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VORTEX GENERATOR

- Vortex generators are small components **deployed on the wings and stabilizers surfaces.**
- They modify the flow around this surfaces **affecting boundary layer**. Properly arranged, improve the performance and controllability of the aircraft, particularly at low flight speeds, climb, and high angles of attack.

- A vortex generator (VG) is an aerodynamic device, consisting of a small vane usually attached to a lifting surface (or airfoil, such as an aircraft wing) or a rotor blade of a wind turbine.

- When the aerofoil or the body is in motion relative to the air, the VG creates a vortex, which, by **removing some part of the slow-moving boundary layer** in contact with the aerofoil surface, delays local flow separation and aerodynamic stalling, thereby improving the effectiveness of wings and control surfaces, such as flaps, elevators, ailerons, and rudders.

How it works?

- The air stream is flowing close to surface of wing called boundary layer of airflow.
- In the boundary layer significant are viscosity and friction forces.
- The viscosity of the fluid and the friction of the object surfaces **generates high transverse velocity gradients**.
- Outside the boundary layer, where viscous forces play a minor role, usually assume that the flow is inviscid.

- During the flight, the air flows around the wing. The viscosity of the air and the surface friction of the wings causes the air molecules in contact with surface of **the wing have zero velocity.**
- In the case of flow around a wing, boundary layer near the leading edge is thin and laminar. With the movement toward the trailing edge, **gradually increasing its thickness.**
- At a certain distance from the leading edge is a transition region in which the boundary layer changes its **nature to turbulent**.
- Despite the turbulent nature of this area, right on the wing surface, there is still a **thin laminar sub layer where there is no turbulence**.

- This is due to the dampening effects of viscosity. This sub-layer slows down and becomes the cause of separation and reverse flow, and thus the wing stall.
- To avoid separation, but rather delay the formation and reduce the intensity of separation, we should the **accelerate and "energize" slowing layer**.
- VG creates a **swirling wake** who places a energy in the boundary layer of the wing. The result is a higher critical angle of attack, a lower stall speed, gentle stall characteristics, and less tendency to "drop the wing".

- The fundamental reason for the breakaway is that the boundary layer becomes sluggish(slow) over the rear part of the wing section, flowing as it is against the pressure gradient.
- The formation of a shock wave makes matters worse the speed in the boundary layer is still subsonic which means that pressure can be transmitted up stream, causing the boundary layer to thicken and, if the pressure rise is too steep, to break away from the surface.
- Now vortex generators are small plates or wedges, projecting an inch or so from the top surface of the wing, i.e. three or four times the thickness of the boundary layer.
- Their purpose is to put new life into a sluggish boundary layer; this they do by shedding small lively vortices which act as scavengers, making the boundary layer turbulent and causing it to mix with and acquire extra energy from the surrounding faster air, thus helping it to go farther along the surface before being slowed up and separating from the surface.

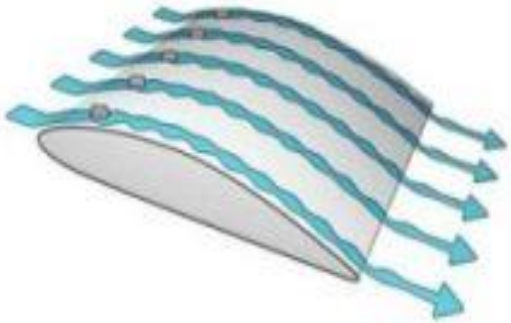
- In this way the small drag which they create is far more than compensated by the considerable boundary layer drag which they save, and in fact they may also weaken the shock waves and so reduce shock drag also; and the vorticity which they generate can actually serve to prevent buffeting of the aircraft as a whole – a clever idea indeed, and so simple.
- The net effect is very much the same as blowing or sucking the boundary layer, but the device is so much lighter in weight and simpler. The greater the value of the thickness/chord ratio the more necessary does some such device become.

Benefits

- Shorter take off run.
- Lower stall speed.
- Lower approach speed.
- Higher angle of attack.
- Gentle stall characteristics.
- Increased stability at low speeds.
- Higher rate of climb.
- More effective control.
- Easy and quick installation.

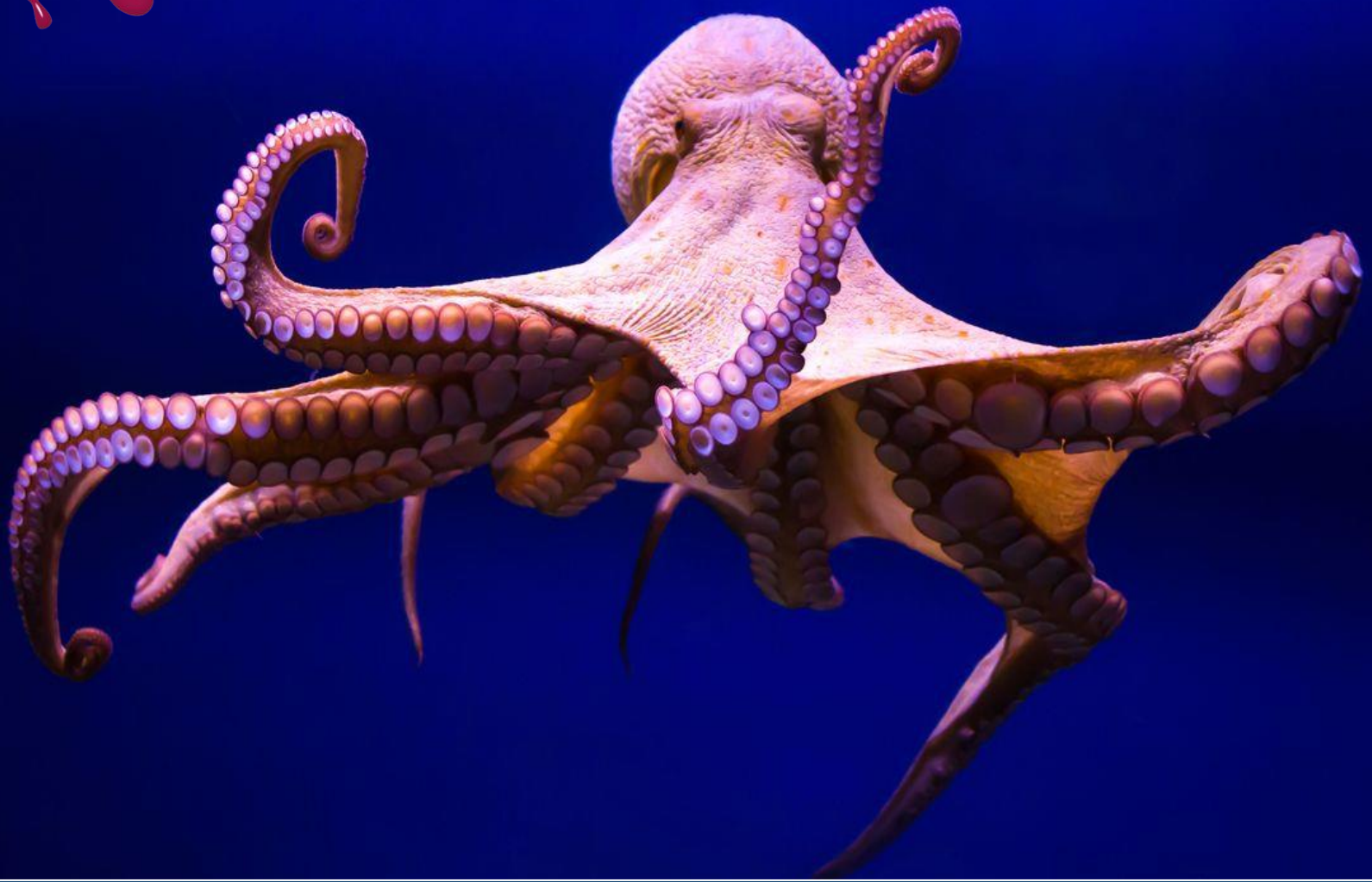
Before

After



Did You Know?

Today's Amazing Fact



OCTOPUSES ARE OLDER THAN DINOSAURS

धन्यवाद

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