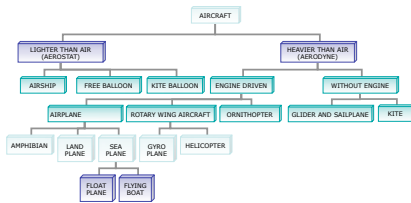


CLASSIFICATION OF AIRCRAFT AND SPACECRAFT

TYPES OF AIRCRAFT

- Aircraft can be classified into various types based on the mode of classification.
- In the following slide, a general classification of aircraft is shown.

CLASSIFICATION OF AIRCRAFT



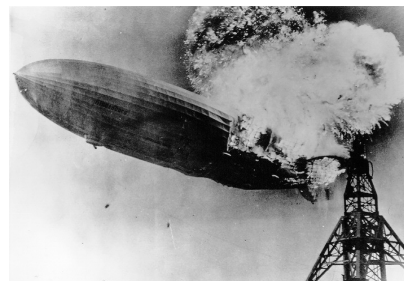
LIGHTER-THAN-AIR AIRCRAFT

- Any aircraft kept aloft by gas, which is lighter than air, contained in the craft is known as an aerostat.
- Examples of aerostats are balloons and airships.
- Today, lighter-than-air aircraft are used almost only for recreational purposes.

Air Ship - Hindenburg



Hydrogen is Inflammable!



LIGHTER-THAN-AIR AIRCRAFT

- Aerostats are further classified as follows, airships, free balloons and kite balloons.
- Airships - These are aerostats having power plant for propulsion and means of steering the craft. They are made buoyant by enclosing a volume of gas which is lighter than air.

LIGHTER-THAN-AIR AIRCRAFT

- In the case of airships, the internal pressure of the gas keeps maintains the shape of the envelope without the need of any longitudinal members.
- Free balloons - These are balloons which are not anchored to the ground and are free to move with the wind.

LIGHTER-THAN-AIR AIRCRAFT

- Kite balloons - A Kite balloon is a balloon which is shaped and trimmed so as to derive stability from wind.



HEAVIER-THAN-AIR AIRCRAFT

- Aerodyne is the technical name for any type of heavier than air aircraft.
- This covers all aircraft that derive lift in flight principally from aerodynamic forces.
- Examples are conventional planes, gliders, helicopters etc.

HEAVIER-THAN-AIR AIRCRAFT

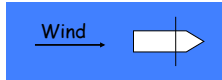
- Aerodynes can be with or without engines.
- Aerodynes with engines are classified as airplanes, rotary wing aircraft and ornithopters.
- Airplane - This is an engine driven aerodyne that achieves lift from the dynamic action of air against fixed wings.

HEAVIER-THAN-AIR AIRCRAFT

- Rotary wing aircraft - These are aerodynes that achieve lift through the dynamic action of air against rotating wings.
- Ornithopter - This is an aircraft that flies due to the lift generated by flapping wings.

Aerodynamics of Sailing

- Sailing with the wind (running)

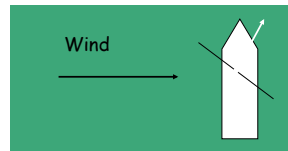


- $V_{max} < V_{wind}$



Faster Sailing

- Sailing across the wind (reach)



Aerodynes - Kite



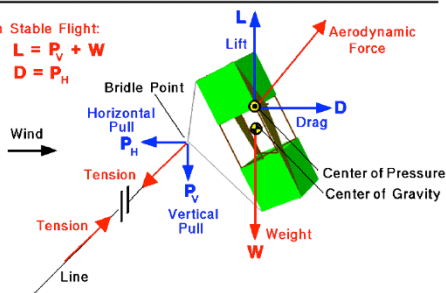
Forces on a Kite

Glenn Research Center

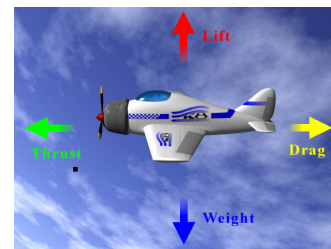
In Stable Flight:

$$L = P_v + W$$

$$D = P_h$$

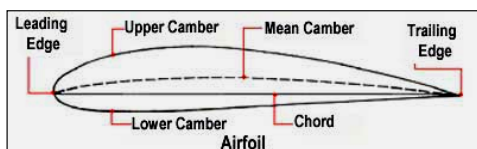


Aerodynes - Airplane



- Ideally, $L=W$, $T=D$
- L/D Ratio and T/W ratio

Wing Airfoil Section



HEAVIER-THAN-AIR AIRCRAFT

- Airplanes can be further classified as amphibians, land and sea planes.
- Amphibians - These are airplanes which can take off and land on both land and water.
- Land planes - These can take off and land only on a land surface.

HEAVIER-THAN-AIR AIRCRAFT

- Sea planes - These are aircraft that take off and land only on sea.
- Sea planes are classified further as float seaplanes and flying boats.
- Float seaplane - This is a seaplane supported on water by a pair of floats instead of a hull.

HEAVIER-THAN-AIR AIRCRAFT

- Flying boat - This is an aircraft which has a hull as its main body. The hull also supports the aircraft on water.
- Rotary wing aircraft are classified into two types as gyroplanes and helicopter.

HEAVIER-THAN-AIR AIRCRAFT

- Gyroplane - This is a power driven aerodyne which derives lift mainly from a rotor freely rotating in the horizontal plane, but thrust is obtained from a conventional engine.
- Helicopter - This is an aerodyne which derives both lift and thrust from rotating rotors.

HEAVIER-THAN-AIR AIRCRAFT

- Helicopters can be classified into various types depending on the type of rotor like,
 - Single main rotor with tail rotor,
 - Side-by-side non intermeshing rotors,
 - Torqueless single rotor,
 - Side-by-side intermeshing rotors,
 - Tandem rotors,
 - Three rotors,
 - Coaxial rotors etc.

Tandem Rotor – CH47 Chinook



HEAVIER-THAN-AIR AIRCRAFT

- Aerodynes without engine are classified as gliders, sailplanes and kites.
- Glider - This is an aerodyne which flies without any applied power due to aerodynamic lift generated by its wings and initial thrust given by some launching mechanism.

HEAVIER-THAN-AIR AIRCRAFT

- Sailplanes - These are high performance gliders that soar, maintain and direct their flight over extended periods of time and distance.
- Kites - A kite is any non-power driven structure which is anchored to the earth, and which derives lift from aerodynamic forces.

HEAVIER-THAN-AIR AIRCRAFT

- These aircraft can also be classified based on the following,
 - Mach Number
 - Purpose
 - Type of Engines
 - Number of Engines
 - Number of Wings

CLASSIFICATION OF HEAVIER-THAN-AIR AIRCRAFT

- Range
- Mode of take-off and landing
- Size and Payload Capacity
- Source of Power
- Special features

CLASSIFICATION BASED ON MACH NUMBER

- Aircraft are classified based on their maximum Mach number,
 - Subsonic ($M < 1$)
 - Transonic ($M \sim 1$)
 - Supersonic ($M > 1$)
 - Hypersonic ($M \gg 1$)

CLASSIFICATION BASED ON PURPOSE

- Aircraft are mainly classified based on their purpose as follows,
 - Passenger Transport
 - Business jets
 - Cargo Transport
 - Experimental aircraft
 - Trainers

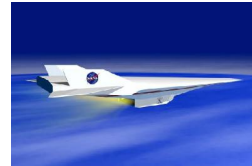
CLASSIFICATION BASED ON PURPOSE

- Military aircraft
 - »Fighters
 - »Bombers
 - »Medical / Rescue Aircraft
 - »Spy / Reconnaissance Aircraft

CLASSIFICATION BASED ON PURPOSE

- Agricultural aircraft
- Sports aircraft
- » Glider
- » Recreational aircraft
- » Man-powered aircraft

CLASSIFICATION BASED ON PURPOSE



- Simulation of a hypersonic vehicle

CLASSIFICATION BASED ON PURPOSE



- A typical business jet and a commercial airliner.

CLASSIFICATION BASED ON PURPOSE



- Bomber aircraft (Stealth and B 52)

CLASSIFICATION BASED ON PURPOSE



- Fighter aircraft (F 16)

CLASSIFICATION BASED ON PURPOSE



- Sports aircraft

CLASSIFICATION BASED ON PURPOSE



- Experimental Aircraft

CLASSIFICATION BASED ON TYPE OF ENGINE

- Aircraft with engine are classified based on the type of engine as follows,
 - Propeller
 - Turboprop
 - Turbofan
 - Turbojet
 - Ramjet

CLASSIFICATION BASED ON NUMBER OF ENGINES

- Another way of classification is the number and position of engines.
- This varies depending on the mission requirements of the particular aircraft.

CLASSIFICATION BASED ON ENGINES

- The classification of aircraft based on the number and type of engines is not an entirely independent classification since the maximum or cruise Mach number roughly fixes the type of engine and the number of engines to be used.

CLASSIFICATION BASED ON NUMBER OF WINGS

- Airplanes are classified based on the number of wings as,
 - Monoplanes
 - Biplanes etc.
- Present day aircrafts have a Monoplane configuration

CLASSIFICATION BASED ON RANGE

- Aircraft are classified based on their range as follows,
 - Short range (<500 km)
 - Medium range (<3000km)
 - Long range (>3000 km)

CLASSIFICATION BASED ON MODE OF TAKEOFF AND LANDING

- Aircraft can also be classified based on the mode of takeoff and landing as follows,
 - Normal
 - VTOL
 - STOL
 - STOVL etc.

CLASSIFICATION BASED ON SIZE AND PAYLOAD CAPACITY

- Aircraft are classified based on size as follows,
 - Micro-airplanes
 - Single or double seater airplanes
 - Medium size airplanes (~50 passengers)

CLASSIFICATION BASED ON SIZE AND PAYLOAD CAPACITY

- Large Airplanes (~ 400 passengers)
- Cargo planes for transporting cars, trucks, military tanks etc.

CLASSIFICATION BASED ON SOURCE OF POWER

- Aircraft are classified based on their source of power as,
 - Oil,
 - Solar Power,
 - Electric Power,
 - Nuclear Power (quite rare)

SPECIAL AIRCRAFT

- These include
 - Helicopter
 - Ornithopter or Flapping wing aircraft
 - Flying Wing Aircraft
 - Stealth Aircraft

THE STEALTH



CLASSIFICATION OF ROCKETS

- Rockets are classified based on
 - Type of fuel
 - Type of engine / thrusters
 - Number of stages
 - Purpose

CLASSIFICATION BASED ON TYPE OF FUEL

- Rockets can be classified based on the type of fuel used to propel itself. The two main types of fuel used are
 - Solid Fuel
 - Liquid Fuel
- The other main type of rocket is the nuclear rocket, which uses nuclear energy.

CLASSIFICATION BASED ON ENGINE/ THRUSTERS

- Rockets are also classified based on the nature of propulsion, as
 - Electromagnetic Propulsion Rockets
 - Ion Propulsion Rockets
 - Plasma Thrusters
 - Ramjets
 - Scramjets etc.

CLASSIFICATION BASED ON NUMBER OF STAGES

- Rockets are also classified based on the number of stages.
- Staging is done to improve performance, reduce unnecessary load and also because different regions of the atmosphere require different types of engines for optimal performance.

CLASSIFICATION BASED ON PURPOSE

- If the rockets are used for carrying instruments for doing some experiments, it is called a Sounding rocket.
- Rockets can also be used as missiles.
- Rockets are also used as launch vehicles.

MISSILES

- Missiles are basically sub-orbital rockets.
- Some of the main types of missiles are as follows,
 - Ballistic Missiles
 - Surface-to-air missiles
 - Torpedoes
 - Heat-seeking missiles
 - Guided missiles

LAUNCH VEHICLES

- Launch Vehicles (LV) are used to place satellites in orbit.
- The major types of launch vehicles are
 - Reusable
 - Nonreusable

LAUNCH VEHICLES

- The reusable Launch Vehicle includes the Space Shuttle.
- At present, Space Shuttle is the only one of its kind in the whole world

LAUNCH VEHICLES

- The non reusable Launch vehicles are classified as follows,
 - Land based
 - Sea based
 - Submarine based
 - Air based

LAUNCH VEHICLES



- Pegasus - Air based launch.

LAUNCH VEHICLES



- Sea based launch.

LAUNCH VEHICLES



CLASSIFICATION OF SATELLITES

- The different types of satellites are classified based on their purpose,
 - Amateur Radio Satellites
 - Astronomical Satellites
 - DBS (Digital Broadcasting System)
 - Domestic Communication Satellites
 - Early Warning Satellites

CLASSIFICATION OF SATELLITES

- Satellites for monitoring Earth' s resources
- Geodetic Satellites (for studying Earth' s geography)
- Lunar Satellites
- Military Communication Satellites
- Navigation Satellites
- Nuclear detection Satellites

CLASSIFICATION OF SATELLITES

- Planetary Satellites
- Research Satellites
- International Space stations
- Surveillance Satellites
- Weather Satellites