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Recreational Boat Docks and Seaplanes:
Safe Designs for Sharing of Facilities

September 27, 1999

by Aron Faegre

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"The Care and Sharing of the Waterways"
to be held in Little Rock, Arkansas

Introduction: Seaplanes are Vessels Too

Under Coast Guard regulations, once a seaplane is on the water it becomes a "vessel" and must follow the same safety rules as other power boats.

> "The word "vessel" includes every description of water craft, including nondisplacement craft and **seaplanes**, used or capable of being used as a means of transportation on water." -- USCG Rule 3 (a).

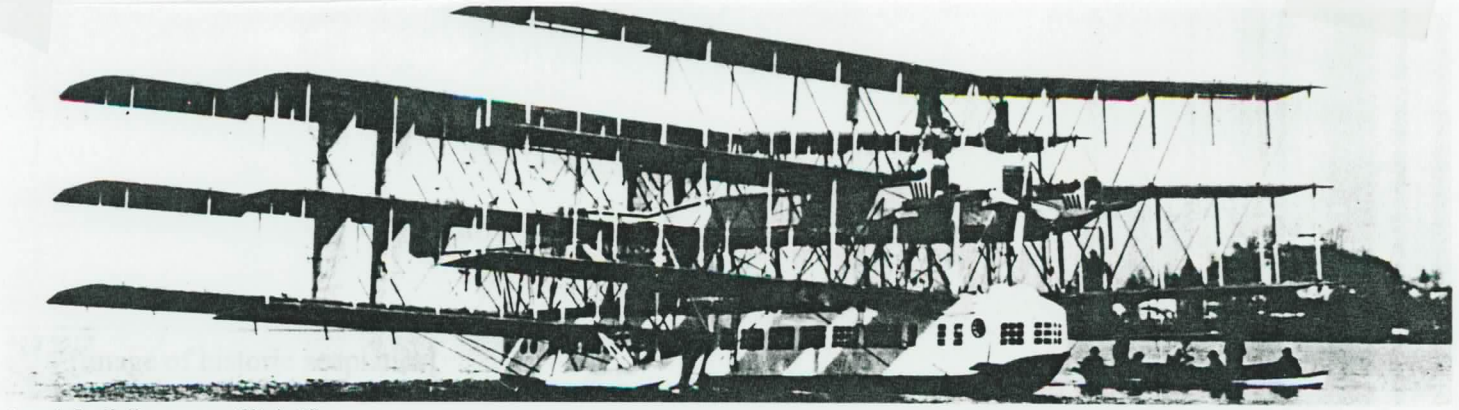
Thus, imagine a seaplane has approached to land in your water body, it has touched down at 50 knots, well clear of all vessels, after about 300 feet of run it has come "off its step" (on the bottom of the float), and then has abruptly come to a stop. It is now taxiing in displacement mode at about 3 knots, and is generally pointed toward a dock or marina.

This paper is aimed at boaters and dock designers who might wonder: "What is the seaplane going to do next?"

Seaplanes as Oddly Shaped Recreational Boats

Recreational boats come in many shapes and forms, ranging from a 10 foot dugout canoe to an executive's private 150 foot luxury cruiser. On the commercial side of course, there are everything from tugboats and barges to ferries and cruise ships.

Seaplanes have long had an uncertain location within this mix of boats. In the earlier years of aviation, seaplanes were envisioned as being the future mode to provide most of the commercial air transportation for the public. It was assumed that the use of lake and river water surfaces would provide the most efficient network of airport bases since they are pre-existing. In addition, seaplanes were viewed as safer than land planes because they generally had more opportunities for emergency landing. In fact, seaplanes are safer to land in a farm field than a wheel plane due to the floats acting like skis, whereas wheels often can get stuck in chuckholes, resulting in a light plane sustaining substantial damage.



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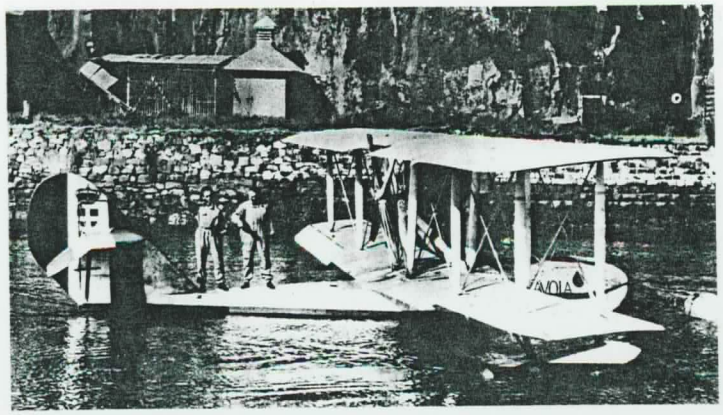

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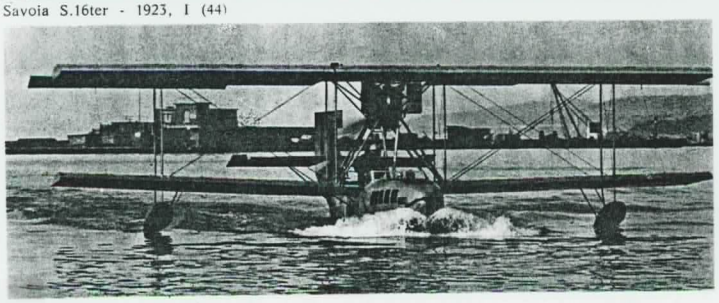

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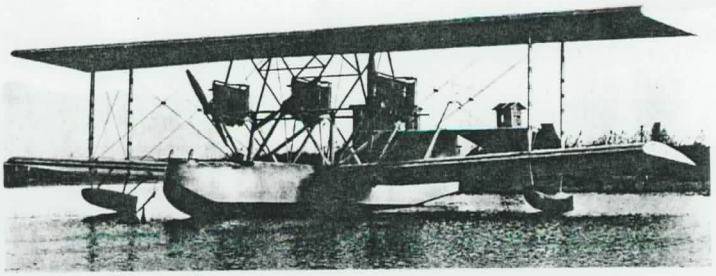

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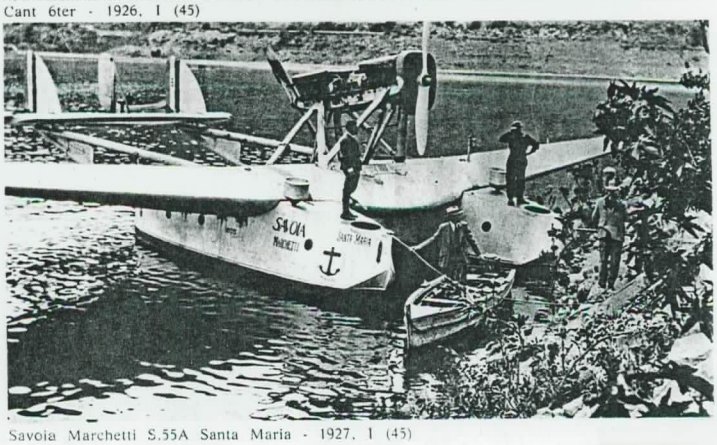

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However, history proved that land planes would win the day for commercial air transport. The development of a national system of excellent paved runways avoided the problem of waves, the difficulty of maintenance while afloat, and the problem of how to land at night. In the big picture, a dedicated land area for aircraft landings and take-off provided the best solution for most public air transport purposes.

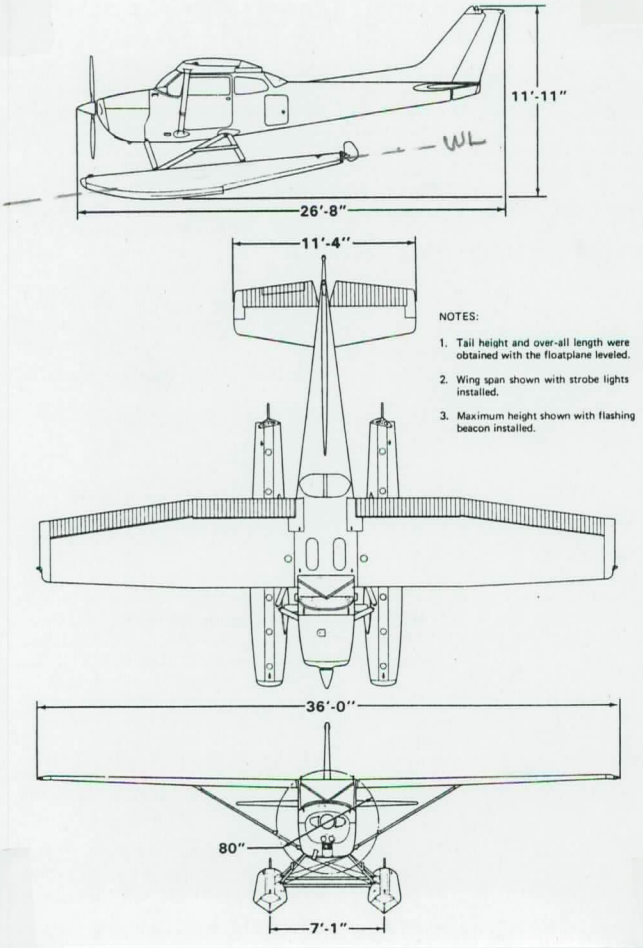
In southeast Alaska, northwest Washington, northern Minnesota, northern Maine, and a few other parts of our country, seaplanes have remained the primary commercial air transportation mode. In these places, either lack of enough level ground or the convenience of good water areas has resulted in the seaplane being the primary viable method of air transportation.

However, in the rest of the United States, seaplanes nowadays are principally used as a form of recreational travel and enjoyment. The majority of seaplane pilots are people who have long enjoyed water activities such as boating and water-skiing, while also enjoying the skills and experience of flying airplanes. Thus, I would posit that in our modern age, in many areas, seaplanes are best thought of as the equivalent of recreational boats.

Typical Recreational Seaplanes

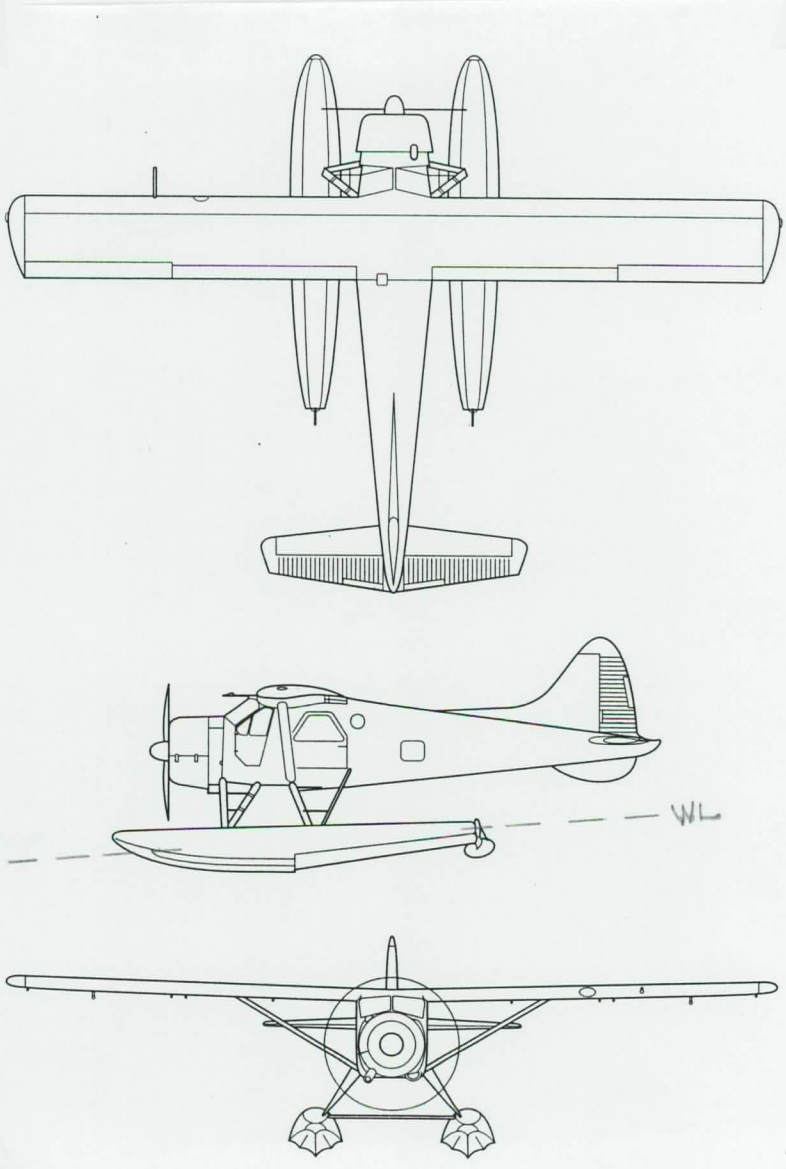
The typical seaplanes in use in the lower 48 states are small two- and four-place aircraft that are 20 to 30 feet long and generally sit on two pontoons, each about the size of a standard canoe. They typically weigh from 1,000 to 3,000 pounds and have a single engine with horsepower ranging from 65 to 300. There are very few new seaplanes being manufactured today, thus most consist of older aircraft and cost between $20,000 and $100,000 depending on size, horsepower, and condition.

When we say condition, there is of course, a minimum mechanical standard condition required by the FAA which is essentially that it must be "very good condition". To be "airworthy", an airplane must go through an exhaustive inspection and repair program once every year. This involves opening all inspection plates, looking at all moving parts, and upgrading any items that are below established minimum standards.



Cessna 172 – "A common trainer"

Drawing scale: 1"=120'



de Havilland DHC-2 Beaver – "Workhorse of the North"

Of Boaters and Seaplaners

Apologies are hereby made to you boaters in the audience, that I may provide too much detail about seaplanes. The underlying point that I want to get across is that a seaplane "fanatic" is in reality not much different than a boating "fanatic". A small seaplane is about the same cost as a car or a somewhat fancy recreational boat. Perhaps the biggest difference for those who enjoy both seaplaning and boating is that for seaplanes the federal government is constantly looking over your shoulder mandating regular aircraft inspections and recurrent pilot training, whereas for boating one is more or less left on their own.

If I can get you as a boater to generously accept that us seaplaners on the water are not much different from you, and that our "boats" are in length not that much different from your boats, I'm hoping that I can convince you that in spite of our odd addition of a wing over the top of our two canoes, you'll at least entertain the idea that we might safely and reasonably tie up at the same dock with you. I know that this may be a hard thing to ask and that there has been a lot prejudice against seaplanes in the past. But like any prejudice, I hope you will be open to hearing the facts and perhaps feel OK about letting us share water and dock space with you.

Approaching the Dock — 3 problems

If we had folding wings like a duck, coming up to a dock would not be that big of a deal. In addition to this problem of a wing, we add the problem that we have only forward power and no reverse. Finally, we're fairly high off the water surface and have a big tail, so we catch the wind very easily. These three issues — wing, lack of reverse, and wind susceptible -- form the basic dilemma involved with docking a seaplane.

As to the first issue of the wing, our initial point of great concern is whether the dock has pilings or not. If there are piles then we must approach the dock, and then turn to tie up with just the right radius of turn and speed so that the wing can swing over the dock between two piles, and the aircraft come to a halt beside the dock. Of course, this must happen all in one continuous motion with no second try. What we want to avoid is denting the wing on a pile. This may make our airplane "unairworthy" and at a minimum costs a lot of money to get repaired.

The fact that we have no reverse means that when approaching a dock, a seaplane typically taxies as slowly as possible. This involves often using minimum power, approaching into the wind and/or into the current so that the speed coming up to the dock is as little as possible. Ideally, the pilot will cut the power to the propeller at some distance from the dock and has planned the docking maneuver so that by the use of momentum the airplane comes alongside the dock just as it stops. The pilot (who has previously gotten out on the float) simply has to step off on the dock and tie up the plane. Of course as with power boats, only the expert pilots make this kind of thing look easy. In practice, all floatplanes carry paddles and often the paddle is used for the final few feet because it provides the most maneuverability. If you think of it, even a canoe has reverse power! For years, I tried to convince my friends that a seaplane is just two canoes bound together with a wing over the top. I assure you that my paddle is out quite often while docking the seaplane.

Alternatively, if there is a significant amount of wind, the docking of a seaplane is perhaps more like the docking of a sailboat than it is like the docking of a power boat. With even a gentle wind

the seaplane will want to swing nose first into the wind, since like the feathers of an arrow the tail will naturally stay behind the body. In fact, seaplane pilots are specifically trained to "sail" their seaplanes during windy conditions and use the wind as a primary force to get where you want to go.

The similarity between a seaplane and a sailboat during windy conditions is an important one. However, the seaplane functions as a poor sailboat given that the sail area is mostly located far aft of the center of gravity, at the stern of the airplane. The seaplane has rudders which are lowered into the water during taxiing, however its 1 inch keel on the bottom of the floats doesn't begin to compare to that of a normal centerboard, daggerboard, or more typical sailboat keel. A seaplane probably handles a bit like a very small square-rigged ship. It sails downwind quite nicely — as long as you don't mind going backwards.

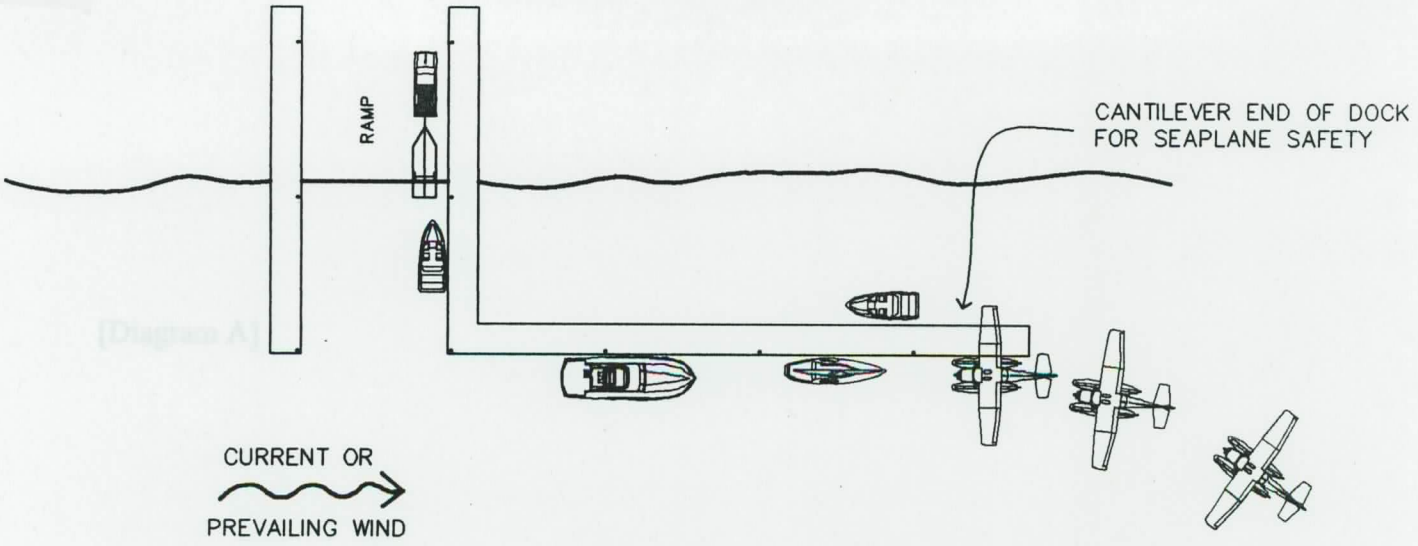
Typically, the seaplane is "sailed" backward so that in these circumstances a seaplane may approach a beach (or possibly a dock) tail first. This method is more often used when approaching a beach since the tail of the plane sits beyond the end of the floats and could hit the dock. With high winds or waves, this may be the only safe maneuver available for approaching the dock. With use of some power, it is possible to "sail" sideways to the wind, too. In any case, once the seaplane slows, there is no doubt the plane will swing facing the wind. While docking, this force must be taken into account by the pilot as an extremely important one. It is often used as a force to swing the seaplane parallel to the dock at the end of a taxi maneuver.

General Dock Layout Issues for Seaplane Safety

Back to the issue of docking seaplanes in with other recreational boats. Any pilot's first goal would be to dock in as open an area as possible away from other vessels. Next the pilot would choose an area with the minimum number of piles or other obstructions. Finally, the direction of wind and currents will be taken into account to establish how the approach to the dock is made and whether it involves use of paddles or "sailing" to achieve its goal.

Although not an essential marina requirement, a seaplane pilot is happiest when he or she can approach a dock knowing that they have sufficient maneuvering room to make a U-turn and go back out the way they came. This adds a great factor of safety since it allows an easy solution to any significant unforeseen conditions. One can always shut off the engine and stop, and then use paddles to maneuver the airplane, however even easier would be to be able to approach close to the dock and then circle around a second time if conditions warrant.

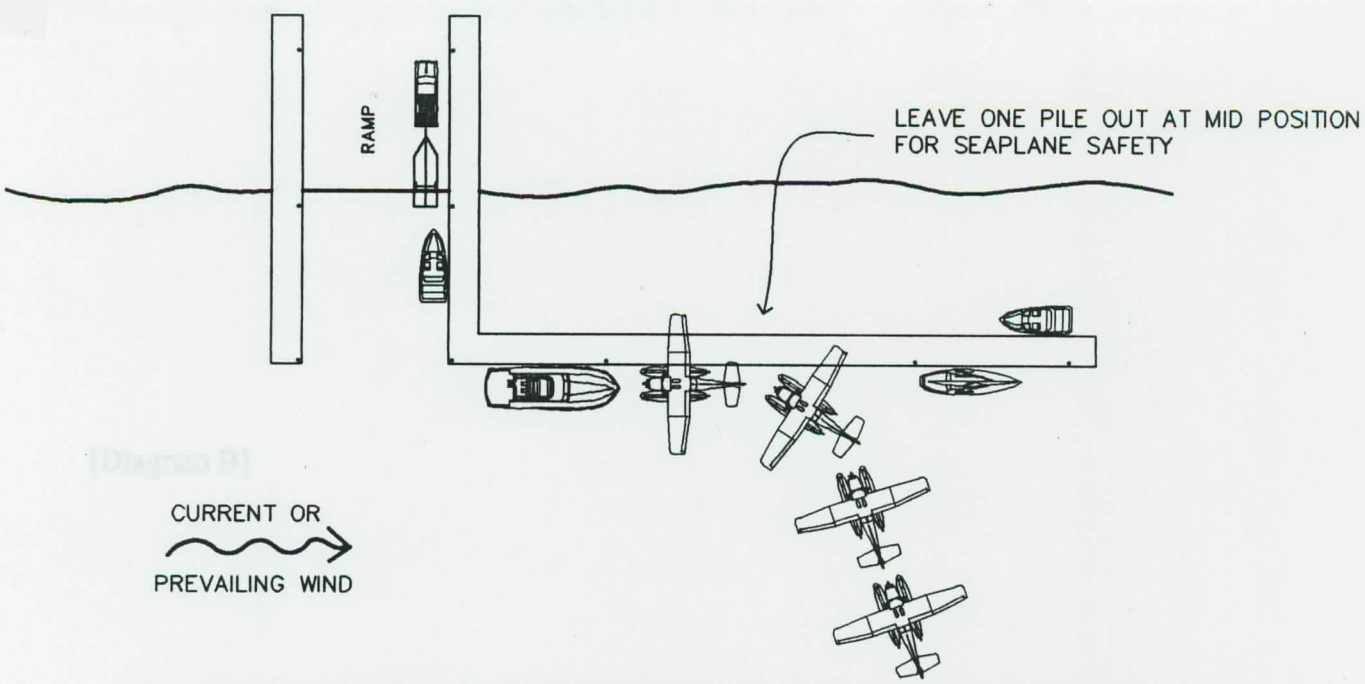
Given the advantage of having maneuvering room, if at all possible a dock position intended also for potential use by a seaplane should be located near the end of a dock where the space is perhaps greatest, as shown in Figure A below. Another advantage of being near the end of a dock is that where piles are used, the end of the dock can cantilever beyond the last pile some distance allowing a completely clear area to swing a wing over the dock. Locating a seaplane accessible dock adjacent to a marina's "turning basin" is very helpful in meeting these concerns.



A. DOCK WITH PREFERRED SEAPLANE END POSITION

SCALE APPROXIMATELY 1"=50'

If an end position is not possible, a mid-position can be created by leaving a pile out along the length of a dock to create a wider area for a seaplane. In Figure B below, a space of 80 feet width is shown, which is probably a useable dimension.



B. DOCK WITH LESS PREFERRED SEAPLANE MID-POSITION

SCALE APPROXIMATELY 1"=50'

As to the dock construction, since the wing and tail must pass over the dock while the plane is tied up along side, the dock structure must not have vertical posts, electrical masts, chests, or other elements that the tail or wing can run into. Ideally, an area for seaplane use should be just plain dock with nothing sticking up. Aside from some cleats to tie to, the less the better.

As with any boater, we are always happy to have someone at the dock take a line or otherwise help in approaching or departing the dock. Often there is a rope hanging from the end or midpoints of our wings. Assuming the seaplane is fairly close to the dock, these ropes are intended to be grabbed and pulled at a 90° angle to the seaplane. Pulling on the ropes in a forward or aft angle will tend to rotate the seaplane more than get it comfortably to the dock.

Seaplane pilots learn skills of approaching difficult docks by necessity. If the piles seem too close together, a pilot may approach the dock head on and then rotate the airplane by hand from the dock. Another option is for the pilot and a passenger, one on each float with a paddle, to accomplish a very careful and gentle controlled docking.

An alternative to providing combined large docking facilities shared between boats and seaplanes, is to make available a smaller dock specifically for itinerant seaplanes. During a recent floatplane cross country trip, the author visited several marinas that fortunately had small single boat docks off to the side of the main activity area. It was assumed that these were either old docks, or were for tie-up by single itinerant boats. They worked very well for the seaplane. An example of this kind of dock is shown in the picture below, of a small dock at the marina in Garrison, North Dakota, on Lake Sakakawea.

Of course, in Alaska, British Columbia, Washington, and even our home state of Oregon, there are many docks which are dedicated only to seaplane use. Photos of a few are shown below for your general interest.

This talk has focused on "floatplanes" which have two floats below the aircraft and a high wing over the top, since the majority of seaplanes are of this type. It should be mentioned in passing that there are also "flying boats" which use the hull as the water landing member. These aircraft

usually have a smaller float hanging from each wing to keep it from dipping into the water. These seaplanes often have greater difficulty in docking as the wing float and tail are close to the water. We should also note that there are also "amphibian" seaplanes, which have wheels that can be let down allowing them to also land at normal land airports. If of sufficient width (50 to 60 feet), and with marina authorization, normal boat ramps are easily used by amphibian aircraft to taxi from the water up to a parking lot area. For boat ramp facilites unused to this procedure, it is recommended that there be a person standing by to ensure safety. It is an easy 1 minute procedure — its worst vice is that it is noisy.

Seaplanes can tie up to mooring buoys or anchors. However seaplanes are much more susceptible to wind than to current, whereas most boats are more susceptible to current than to wind. So if current is a significant force in the mooring location, extreme care must be taken to ensure that the two vessels will not swing into each other. The seaplane pilot knows that the lighter constructed seaplane will likely take the worse of the beating.

Detail Dock Issues for Seaplane Safety

Of course, there is also the issue of a spinning propeller when approaching a dock, and as with all seaplane safety issues, the seaplane pilot has the sole responsibility to ensure that the propeller is well away from boats and people. If a boater has any uncertainty that he or she is not seen by the pilot, please wave at the pilot or use any other means of getting attention. We all know that safety has to come first and that under Murphy's Law, accidents can occur in any situation.

The good news is that the safety record between seaplanes and other vessels is outstanding. The attached table shows a comparison of accident rates involving different transportation modes and other everyday activities as a comparison. The average annual fatality between a seaplane and another vessel is 0.2 per year. Thus, fatalities occur on average only once every five years. Much worse are the 4.1 fatalities in seaplanes per year for accidents which do not involve another vessel. In this regard, it is worth mentioning that the most common cause of death to the seaplane occupants is drowning, not head trauma or other injury. The seaplane will likely be on its side or back, will take on water, and ultimately end up hanging upside down from the floats. The typical problem to passengers is that their seatbelts are fastened, they become disoriented with the plane upside down, and thus are unable to get out. As a boater, if you see a seaplane overturn while landing or taking off, your help in getting passengers out from the plane may well save a life.

Comparison of Seaplane Related Accidents to Other Causes of Fatalaties

Average Annual Fatalities Nationwide

Automobile Accident	43,200
Fall or Slip	14,900
Poisoning	8,600
Drowning	4,000
Choking	3,300
Bicycling	1000
Struck by Train	591
Struck by Lightning	189
Boating Accident	76
Electrocuted by Household Appliance	73
Seaplane Accident (occupants included)	4.1
Crushed by Falling Vending Machine	2.2
Snow Thrower Accident	1.8
Trampoline Accident	1
Struck by Lawn Dart	0.3
Seaplane Accident (occupants excluded)	0.2

Statistics compiled from the following sources: National Safety Council; Consumer Product Safety Commission; National Lightning Institute; U.S. Coast Guard; Seaplane Compatability Issues Report; Federal Railroad Administration-Office of Safety Analysis.

Figure from *Water Flying*, 1999 Annual, Vol. 21, page 1, Seaplane Pilots Association.

Other dock issues that promote safety for seaplanes are: height, bumpers, and signs. The height of the dock should be kept as low as possible. The tail is low to begin with, and with boat wake it can swing up and down, getting even closer to the water. A dock height of 15" will work for the smallest seaplanes, while a height of 20" will work for the medium sized seaplanes.

As to dock bumpers, the widest point of seaplane pontoons are below the water line. Thus, bumpers should go below water line a foot or two if possible. Obviously, this is quite different than for boats that usually get wider the higher above water line they get. Finally, it would be desirable to have a sign identifying the seaplane position, so that when possible, other boaters will leave this spot available for seaplanes. It is also a good spot for any safety literature, such as the brochure which was recently created by the Oregon Marine Board and the Oregon Aeronautics Division.

Environmental Issues

The slow speed of taxi, and the quickness with which they get up "on the step" when taking off means that seaplanes don't create much wake. This is good for other boats, and is good in reducing impact to the shoreline habitat. The lack of a propeller stirring up the water is another environmentally friendly quality. There is at least one lake in the northwest that allows sailboats, canoes, duckboats, motorboats under 3 hp, and seaplanes, but do not allow traditional motorboats, as an environmental water quality measure to prevent turbidity from the stirring up of mud. Seaplanes are extraordinarily gentle in their impact on the natural environment.

Noise is usually not a significant issue during docking, since while taxiing, the airplane is at idle power and is very quiet. However, sometimes when high winds create waves in the larger body of water a seaplane is forced to take off near a harbor. Since noise is one of the biggest complaints about seaplanes we'll add a few words here.

The amount of noise depends on the size of the seaplane engine, the type of propeller, and the distance and angle between the seaplane and the observer. There is a world of difference between a 65 hp small two-place Taylorcraft on floats, and a 300 hp six-place Cessna 185. The former creates noise levels less than many motorboats, while the latter will create noise levels significantly greater than that of most motorboats. Fortunately the seaplane pilot can control where the noise is made. He or she can taxi well out into a lake or river, and get far from noise sensitive uses, prior to the take-off. The greatest noise impact occurs abeam the aircraft, with much less sent to the fore and aft of the seaplane. During taxi, all seaplanes are much quieter than an average motorboat. During landing they may be making no noise at all.

If a seaplane pilot is aware of annoyance issues in the area of the water body, he or she can usually perform a take-off at reduced rpm's (although this requires a longer takeoff distance) often reducing the noise energy by as much as half of its full power take-off level. Please talk to any seaplane pilots at your local dock to let them know if their noise levels are too great. They can probably make changes to their takeoff locations, paths, or power settings to fit in better with the neighborhood. If he happens to be obnoxious or refuses to be cooperative, call me or another seaplane industry representative and we'll talk to him.

Dock Safety Design Summary

The fundamental rules for dock or marina design to promote safety for seaplane access are:

- Locate dock near a turning basin or other large open maneuvering area.
- Locate dock to allow seaplane approach into current (if river) or into prevailing winds (if lake).
- Locate tie-up location near the end of the dock.
- Cantilever the dock well beyond the last pile to allow wing to swing over end of dock, or space piles as widely as possible at tie-up location.
- Keep the dock as low to the water as practical, and if possible provide bumpers both above and below water line, and provide identifying signage of the seaplane position.
- Provide a procedure for an amphibian seaplane to taxi up a boat ramp to a parking area.

It is recognized that very few recreational boating docks will be designed with a dedicated seaplane tie-up position, as there may be only occasional itinerant seaplanes passing through your water area. Rather, it is hoped that those creating dock facilities will create spaces so that when seaplanes are present, they have an intentionally designed good, safe location to tie-up. It is recognized that during peak use periods, such a spot may well be used by a boat.

Why Make your Docks Seaplane Friendly?

A year ago in August the author of this paper was able to make a 2,500 mile cross country seaplane flight from Portland, Oregon on the Willamette River, across the country along the Lewis and Clark Trail. We landed along the Missouri River at several marinas, were warmly received, and generally found an easy place to tie up. In most cases, we happened to find very small self-contained older docks that perhaps predated more recent marina development— or perhaps they were just intended for small itinerant boater tie-up. We had a wonderful recreational trip and immensely enjoyed getting to see the beautiful landscapes of our country.

In many parts of the country seaplanes regularly fit in with recreational boating waterways and dock facilities. Seaplanes typically land and take off in less than a ¼ mile of water surface, but generally won't land on a water body less than a ½ to 1 mile in extent as a safety measure. Surprisingly to some boaters, the seaplane fits in easily with other boaters. When there are a lot of boaters on a water body the seaplane pilot just waits until a sufficient area of clear water opens up.

During cross-county trips, seaplanes are in need of tie-up locations for stops along the way for all of the usual reasons — fuel, food, rest, toilet, or just a tourist visit. We appreciate other boaters' willingness to share the waterways and dock facilities with us. And like any boat, we'll gladly pay any docking fees, purchase fuel if available, and share knowledge of the boating and flying experiences. The title of this conference includes the phrase "Sharing of the Waterways";

although we are a minor user, we greatly thank you in advance for considering the needs of our unusual ships and their pilots.

Additional Thoughts on Boater-Seaplane Safety: Sharing the Water

After presenting seventeen general rules of navigation covering all vessels, the USCG Navigation Rules provide an added general rule for seaplanes:

> "Except where Rules 9 [Narrow Channels], 10 [Traffic Separation Schemes], and 13 [Overtaking] otherwise require: . . . (d) A seaplane on the water shall, in general, keep well clear of all vessels and avoid impeding their navigation. In circumstances, however, where risk of collision exists, she shall comply with the Rules of this Part." -- USCG Rule 18 (d).

During landing and takeoff while at speeds of 30 to 50 knots, most seaplanes have considerable maneuverability. At this speed the seaplane is still hydroplaning "on the step" and has the ability to stay well clear of all vessels. It can likely even add power to fly over other vessels if needed. However, once a seaplane has slowed and is in displaced taxi mode, it is highly susceptible to the wind and current, and has a typical maximum speed of 3 to 5 knots. In addition, if there is considerable boat wake or waves in the area, it may be unsafe for the seaplane to add power and get to a higher taxi or takeoff speed.

Thus, a seaplane can be expected to stay well clear of other vessels while landing and taking off, but while taxiing to a dock, it must revert to the same fundamental rules that all vessels use. The seaplane must follow the normal USCG Steering and Sailing Rules of Part B to: "Look Out", use a "Safe Speed", determine if there is a "Risk of Collision", take "Action to Avoid Collision", and all the more detailed rules for "Overtaking", "Head-on", "Crossing", "Narrow Channel", "Traffic Separation", and "Following Current right-of-way over Upbound Vessel" situation requirements.

It is worth noting that the Federal Aviation Administration also has rules that seaplanes must follow while on the water. These require similar piloting actions to those of the USCG Rules, although they are not as comprehensive and do not cover as many conditions as the USCG Rules. For reference we quote them here:

> "Right-of-way rules: Water operations.
> a. General. Each person operating an aircraft on the water shall, insofar as possible, keep clear of all vessels and avoid impending their navigation, and shall give way to any vessel or other aircraft that is given the right of way by any rule of this section.
> B. Crossing. When aircraft, or an aircraft and a vessel, are on crossing courses, the aircraft or vessel to the other's right has the right-of-way.
> C. Approaching head-on. When aircraft, or an aircraft and a vessel, are approaching head-on, or nearly so, each shall alter its course to the right to keep well clear.
> D. Overtaking. Each aircraft or vessel that is being overtaken has the right-of-way, and the one overtaking shall alter course to keep well clear.
> E. Special circumstances. When aircraft, or an aircraft and a vessel, approach so as to involve risk of collision, each aircraft or vessel shall proceed with careful regard to existing circumstances, including the limitations of the respective craft." Federal Aviation Regulations 91.115

These FAA rules are generally consistent with the USCG rules. There do not appear to be contradictions between them. However, the last paragraph of the FAA rules perhaps more directly identifies what is perhaps the most important aspect for maintaining safety between seaplanes and other vessels. The "limitations of the respective craft" recognizes that "existing

circumstances" — for example wind, or wake, or waves — may have great impact on what maneuvers an airplane or vessel can accomplish. Perhaps USCG Rule 7a carries the same general force:

> "7a. Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt such risk shall be deemed to exist." USCG Rule 7a.

This paper is in part intended to help boaters better understand the maneuvering limitations which seaplanes can have, so that they might better determine risks of collision. The seaplane pilot by necessity has the sole responsibility to determine the location for landing and takeoff and must remain well clear of other vessels. But during taxiing the seaplane usually has much less maneuverability than other power boats, and so must rely to some extent on the other vessel's captain to recognize this.

Conclusions

So, if on a very high wind day, with whitecaps out on the bay, you pass a seaplane under power, and that seaplane is approaching the harbor backwards — understand that you have not just entered the world of *Alice in Wonderland*. Rather, you are seeing a seaplane doing its best under difficult circumstances. On that day, I assure you, the seaplane pilot is looking at your craft — be it sail or power — and wondering if this idea of making a boat that can fly is really such a great idea after all.

Lest I leave the wrong impression, I can also assure you that when the next day dawns with diminished wind, and the waves retire, the lure and magic of flying in a boat will return. I challenge you boaters who haven't yet been up in a seaplane — please ask your local seaplane pilot for a ride, so that you can experience this amazing feeling of being able to travel on both water and air. Thank you for this opportunity to talk with you about the sharing of the water and docks between boats and seaplanes.

Additional References

Seaplane Bases, U.S. Department of Transportation, Federal Aviation Administration, Advisory Circular No. 150/5395-1, 6/29/94. This document has a general discussion of how to establish a major seaplane base facility, including recommended design information for water operating area dimensions, taxi channel dimensions, turning basins, anchorage areas, slipways, ramps, docks, piers, hangars, marine railways, and administration buildings. FAA standards are usually a requirement for FAA funded projects, but considered as only recommendations for non-FAA funded projects.

Seaplane Pilots Association, 421 Aviation Way, Frederick, Maryland 21701-4756, telephone (301) 695-2083, Website: www.seaplanes.org This national organization has members throughout the United States and represents its membership on all aspects of seaplane access, safety, and pilot training. SPA publishes a regular magazine, Water Flying, which discusses all aspects of seaplane flying, including on occasion, dock design.

Seaplane Operations, by Dale De Remer & Cesare Baj, 1998. This book is an excellent guide to all aspects of seaplane operations. Two chapters deal with issues of seaplane docking under varying wind and current conditions.

The Immortal Beaver, by Sean Rossiter, 1996. The Beaver, designed in 1947 by de Havilland Canada, remains as the best designed floatplane for all-round commercial and recreational use. This book tells the fascinating story of its development and history.

The Author

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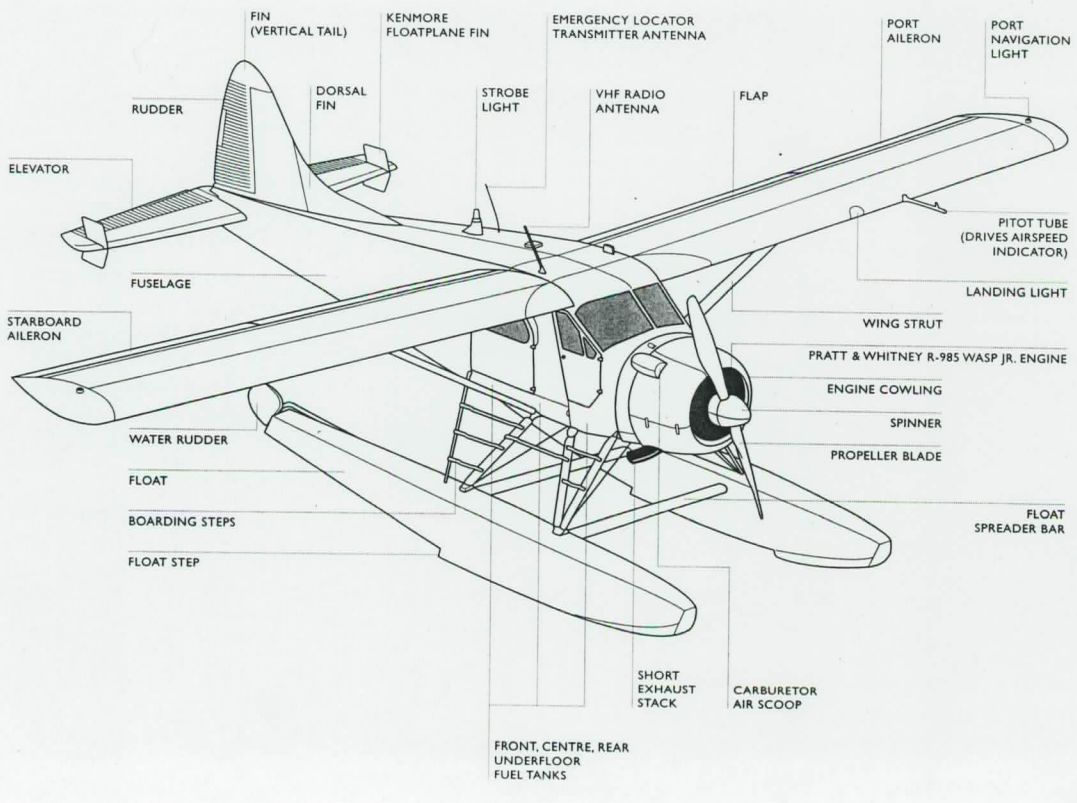

"The Parts of a Seaplane" from The Immortal Beaver by Sean Rossiter