

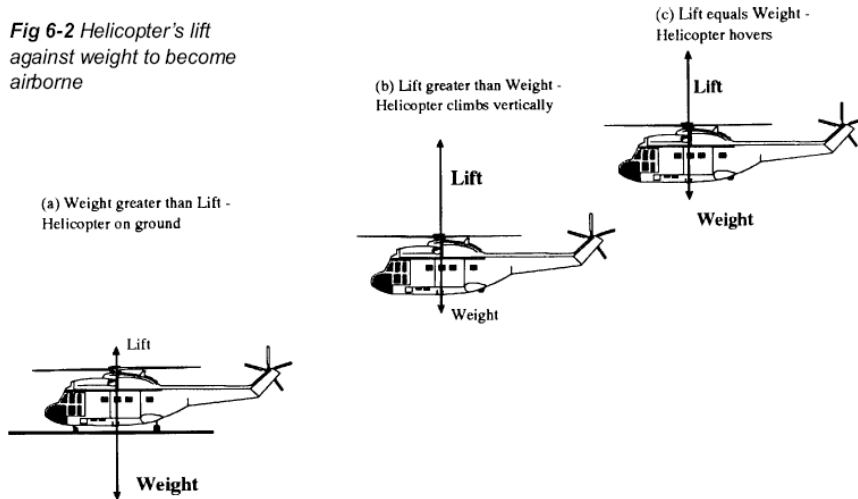
THE HELICOPTER (Chapter 6)

How a helicopter produces lift

- A cross-section of a rotor blade has an aerofoil shape, similar to that of a conventional aircraft wing.
- The helicopter's engine is used to make the blades rotate which have an angle of attack to the airflow, this generates lift making the helicopter take off.



Fig 6-2 Helicopter's lift against weight to become airborne

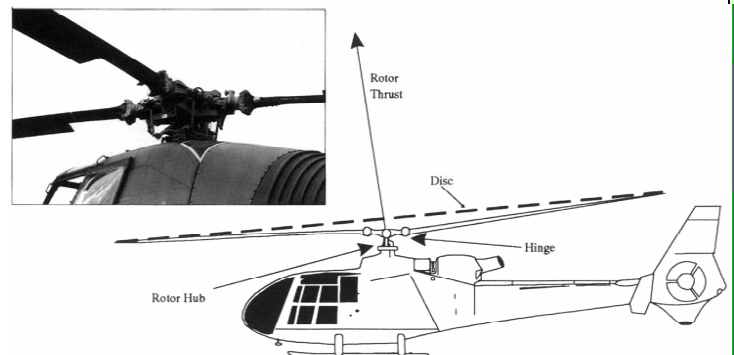


(b) The pilot has **increased the angle of attack** of the main rotor blades and so **increased the lift** until it exceeds the weight and the aircraft rises vertically.

(c) The pilot has slightly reduced the angle of attack of the blades so that the lift from the rotor now balances the weight of the helicopter, which now hovers.

Horizontal Helicopter Flight

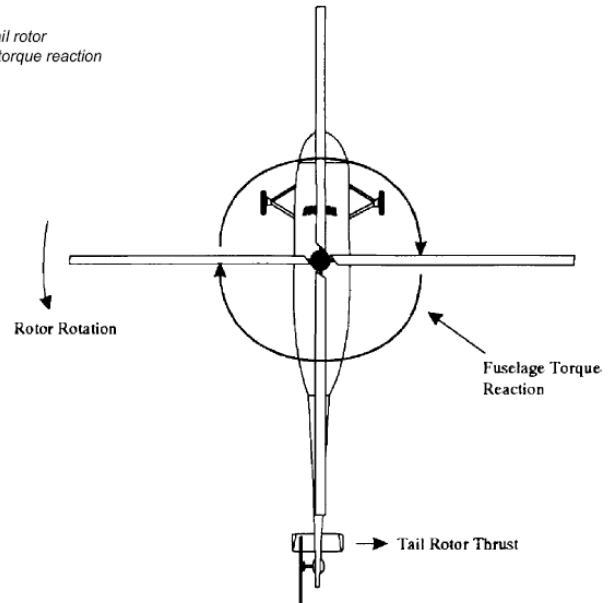
- Each blade is hinged, and can be made to rise and fall as it goes round the plane of rotation (**disc**).
- If the disc is tilted forwards, there is a horizontal component of thrust to propel the helicopter forwards.
- Tilting the disc backwards - each blade will rise as it passes over the front and fall as it goes over the rear of the helicopter; making the helicopter move backwards.



Torque Reaction

- When the engine of a helicopter drives the rotor in its circular motion, there is a tendency for an **opposing force (torque reaction)** to spin the fuselage of the helicopter the opposite way.
- The normal solution on a single-rotor helicopter is to fit a small rotor, far back on the tail for leverage, with its rotational disc vertical. Its horizontal thrust force opposes the fuselage torque reaction and permits balanced flight.
- The pilot can vary the thrust force provided by the tail rotor to yaw the aircraft at will (useful when hovering). This is done by changing the **pitch angle** of the **tail rotor blades**, giving more or less thrust

Fig 6-4 Tail rotor balances torque reaction



Helicopter Controls

The helicopter has four main flying controls:

Collective Pitch Control:

- This changes the pitch angle of all the blades of the rotor by the same amount at the same time. This allows it to control the **vertical** movement of the helicopter.
- The lever is moved up to increase the pitch angle of the blades and down to decrease the angle.
- When the pitch angle of the blades is increased, the angle of attack and thus the lift will be increased and the helicopter will rise off the ground. However this causes more drag so more power is needed.

The Hand Throttle:

- Situated on the end of the collective lever; it is a twist-grip control similar to a motor cycle throttle.

Cyclic Pitch Control:

- By tilting the rotational disc of the main rotor away from the horizontal, the cyclic pitch control is used to make the aircraft move **horizontally**.
- If the stick is moved forward, the disc is inclined forward and the helicopter moves into forward flight.

Tail Rotor Control:

- Controlled by the pilot's feet.
- Controls the aircraft in the yaw plane.
- If the left pedal is pushed forward, the nose of the helicopter yaws to the left and vice versa.
- The main purpose of the tail rotor control is to oppose the tendency of the main rotor to make the fuselage rotate.