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DEPARTMENT OF AEROSPACE ENGINEERING
19AST101-INTRODUCTION TO AEROSPACE ENGINEERING

UNIT I HISTORY OF FLIGHT

Helicopter and their functions

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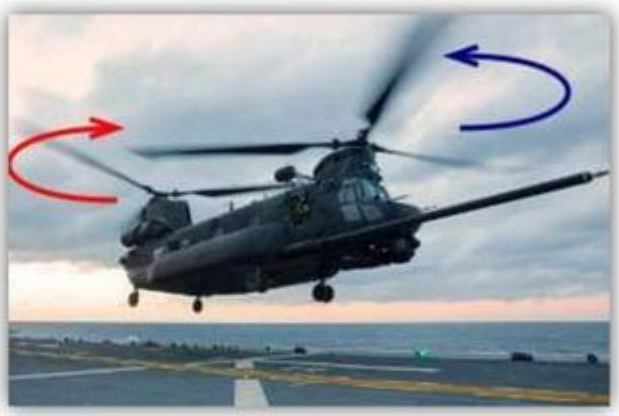
To lift a helicopter

INTRODUCTION:

- While a helicopter is a far more complex machine than an aeroplane, the fundamental principles of flight are the same.
- The rotor blades of a helicopter are identical to the wings of an aeroplane –when air is blown over them, lift is produced.
- The crucial difference is that the flow of air is produced by rotating the wings – or rotor blades – rather than by moving the whole aircraft.
- When the rotor blades start to spin, the air flowing over them produces lift, and this can cause the helicopter to rise into the air.
- So, the engine is used to turn the blades, and the turning blades produce the required lift.

WORKING:

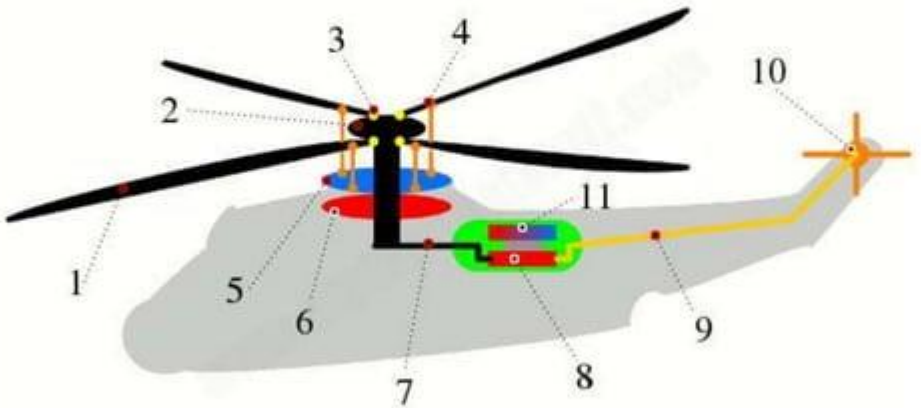


- In order to fly, an object must have "lift," a force moving it upward. Lift is usually made by wings. Wings create lift because of a relationship called the Bernoulli Principle.
- The Bernoulli Principle describes how the speed of air and the pressure in the air are related. When the speed goes up, the pressure goes down and the opposite is also true.
- Wings are curved on top and flatter on the bottom. This shape is called an airfoil. That shape makes air flow over the top faster than under the bottom.
- As a result, there is less air pressure on top of the wing; this causes suction and makes the wing move up. A helicopter's rotor blades are wings and create lift.

- An airplane must fly fast to move enough air over its wings to provide lift.
- A helicopter moves air over its rotor by spinning its blades.

Key parts of a helicopter:

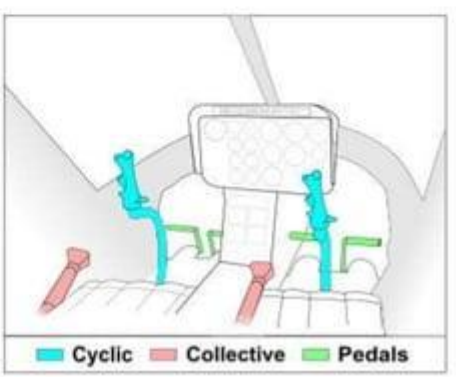
A quick summary of the essential, mechanical parts of a helicopter:



- Each rotor blade (1) is connected to the hub (2) and rotating mast by a feathering hinge (3), which allows it to swivel.
- A pitch link (a short rod) attached to each blade (4, orange) can tilt it to a steeper or shallower angle according to the position of the rotating upper swash plate (5, blue), which spins on bearings around the static lower swash plate (6, red).
- That's how a chopper hovers and steers and it's described in more detail later in this article.
- The two swash plates are moved up and down or tilted to the side by the pilot's cyclic and collective cockpit controls (not shown), which are explained below.
- The rotor is powered by a driveshaft (7) connected to a transmission and gearbox (8, red).
- The same transmission powers a second, longer driveshaft (9, yellow) connected to a gearbox that spins the tail rotor (10, orange).
- The power from both rotors comes from one or two turboshaft jet engines (11).

Flight controls:

- A helicopter has four flight control inputs. These are the cyclic, the collective, the anti-torque pedals, and the throttle.
- The cyclic control is usually located between the pilot's legs and is commonly called the cyclic stick or just cyclic
- The control is called the cyclic because it changes the pitch of the rotor blades cyclically.

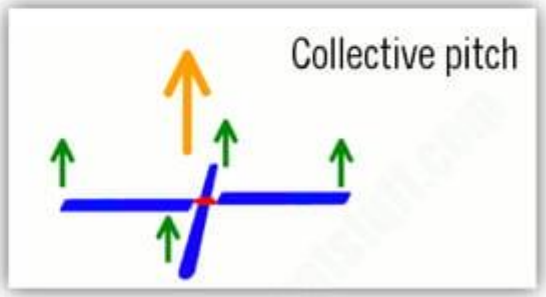


The result is to tilt the rotor disk in a particular direction, resulting in the helicopter moving in that direction.

- The collective pitch control or collective is located on the left side of the pilot's seat with a settable friction control to prevent inadvertent movement. The collective changes the pitch angle of all the main rotor blades collectively (i.e. all at the same time) and independently of their position.

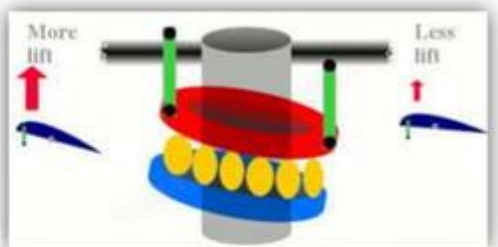
Helicopter hover and steer:

- **Hovering:**



The airfoils on the rotor blades generate lift that overcomes the weight of the craft, pushing it up into the air.If the lift is greater than the weight, the helicopter climbs; if it's less than the weight, the helicopter falls. When the lift and the weight are exactly equal, the helicopter hovers in mid-air. The pilot can make the rotor blades generate more or less lift using a control called the **collective pitch**, which increases or decreases the angle ("pitch") that all the blades make to the oncoming air as they spin around. For takeoff, the blades need to make a steep angle to generate maximum lift.

- **Steering:**



The rotors also provide the steering for a helicopter by making more lift on one side than the other. They do this by swiveling back and forth as they rotate, so, for example, they make a steeper angle when they're on the left side of the craft than when they're on the right. That means they generate more lift on the left, tilting the craft over to the right and steering it in that direction. The pilot steers like this using a second lever called the **cyclic pitch**, similar to a joystick, which makes the blades swivel as they cycle around.

USES:

- Due to the operating characteristics of the helicopter its ability to take off and land vertically and to hover for extended periods of time.

- As well as the aircraft's handling properties under low airspeed conditions it has been chosen to conduct tasks that were previously not possible with other aircraft, or were time or work intensive to accomplish on the ground.
- Today, helicopter uses include transportation of people and cargo, military uses, construction, firefighting, search and rescue, tourism, medical transport, law enforcement, agriculture, news and media, and aerial observation, among others.

A United States Navy Sikorsky HO3S-1 in action during the Korean War (1950-1953)

A Sikorsky S-64 Skycrane lifting a prefab house

An Agusta/Westland Apache attack helicopter

A Harbin Z-19 reconnaissance-attack helicopter

A Bell 205 dropping water onto a fire

An HH-65 Dolphin demonstrating hoist rescue capability

A Spanish Maritime Safety Agency AW139S4R rescue helicopter

A Sikorsky S-76C+ air ambulance

A Eurocopter EC145 of the Swiss Air-Rescue (REGA)

A Ukrainian Naval Aviation Ka-27 preparing for take off from the USS Taylor

Search and rescue training in Estonia with a Mil Mi-8

An Aerospatiale Ecureuil AS 355N Twin (EC-JMK) of the General Directorate of Traffic, Moaña, Spain

Advantages and disadvantages of helicopters:

- Choppers have lots of advantages over planes. You don't need a runway, for starters, or big wings, and you can operate helicopters more easily from ships.
- From the center of a city to the middle of a jungle, you can take off or land more or less anywhere.
- You can pause, mid-flight, to rescue someone, pick up a load, or drop it off with a winch.
- Admittedly, you can't usually fly as fast or as far as a plane, or carry as many people or as much cargo, but you have much more flexibility in where you cango.
- Unfortunately, this versatility comes at a price: helicopters with spinning rotors are mechanically more complex than planes with static wings, more prone to failure, need more maintenance, and are expensive to operate.
- Since you can fly a helicopter in all kinds of ways it's effectively several different flying craft all rolled into one you might think piloting a chopper is automatically harder than flying a plane.

THANK YOU