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Proper Setup of Skis and Floats

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If it flies...
Column
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As a youngster I flew at the Hackensack Valley Club flying field in the swamp within sight of the Manhattan, New York, skyline. That field flooded each spring. The ankle-to-knee-deep water persisted for only two or three weekends a year, and the decomposing carp left behind as the water receded helped the grass to grow lush and green.

It also meant that many of us in the club had a set of floats handy in the workshop, and maybe even an airplane that was specially set up for water-flying.

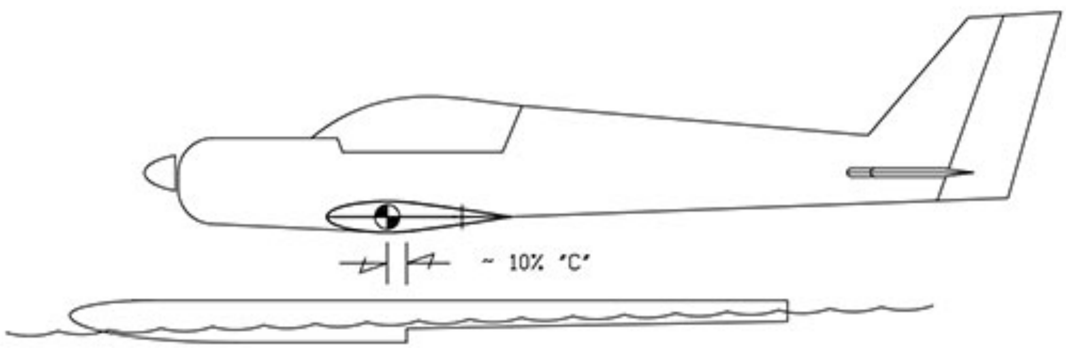
I want to write about the proper setup of skis and floats for flying from both kinds of water: fluid and frozen. I've made an observation about something I learned as a young teenager, which surprised me at the time. First I'll cover the part that isn't surprising.

When you compare the effect that aligned floats and aligned skis have on the flying characteristics of an airplane, the skis have less of an impact. No doubt that it is because they are smaller.

On the other hand, even a tiny misalignment of skis has a dramatic effect on how the airplane flies, while even substantial misalignment of floats has a comparatively modest effect on the airplane's state of trim.

How can that be? The answer is in the different shapes: flat plate vs. torpedo-like. Let's look at a properly set-up floatplane. This is where we stop talking aerodynamics for a while and discuss something of practical use!

While airplanes and their airfoils vary all over the place, as a general rule, floats should be set up parallel to each other, both when viewed from the side and from above. And their nominally flat top edge should be set up parallel to the wing chordline, and with the "step" in the bottom of the float placed slightly aft or directly under the CG. I'll tell you why in a moment.



The top of the floats should be parallel to the wing chordline, and the step should be slightly behind the CG. Note the waterline in the illustration.

The floats must be mounted firmly, because water is much tougher than you'd think. Even a decent water landing involves substantial impact loads in every direction you can imagine.

At speed, water seems to grab things with the intent to rip them apart. If you fly from, or even near, water, you might have seen the results of a water crash. The pieces are smaller and more numerous than after a crash on land. The boat racers (both model and full scale) know this all too well!

Mount those floats like you mean it; after all, any care you take in aligning them will be for naught if the mountings distort and the floats misalign as a result of “normal” takeoff and landing loads.

How big should the floats be? There are three ways I know to answer this question, and the first is simple. Those who manufacture and sell floats or float-making kits rate their products by the range of airplane weights for which they are suited.

This doesn’t take into account the difference between a large, light airplane and a smaller aircraft at the same weight, though. When in doubt, go up in size for water and down in size if you plan to use floats for flying from snow.

The second way to answer that question is that floats are typically approximately 80% of the overall length of the airplane from the propeller to the rudder’s end. If you look at photos of full-scale floatplanes, you’ll see that this four-fifths ratio is typical.

The third method is probably going to be the most useful for those of you who are thinking about rolling your own. In general, the front end of the floats should be maybe a half wing chord in front of the propeller(s).

As you read earlier, the “step” in the bottom of the float needs to be a bit aft of the CG. And since the aft part of the float is normally slightly longer than the front half, that determines the minimum overall length.

With the right-size float, and with the step located approximately 10% of the average wing chord behind the CG, the airplane should float with the back end of the float in the water but not fully awash. (Seaplanes require the use of nautical terminology! “Awash” means that the water almost covers the end.)

If the aft end of the float is under water, move the floats back and recheck. If the stern (another nautical term!) is out of the water, move the floats forward.

Positioned as I have described, the floats are set up in what should be the best compromise between nose-over prevention and ease of takeoff. I hardly think we need to discuss nose-overs, except that you should try to avoid them, but water spray is another matter.

Water spray in the propeller will literally chew up a wooden propeller in a handful of takeoffs, and it robs an unbelievable amount of power. Sure, a nylon composite propeller might be a better choice, but water spray in the propeller disc needs to be avoided.

The chines, or spray rails, on a float are like skinny downturned gutters on the edges of the bottom of the hull. They deflect water spray to both sides rather than letting it go up into the propeller. A 1/4-inch-wide spray rail on the hulls in front of the propeller might be the only thing needed to solve a bad water-spray problem, but good float designs probably won’t need them.

By the way, that step on the bottom of the float is there to break the Coanda effect attachment of the water to the hull, making takeoff much, much easier than it would be otherwise. Aviation pioneer Glenn Curtiss invented it, along with the aileron. (That ought to start an argument!) The diagram shows the preferred alignment of floats to the airframe.

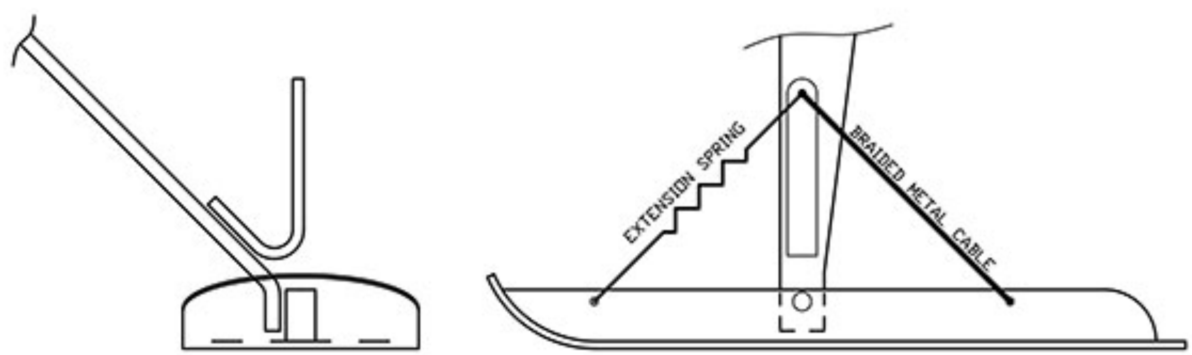
The only thing I haven’t covered is water rudders. I am merely a part-time water flier, but I’ve never used them. Most pilots I know who do use them create some sort of linkage or spring-loaded mechanism to pull them up out of the water for takeoff, because it makes a big difference in takeoff performance.

The full-scale fliers normally lift them out of the water as soon as they have enough air over the rudder for acceptable control authority. If I regularly flew from water, I'd put steerable water rudders on at least the starboard float.

Skis are another matter altogether. For one thing, they can be much smaller than floats, especially on hard-packed snow. Come to think of it, large tires work on hard-pack too. If you plan on flying from freshly fallen powdery snow, skis need to be practically as large as floats!

The problem is that skis are flat-plate flying surfaces, in the air, and small misalignments have roughly three to five times more effect than the torpedo-shaped floats would if both were the same size.

The best method I have seen for setting up skis for snow is to replace them with small floats; I mean, to set them up so that they can rotate in the nose-up direction but are spring-loaded back to parallel with the wing.



The ski must be free to allow the model to rotate nose-up for takeoff as well as maintain perfect alignment in flight. The spring/cable attachment point must be directly above the ski pivot, or binding will result.

By doing this, the airplane can sit flat on the snow, rotate nose-up for takeoff, and then the skis return to parallel with the wing chordline for flight. It's amazing how much aileron trim a little tweak can require.

The setup is as shown in the diagram. A strong but flexible cable attaches the tail of the ski to an upright that is attached to the main landing gear leg. This cable's length is adjusted so that when it is taut, the ski is parallel to the wing. The cable is kept taut by a rubber band or spring (rubber bands aren't all that good in the cold weather) that is stretched between the upright and the front or tip of the ski.

If the model has a tricycle landing gear, the nose ski can be treated similarly or simply locked at the correct angle. The mains are the ones that need to rotate for takeoff and the landing flare.

There is one other difference between skis and floats, and it clearly falls in favor of skis—for some airplanes, at least. Skis offer little or no side area, while floats have plenty of it low on the airframe. Not only that, but floats have more side area in front of the CG than they do aft of it, which reduces the yaw stability of the aircraft.

In the case of my trusty sport model, the Carl Goldberg Models Tiger 60, this is no problem. The long-tailed Tiger has yaw stability to burn, while shorter-tailed airplanes might develop the tendency to sashay slowly from side to side, or even develop an annoying tendency to drop the tail into the turns. This can turn an otherwise enjoyable aircraft into a complete dog.

The cure is added vertical fin. Fullscale pilots typically add a pair of semicircular fins to the underside of the horizontal stabilizer—one on either side.

I have seen a modeler add a fin to the top of the stern (more nautical stuff!) of each float to fix the yaw stability deficit, so that the airplane reverts to its usual self as soon as the wheels are replaced. I'll bet you could even use thick clear plastic if you don't like the thought of how it would look.

So why, when all is said and done, do skis create more trim problems than floats when they are misaligned?

The lift created by a flat-plate flying surface, even a fairly narrow one such as a ski, is somewhere between three and five times that created by a float-shaped or fuselage-shaped object with the same projected area and the same angle relative to the oncoming air. The difference also partly depends on the size of the object and airspeed, or the Reynolds number.

Do you remember maybe two years back, when I wrote about computing the neutral point for a blended-body/wingtype airplane, or any airplane for that matter? I claimed that the area of the nose and tail of the fuselage (as viewed from the top) also figures into the calculation. I have a refinement to that statement. Because the nose or tail is a skinny tubelike object, that area counts only close to one-third as much as the same area would if it were part of the wing or stabilizer.

In aerodynamic texts there are tables and graphs of this area effectiveness multiplier for a variety of fuselagelike shapes and for objects such as drop tanks.

They are useful for approximation purposes, although long ago the professionals changed to computational fluid dynamics modeling. That's right; a "virtual wind tunnel."

I'm out of room, but I enjoy the daylights out of water-flying and hope that you might too. I'll be back next time. Until then, have fun and do take care of yourself.

-Dean Pappas