In general there are two types of wind impact on the sail. One is static when the wind blows from behind and is simply pushing us forward. This happens when running downwind.

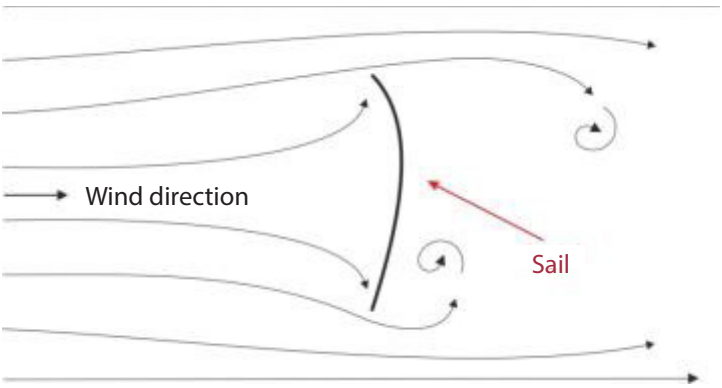

Fig. 1. *Downwind wind circulation scheme*

The other one is dynamic where the wind circulates around the sail creating the aerodynamic force. The latter way of transforming the energy is more effective. Figure 2 depicts the air pressure difference creating the aerodynamic force. This force is more powerful than just mere direct pressure of the wind against the sail.

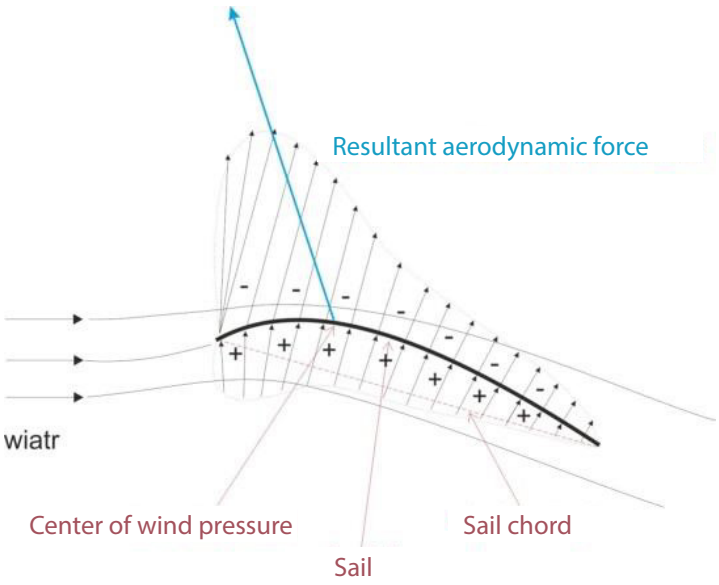

Fig 2. Aerodynamic force around an Optimist sail

In Figure 2 we see the wind creating the aerodynamic force in the sail. The plus marks the excess pressure and the minus marks the negative pressure. The aggregate of both is the resultant aerodynamic force. The boat should sail along the resultant aerodynamic force. However the centreboard enables the boat to sail straight. The centreboard divides the aerodynamic force into thrust which is more than welcome and the heeling force which is a disturbing phenomenon.

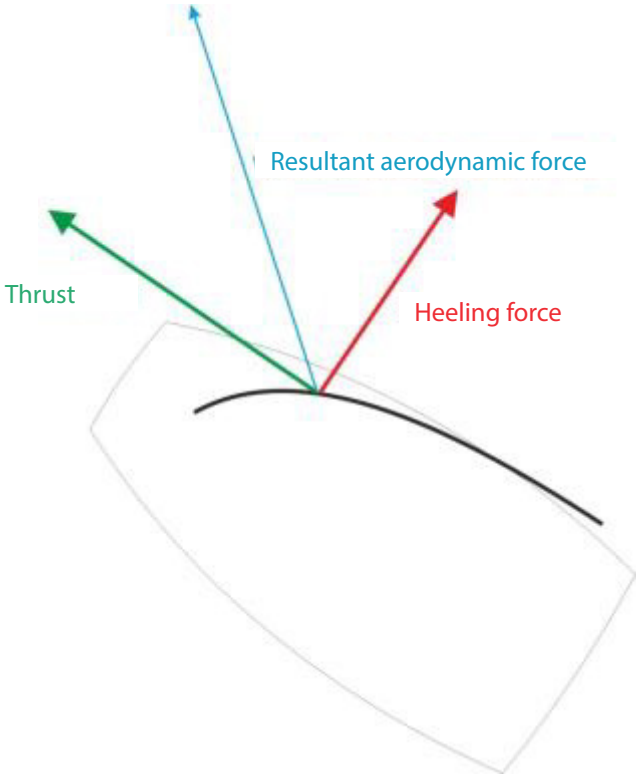

Fig. 3. Aerodynamic force and its components

These forces have a constant aggregate value. A big thrust is accompanied by a small heeling force and the other way round. When one grows the other one diminishes. Obviously it is not possible to get rid of the heeling force entirely but we can minimize it by sailing with the maximum speed. So sail as fast as you can!

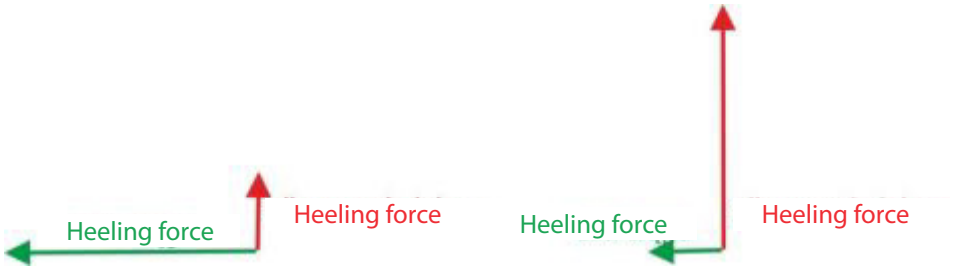

Fig. 4.Thrust and heeling force ratio change example

If we could see the wind or actually the wind streams around the sail, we would see two types of flow: laminar (parallel layers, no disruption) and turbulent (chaotic). The laminar flow is more effective, its value is around 20% of the sail chord. The laminar flow depends on many factors. We can't influence the majority of them. However we can take care of the two of them which are the sail smoothness and the state of the sail surface.

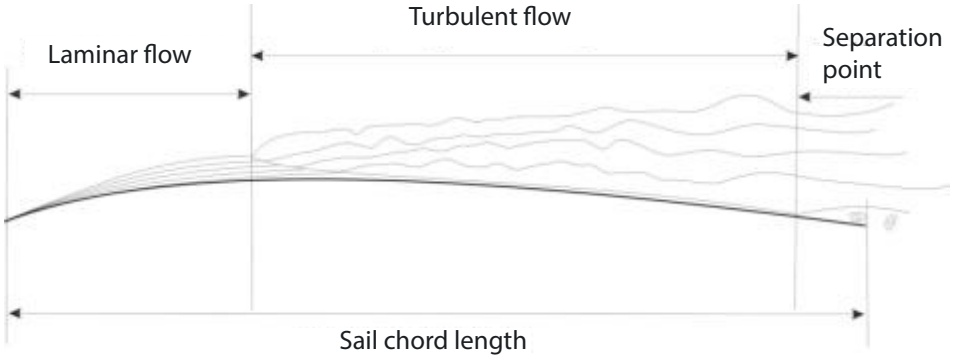

Fig. 5. Laminar and turbulent flows and the separation point

We can see indirectly whether or not the sail works properly. To do this we have to place telltales entirely within the laminar flow and additionally at the leech (at the trailing edge).

While designing the famous tower Gustav Eiffel examined the impact of the wind on a rectangular plate set perpendicularly against the wind. He determined the wake effect to be seven times the height of the plate. If our sail and the hull are some 3 meters of height above the water surface then when running downwind we get the wake effect with the wind derange starting with 2 meters of width and 21 meters of length.