PART 1. WING AIRFOILS FOR MODEL, AND WHY THEY MATTER

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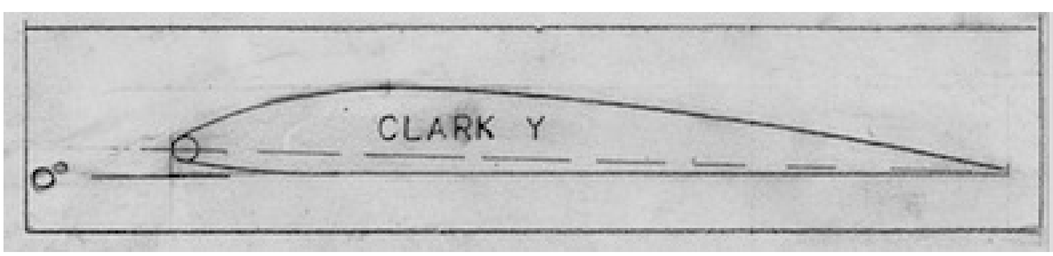
The Wright brothers built a special wind tunnel, one of the earliest, to study airfoils for their new 'flying machine'. The airfoil shapes they studied were similar to that of a bird's wing. The cross section had a convex curved upper surface and thin cross section with a concave cambered bottom surface, which made for a very thin wing construction. This 'bird wing' design developed lift at very low airspeed, but had a high drag that would prevent high speeds and come to make control difficult without flexing the wings.

Soon after, Glen Curtis invented, or discovered, movable flaps on the trailing edge of the wing that could control bank angles easily and reliably.

Move forward a few years and we see more powerful engines and wings with airfoils and controls on aircraft that are similar to what is being flown in full-scale aircraft and models too. The most used airfoil beginning in the 1920's is the flat - bottomed airfoil named the Clark Y and no modern trainer would be caught without this airfoil. It just has so much going for it, like a beautiful blonde.

Here is an illustration of a Clark Y and starting from the leading edge we see a small radius, a circle. Starting from the center of this small circle we draw a straight line to the trailing edge of the airfoil. This line is named the **Chord**. You notice the outline of the airfoil rises above and falls below the chord line and it gives the 'flat bottomed' airfoil a small one to three degree angle which if the bottom of the surface is parallel to the fuselage thrust angle gives the airfoil a small **positive incidence** which then gives a small **angle of attack** relative to the fuselage reference line.

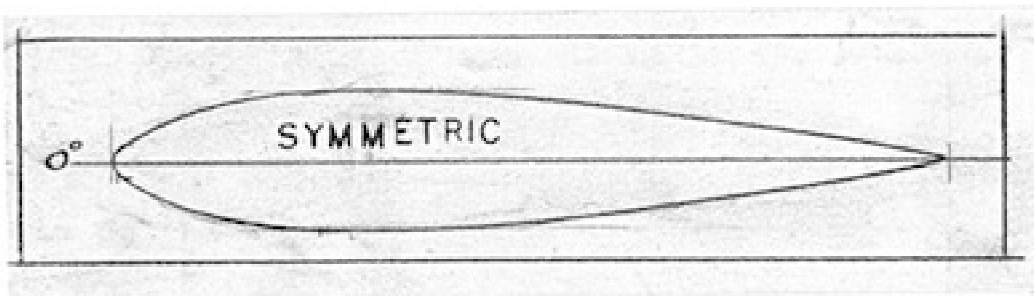


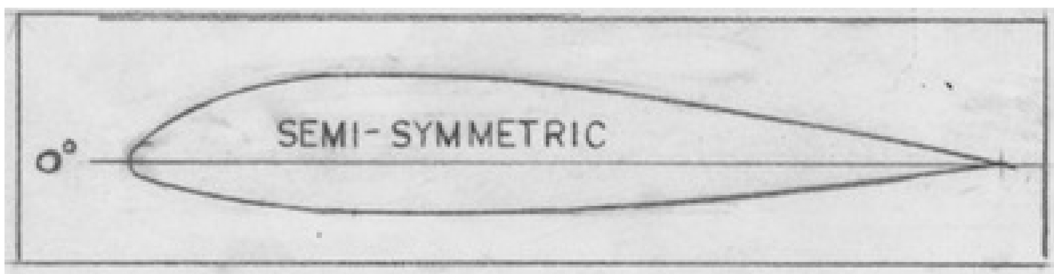
The Clark Y usually has a ten to thirteen percent ratio of thickness to chord length depending on the design application. The **center of lift** is close to the highpoint of the upper curve at 27 percent of chord. This gives the airfoil a gentle stall at a reasonably high angle of attack into the wind, as well as giving a warning before stalling. The **drag to lift** ratio is also reasonable at moderate speeds in full-scale and model applications. This is our simple plain vanilla airfoil, perhaps the most used ever.

It does have one drawback in that it is not very useful for inverted flight, which we don't usually start a beginner on anyway.

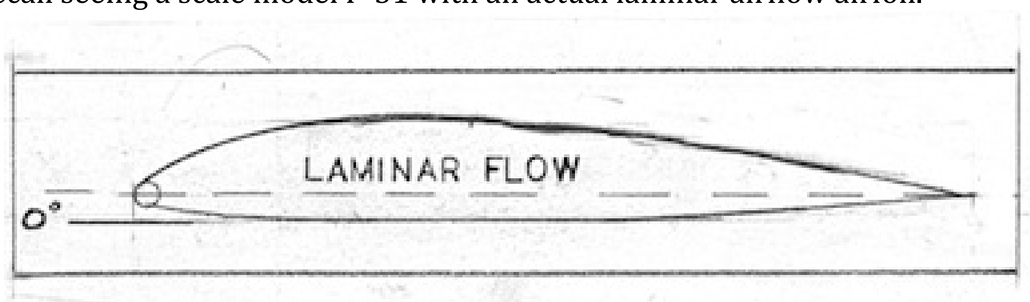
Airfoils are designed for specific applications, including the 'flat-plate' airfoil of the foamies. Here are some other types of airfoils.

Symmetrical and semi-symmetrical airfoils allow good performance inverted and upright which is perfect for aerobatics. These wings are usually as thick as twenty percent of chord and proven high lift at slow to moderate airspeeds. These airfoils tend to stall with little warning.



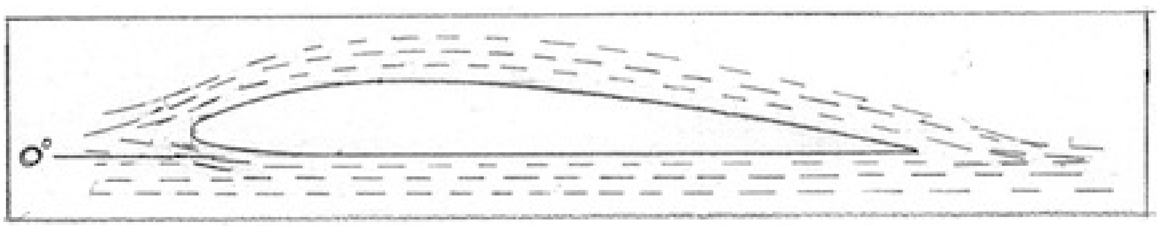


Laminar airfoils are specialized to maintain the laminar airflow further back over the top surface of the wing providing lower drag and higher speeds. The P-51 Mustang WWII fighter and the B-24 Liberator bomber used laminar airflow wings. This airfoil requires very smooth wing surfaces to get the best results. Modern aircraft and models can control laminar airflow to reduce turbulence and drag. The Mustang airfoil is distinctive with the airfoil high point at just over 40% aft of the leading edge. Most models are not so concerned with laminar airflow and I can't recall seeing a scale model P-51 with an actual laminar airflow airfoil.



Flying wing aircraft often use a "**reflex**" trailing edge with the wing 'twisted' to take the place of a fixed horizontal stabilizer. These airfoils resemble a Clark Y with the aft twenty five percent of the airfoil bent up perhaps five or ten degrees. This airfoil and others primarily intended for very high lift or other special performance qualities are beyond the scope of this basic discussion of model airfoils.

In the next discussion, Part 2, we will examine the theory of lift and **Bernoulli's Principle** that says that if air speeds up, the pressure above the airfoil surface is lowered. Doubt has been raised as to why air speed rises over the wing, and this is where the Bernoulli Principle falls apart. I've been taught wrongly on this for probably sixty years. We'll see why Newton's 2nd Law and angular mass airflow dispute my long held beliefs.



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