



If propeller tip velocity is too high, the blade tips will

approach the local speed of sound, then compressibility effects will decrease thrust and increase rotational drag.



Figure 9.10b An increase in the number of blades will increase propeller solidity.

However, as we have learnt, thrust is generated by accelerating air rearwards. So, making the disk too solid will reduce the mass of air that can be drawn through the propeller and accelerated. To increase the number of blades efficiently, contra-rotating propellers could be used; that is, two propellers rotating in opposite directions on the same shaft. However, contra-rotating propellers are practicable only on very powerful propeller driven aircraft.

MOMENTS AND FORCES GENERATED BY A PROPELLER.

Because of its rotation, a propeller generates yawing, rolling and pitching moments. These are due to several different causes such as torque reaction, gyroscopic precession, spiral slipstream effect and asymmetric blade effect.

Torque Reaction.

If the propeller rotates clockwise, the equal and opposite reaction or torque will give the aircraft an anticlockwise rolling moment about the longitudinal axis. During take-off this will apply a greater download to the left main wheel, causing more rolling resistance on the left wheel making the aircraft want to yaw to the left. This is illustrated in Figure 9.11, where the left wheel is shown as having more pressure applied to it than the right wheel. In flight, torque reaction will also make the aircraft want to roll to the left with a clockwise rotating propeller. This effect is particularly noticeable when full power is applied to initiate a climb. Obviously, for a propeller rotating anti-clockwise, all the effects described in this section will be in the opposite direction.



Propeller torque reaction

will be greatest during high power, low indicated airspeed flight conditions. Low IAS will reduce the power of the controls to counter the turning moment due to torque.



The torque reaction generated by the clockwise

turning propeller of a single engined aircraft on take-off will tend to cause it to roll, left wing down.

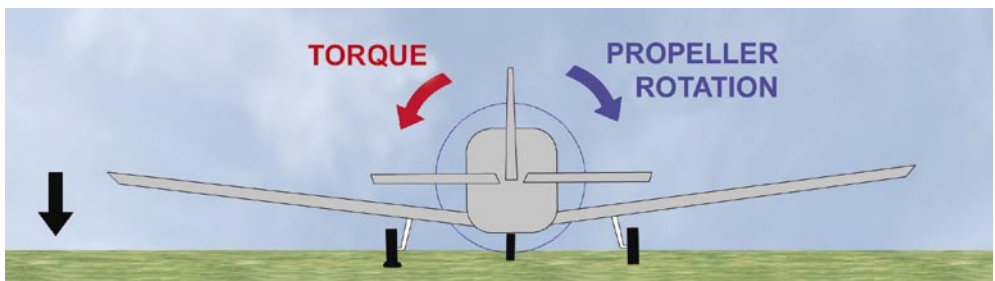


Figure 9.11 Torque Effect.

Torque reaction will be greatest during high power, low Indicated Airspeed (IAS) flight conditions.