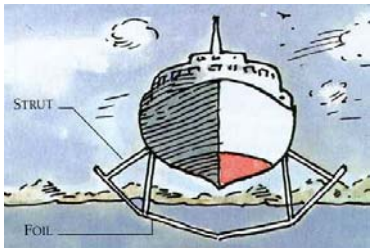
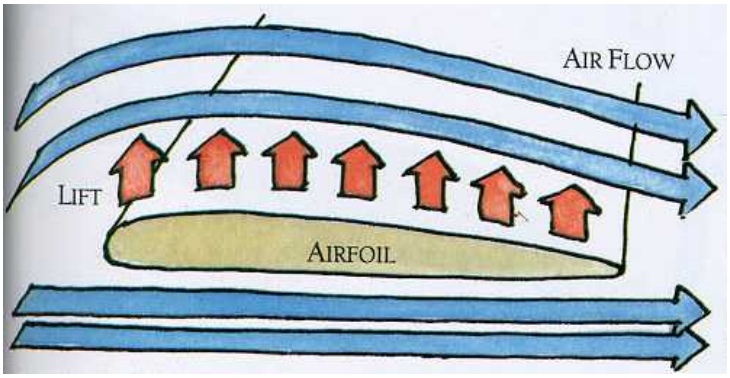
Matthew Avery
ChemE 185, Paper #1
2 February, 1999

How Does a Hydrofoil Lift a Boat Out of the Water?

First of all, what is a hydrofoil? Many people are familiar with ‘airfoils’, which refers simply to the wings on an airplane. A hydrofoil is basically a wing that flies in the water. Hydrofoil is also used to refer to a boat that has these ‘water wings’ attached to it. These ‘water wings’, attached under the boat, then are able to lift the boat out of the water, allowing it to go faster by getting its hull (the bottom of the boat) out of the water. The hydrofoil stays in the water, holding the boat up with struts.



So how are these ‘water wings’ able to lift a boat out of the water? Hydrofoils work just like airplane wings. Airplane wings are curved in such a way so that air passing above the wing moves faster then air passing beneath. Fast-moving air has a lower pressure then slow-moving air. The pressure of the air is therefore greater beneath the wing then above it. This difference in air pressure forces the wing upward. The force is called lift. This phenomena can be seen easily if you take a shower in a bathtub that has curtains. We’ve all noticed that when we take a shower in a bathtub, the curtains billow in towards us. When you turn the shower on, water begins moving through the bathtub, speeding up the air around you. The air outside of the bathtub doesn’t move though. The fast-moving air in the

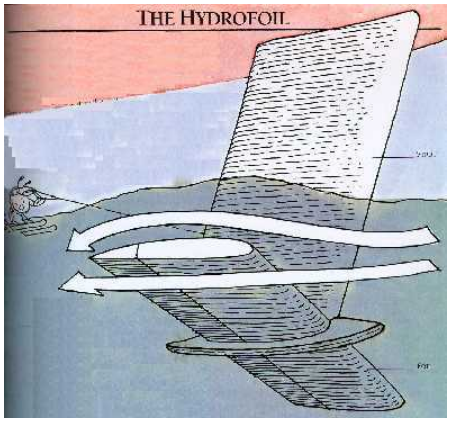


bathtub is at a lower pressure then the stagnant air outside the bathtub, and this causes the shower curtain to billow towards you.

Similarly, hydrofoils are curved so that water flowing over them moves more quickly over the top of the hydrofoil. Just like an airplane wing, this provides lift on the boat.

Boats weigh a lot though. You might think you'd have to move pretty fast to lift a boat out of the water. The large airplanes that you see taking off out of the airport generally need to reach speeds of 200 miles per hour or more to lift off of the ground. In comparison, a boat with hydrofoils only needs to reach speeds of 30 miles per hour to get its hull completely elevated out of the water.

The reason the hydrofoil can lift the boat so easily at low speeds is because water is denser then air. Water is able to provide more lift to the 'wing' then air would be able



to. You can see that water lifts things more quickly when you put a balloon underwater. If you put a balloon at the bottom of a swimming pool, it would quickly rise to the top. Once it reached the surface of the pool, it would begin rising through the air, but we've all seen that balloons rise relatively slowly in the air. The more dense water pushes on the balloon harder, forcing it up faster. Because of this, the water can push on a hydrofoil harder, meaning it doesn't have to move as fast to lift its hull out of the water.

A hydrofoil allows a boat to literally fly through water. Hydrofoils fly on wings in the water, which are attached to the boat with struts. Just like a plane flying through the air, the hydrofoil lifts the boat in exactly the same way, lifting its hull out of the water.