Aerodynamics - Airfoil Properties

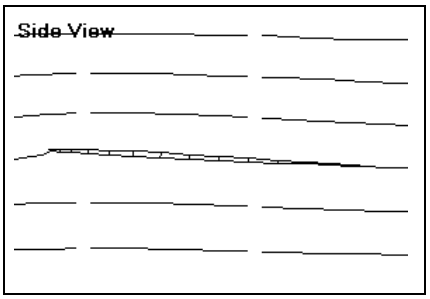
Credit: Data and diagrams calculated and generated by foilsim by NASA Lewis Labs.

Comparison of the aerodynamic properties of a thin slab wing and a wing with thickness and camber.

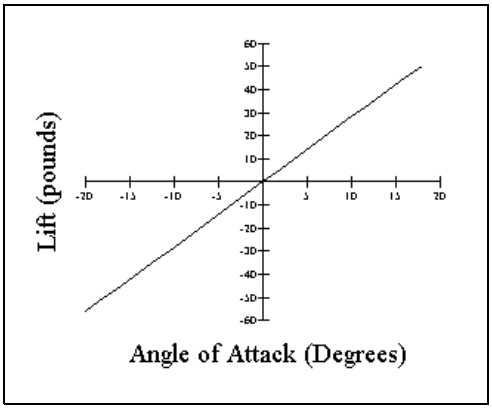
The conditions for both airfoils are:
Sea Level Air Density: **0.00238 slugs/cu ft**
Airspeed: **100mph** Angle of attack: **3 degrees**

Thin Wing - no camber.s

Airflow - Dashed lines represent the flow of air from left to right.
Thickness:0.05
Camber : none
Lift: 9 lbs/sqft

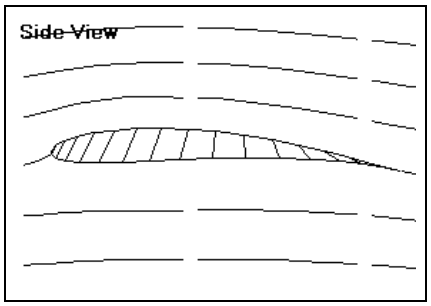


Lift versus angle of attack
Airspeed = 100 mph, area = 1 sqft
Note that the lift = 0 at zero angle of attack.

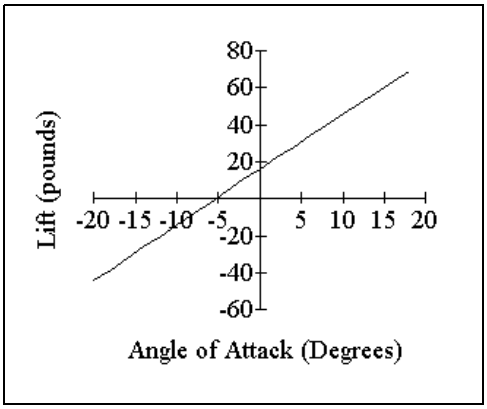


Airfoil with Thickness and Camber

Air Flow
Thickness: 0.3
Camber: 0.2
Lift: 25 lbs/sqft

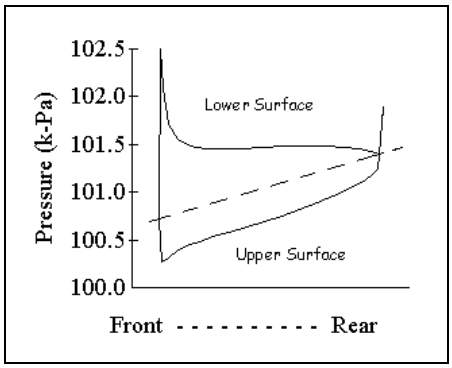


Lift versus angle of attack.
Note that the lift is not zero at zero angle of attack.

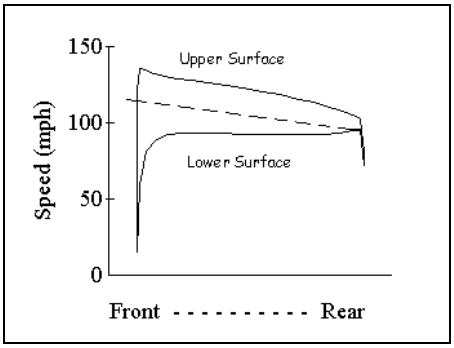


Other Properties of an Air Foil

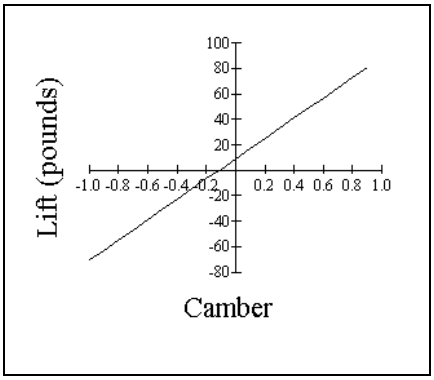
Pressure:
The pressure below the wing is greater than that above. Both vary with distance along the wing. The dashed line divides upper and lower wing pressure. The atmospheric pressure is 101.3 kPa



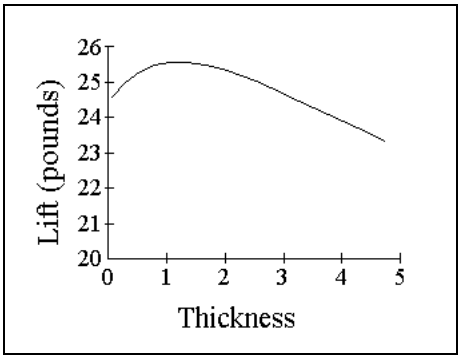
Airflow Rate (mph)
The air above the wing speeds up while that below slows down. As with pressure the speed varies along the wing. The mean airspeed of the air around the wind is 100 mph.



Effects of Geometrical Properties of the Airfoil -
Camber: The lift of the wing increases directly with camber. It might appear that more is better but this also increases drag)



Thickness:
Lift only increase slightly with thickness then decreases but drag increases continually with thickness.



Besides the geometrical properties of the airfoil, the properties of the air also effect the lift. Lower density at higher altitude will decrease the lift but higher airspeed increases the lift with the square of the velocity. The next two graphs show the effect on the curved airfoil.