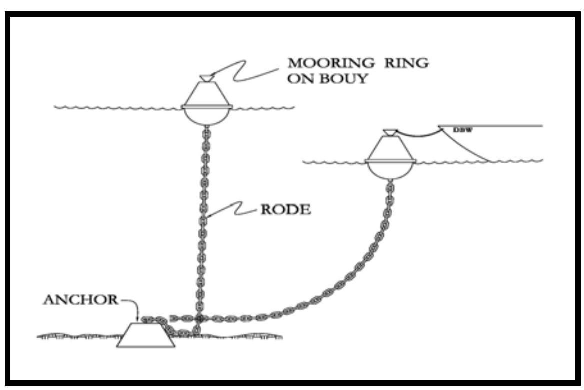
- fore and aft moorings
  (two-point moorings)
- swing boat moorings
  (single-point moorings)

C8.3.1 Fore and aft moorings are used to secure a boat from both the bow and stern, using various arrangements of buoys, rodes and anchors. The illustration to the right shows a mooring buoy (for bow line), a pickup buoy (to retrieve stern tie rode), rodes and two anchors. Once secured, boats will not swing with changes in currents, tides and/or winds. These moorings work well in waters with confused wave climates and currents that would cause adjacent moored boats to react in different ways, and perhaps collide with each other when secured to a single-point mooring. They also work well in coves and small bays with restricted water surface areas. Boats can be secured in well defined rows that can be oriented to the best advantage of boaters entering and exiting the mooring area. These moorings also allow more boats per acre of water surface as compared with swing boat moorings. An example of these moorings can be seen in operation in Avalon Harbor at Catalina Island.



Fore & Aft Mooring

C8.3.2 Single-point swing moorings enable a boater to secure a boat, utilizing a single buoy, rode and anchor. A boat is secured to the buoy with a bow line, and is free to "swing" 360° on the mooring in response to the influences of wind, tides and currents. These moorings are less expensive than fore and aft moorings, and work well in locations where all moored boats can be expected to consistently swing in the same direction under all predictable



Single-Point Swing Mooring
Shown at Two Water Levels

circumstances. Swing moorings work well in open water areas where adequate space can be provided between adjacent moorings. They do not work well in locations where cross currents occur, or where currents and winds occur in conflicting directions, causing moored boats to swing into each other.

C8.4 Design Considerations

C8.4.1 The scope of the rode is the ratio of its length to the depth of the water, typically measured at maximum high water. Therefore, a mooring with a 5:1 scope will have a rode five times greater than the high water depth, including any waves that can be expected to occur.

C8.4.1.1 As the scope increases, the forces applied to the anchor become essentially horizontal, usually making the anchor more effective and resistant to being dragged. However, this is influenced by the characteristics of the rode, including material, weight and length.

C

C8.4.1.2 Many moorings are put together using a combination of materials in order to utilize the best characteristics of each material. In deeper waters, the weight of the rode becomes increasingly problematic. The mooring buoy not only has to function as the connecting link with a moored boat, but has to be large enough to have the buoyancy capacity to support the weight of the rode at maximum water depth. The heavier the rode, the larger the buoy.

C8.4.1.3 An option is the use of an elastometric mooring system that utilizes elastic rodes that stretch and contract under increasing and decreasing loads. This system will enable to rode to stay up off the bottom, and acts as a shock absorber for a moored boat. The design capacity of a mooring is directly related to the maximum size of boats to be moored and the site conditions. The elastic rodes can be single elements, or ganged together to provide the required design capacity.

C8.4.2 Mooring buoys should be highly visible, large enough to support the weight of the rode, strong enough to hold a moored boat of a predetermined size and weight, fitted with a mooring ring for securing a boat, and have sufficient surface area for identification numbers and instructions as required. Mooring buoys are typically made of fiberglass or polyethylene, and should be highly resistant to ultraviolet exposure, and foam filled to insure continued buoyancy in the event of puncture by boats, equipment, spear guns and bullets. Mooring buoys are commonly white in color and have reflective color bands and letters or symbols that conspicuously reflect light at night. Mooring buoys require maintenance and cleaning on a regular basis. They often become resting perches for gulls and other shore birds that defecate on the mooring rings and obscure identification and information markers.

C8.4.2.1 Mooring buoys should be clearly marked to identify the maximum size and type of recreational boat that can be safely moored at specific buoys. If there are currents present, the drag on moorings from deeper draft vessels will be greater than from more shallow draft vessels. Sailboats will respond differently than powerboats. This is important not only for the owners of moored boats, but for others as well who may be moored nearby or underway, especially at night. In coastal waters where commercial shipping lanes may be nearby, these safety issues are of even greater importance for all concerned.

C8.4.3 Anchors used for boat moorings are many and varied, including concrete blocks, heavy recycled metal objects, mushroom anchors, piles, steel anchors with flukes, and spiral steel anchors that are literally “screwed” into the bottom. Some anchors function by virtue of their dead weight, some by their characteristics of holding to the bottom, and others by both dead weight and holding characteristics. C

C8.4.4 Rafting (tying together, side by side) of two or more boats is something that can occur where moorings are used in conjunction with special events such as boat shows, opening day of boating seasons, etc. This is a social phenomena that is common among recreational boaters, particularly where mooring space or dockage is insufficient for the short-term demand during an event. Rafting can also occur at side-tie docks, in rivers, canals and other places where large numbers of boats congregate. C

Boats Rafted on River Bank

Extreme Rafting of Boats Across a River

C8.4.4.1 Where rafting is likely to occur, it should be addressed in one of two ways, or both, as follows:

- Local authorities should make and manage operational policies on the rafting of boats on available moorings. If not allowed, the operational use of the moorings should be monitored and enforced, and the moorings marked accordingly.

- If rafting is allowed, the moorings should be designed, installed and operated with some predetermined maximum rafting load in mind such as a two, three or four-boat maximum rafted mooring load. This will have an important bearing on the minimum sizes and capacities of the buoys, hardware, connections, mooring rodes and anchors. It will also have a bearing on the assessment of the bottom conditions and its capacity to hold various types of anchors under the design loads anticipated. The moorings approved for rafting should be marked accordingly, including the maximum size and number of rafted boats permitted.

C8.4.5 Moorings should be fabricated of highly corrosion resistant materials that will stand up in wet environments over a long service life. The extra expense of using stainless steel, bronze, fiberglass and polyethylene materials will more than be balanced by the reduced maintenance costs. However, corrosion resistance must not be provided at the expense of strength and toughness. For example stainless steel hardware for some of the connections may not be strong enough for the applied design loads. Galvanized steel parts may be a more feasible and reasonable alternative. The selection of proper materials is critical to a well functioning and long lasting mooring system.

C8.4.6 It is imperative that mooring systems be inspected and maintained on a regular scheduled basis. The boating public should be confident that moorings used are completely adequate for the size boats being moored, and that the moorings will function safely and reliably under all reasonable conditions for the site. Maintenance should include annual raising of the anchors, rodes and buoys for visual inspections, repairs and/or replacements.

C8.5 Connections

C8.5.1 All connections on a boat mooring should be of high reliability and trustworthy for public use. Moment developing connections should be avoided to prevent repetitive twisting and bending of mooring components that would lead to fatigue and eventual failure. A maximum degree of freedom should be provided at each connection through the use of a clevis, swivel, connecting links and/or short lengths of chain. C

C8.6 Environmental Considerations

C8.6.1 As the scope of a mooring increases, the length of the rode increases as well, resulting in a progressively larger potential area of disturbance of the bottom. A swing boat mooring has a 360° circular potential area of disturbance with the anchor at the center. As winds and currents change direction, the buoy and a moored boat swing the rode, possibly creating and maintaining a disturbed circle on the bottom. All of this is dependent on the depth of the water, and the type and length of the rode. In the case of fore and aft moorings, the egg-shaped area of potential bottom disturbance is much smaller, being limited to lateral movement allowed by rode length and water depth. Site conditions will dictate which type of mooring is appropriate, safe and reliable.

C8.6.2 It may be difficult to obtain environmental permits from federal and state permitting agencies to install and operate mooring buoys that disturb the bottom of a waterway. Prior to the installation of buoys, permits are needed from local, state and federal agencies that have jurisdiction.

C8.6.3 Boat mooring alternatives that minimize bottom disturbance should be used wherever possible, provided the safety and integrity of the mooring system is not compromised. To avoid dragging of mooring rodes on the bottom, flexible elastic rodes can be incorporated into the design, essentially acting as large rubber bands that stretch under load and contract when the load lessens. If the environmental bottom disturbance issue is not addressed in a permit application, a permit might not be issued and the proposed moorings might not be approved for installation and operation.

NOTES