Clo2

The energy may not be created or destroyed .
Motion: is the act of process of changing place.
Air has no force on power exept pressure unless its moving.
Relative air: is the airflow around the object caused by the movment of the air or the object.
Speed: the rate of motion related to time.
Velocity: is the rate of motion with a direction related to time.
Acceleration: is changing a velocity.
Increasing in velocity = positive acceleration
Decreasing in velocity = negative acceleration (deceleration) .
Newton's first law: inertia: if an aircraft is on ground engine off the inertia keep the aircraft at rest.
If an aircraft is moving in a unformal speed in a straight line inertia keep aircraft moving.
Newton's second law: F= m x a
Newton's third law: for every reaction there is an opposite and equal reaction.
Bernoulli's principle: speed half an inversely relationship with pressure increase the speed of fluid (liquid or gas) the pressure of fluid decrease.
As the air flows over the curved upper surface velocity increase and pressure decrease and inverse on the lower surface.
The difference in pressure between the lower and upper surface of the wing is called lift.
In order to fit Bernoulli's principle, the airflow over the wing surface must be laminar.

Laminar: airflow that is flowing in constant smooth stream.
Turbulent: the air flowing over the surface no longer so closely adheres to it.
Free stream flow: is the air which is far away from the incoming aircraft that it pressure temperature or relative velocity have not got effected by the air craft's passing through it.
The pressure of the free stream flow is static (ثابت).
Free stream flow = aircraft speed
When the free stream flow arrives at the aircraft structure such as the wing it must flow around the surface area.
The pressure and the velocity of the air change depending on the shape of the wing.
Stagnation. : is a point in front of the structure where the velocity is zero.
Stagnation point in aerodynamics:
Positive pressure > atmospheric pressure.
Negative pressure < atmospheric pressure.
Stagnation point pressure = total airstream pressure.
Stagnation point pressure > atmospheric pressure.

As the flow divide and proceeds around the object: velocity increases and static pressure decreases.
(Because the airfoil is symmetrical the pressure at the same and no lift is produced)
(By tilting the airfoil an increase in the upper surface section and decrease in velocity on the lower surface.

Upwash is generated ahead of the airfoil and the stagnation point move under the leading edge.
Downwash is evident after the airfoil or downwash occurs at the trailing edge.
Boundary layers: is the part of the air closer to the surface of the aircraft (air half viscosity (اللزوجة) air faces a resistance to flow over the surface)
The natural viscosity of the airflow reduces the local velocity and increase the skin friction drag.
The beginning flow on a smooth surface gives evidence of a very thin boundary layer.
The boundary layer near the leading edge is similar to layers of air sliding smoothly this type of low is the laminar boundary layer.
As the flow continues back friction force continue to dissipate energy of the air stream and laminar boundary layers increase in thickness.
After some distance back the laminar boundary layer begins an oscillatory disturbance which is unstable a waviness occurs in the laminar boundary layers which destroy the smooth laminar flow.
A transition take place in the laminar boundary layer and change into turbulent boundary layer.
However, some small laminar flow continues to exist in the very lower levels of the boundary layer it's called: laminar sub layer.
Laminar profile:

- low thickness
- Low velocity next to surface
- Gradual velocity change
- Low skin friction

Turbulent profile:

- Greater thickness
- Higher velocity next to surface
- Sharp velocity change
- Higher skin friction

Plane form: is the shape of an aircraft wing as projected on to a horizontal plane.
Airfoil section: properties deal with flow into dimension.
Plane form: properties consider flow entry dimension.
Vortex:

- the fluid moves from high pressure to low pressure
- The movement of air over the wing is from front to rare
- The spanwise movement of air from the bottom of the wing to the outward from the fuselage and upward around the wing tip
- All of the above settings up make vortex

All vortices increase drags because of a turbulence produced and constitute induced drag.
Vortex increase as left increase.
Left increase by increasing the angle of the airfoil into the wind.
Drag increase as the angle become greater.
As the angle increase the pressure between the top and the bottom of the wing become greater.
Chord of the wing is the width from the leading edge to the trailing edge.
Chord line: is a line depicting the chord which extend forward of the leading edge.
Average chord: is the area of the wing divided by the wingspan.
Main aerodynamic chord is the average distance from the leading edge to the trailing edge.
Angle of incident: is the acute angle that the wing chord makes with the longitudinal (طولي) axis of aircraft.
The angle of incident in most cases is built in an angle.
Leading edge higher than the trailing edge = positive angle of incident.
Leading edge lower than the trailing edge = negative angle of incident.
Wash in :

- angle of incident increase from root to tip
- Tip will stall 1st

Wash out:

- angle of incident decrease from root to tip
- Root will stall 1st

Wash out: allows the pilot to have great control of the aircraft during stall.
Wash out important if the airplane have swept wings:

- Wash out prevent the tip from stalling

Left can be increased by increasing the:

- angle of attack
- Wing area
- Velocity
- Density of the air
- By changing the shape or the size of the airfoil

When left = gravity —> level flight

Camber of the wing is the curve of the upper wing surface the lower surface also have camber.

(The amount of lift produced by an airfoil increases with an increase in wing camber.)

Mean camber line: lies within the wing half way between the upper and the lower chamber.

Maximum camber: is locate where the mean camber line is the greatest distance from the chord line.

Camper is positive: when departure from the chord line in outward.

Camper is negative: when departure from the chord line in inward.

Airfoil: Any part of the aircraft that converts air resistance into lift.

The shape of the airfoil determines the amount of turbulence or skin friction.

fineness ratio: control turbulence and skin friction.

High fineness ratio = very thin wing

Low fineness ratio = thick wing

High fineness ratio = large skin friction

Low fineness ratio = large turbulence

Large wingspan = Greater lift.

High Aspect ratio = Greater lift.

High aspect ratio wings produce less induced drag

• All discussion of aerodynamic behavior assumes that the aircraft airfoils are free of contamination. (But it's not)

the most common forms of contamination are:

ice: Ice changes the shape of the airfoil and make it less efficient.

snow.

frost.

Ice and snow must be removed before the flight.

If ice, snow and frost is allowed to accumulate on the aircraft during flight, the aircraft's weight increased while the ability to generate lift is decreases.

There are four forces that act upon an aircraft in flight. Thrust, drag, lift, weight.

Thrust: The force that moves the aircraft FORWARD

weight: The force that pulls the aircraft TOWARD the earth.

Lift: The force that pushes the aircraft UPWARD.

Drag: The force that hold the aircraft BACK.

An aircraft is continuously affected by thrust, weight, lift and drag. [When these forces are not in balance, a resultant or resulting force will exist.]

The aerodynamic resultant is all the forces acting on the aircraft

Lift and drag are the relationship between the relative wind and the aircraft, these forces that produce a resultant lift force on the wing.

Drag is the force oppose (يعارض) the thrust created to move the aircraft forward.
Induced drag is an inventible consequence of the creation of lift.
Induced drag is caused by the down wash at the triling edge of the wing meeting the air that flows under neath the wing.
The greater the lift the greater the induced drag.
Lift is increased by increasing the AOA so induced drag is increasing too.
Lift coefficient (CL) : is the ratio between lift pressure and dynamic pressure and its a function of the shape of the wing and AOA.
Drag coefficient (CD) : is the ratio of drag pressure to dynamic pressure.
DL increases with AOA.
The L/D is the amount of lift generated by airfoil compared to its drag
A L/D indicates airfoil efficiency.
High L/D more efficient.
N accelerated flight with the lift drag study the CL and CD can be calculated.

AOA: is the angle between the relative wind and the chord line.
(photo page 78)
The sum of all these forces called resultant force.
The (CP) is the point of interaction of the resultant lift with the chord line.

- the CP moves along the chord as the AOA change
- The CP moves forward with increasing the AOA
- The CP rearwards with decreasing the AOA
- The AOA change when the attitude change
- When the AOA lift increase rapidly up to a certain point then begin to drop and then drag increases slowly at first then fast

Critical angle: is when the AOA increases to an angle of max left.
When the critical angle is reached the air stop to flow smoothly over the top surface of the airfoil.
When this happens, the lift drops and drag become stronger.
The gravity exerts it self and the nose of the aircraft drops (stall).
Parasite drag : produced by objects that are distrusting the airflow around the wing or the aircraft.
(Parasite drag photo)
Form drag : caused by the aerodynamics resistance due to the shape of the aircraft.
Skin drag: which is related to the smoothness or roughness of the aircraft.
Interference drag : which occurs where surface with different flow features meet.
To reduce form drag aircraft surface which are exposed to the airflow of the relative wind are stream lined.
At the streamlining increase the form drag decrease.
Friction drag is caused by the friction of the atmosphere against the surface of an object that moves through it.
Friction drag is created in the boundary layer by the velocity of the air.
Friction drags reduced by delaying the point at which laminar flow become turbulent.
Interference drag: is generated by mixing of airflow stream lines between :
Air frame components (the wing and fuselage, the engine pylon and the wing)
The air frame and the attached external stores (fuel tanks weapons sensors pods)

The interference drag cna be minimized by the appropriate use of fairings and filets between the components.
Induced drag : is a result of the lift and is produced by the movement of an airfoil through the air.
Air flowing over the top of a wing tends to flow in words.
Air flowing below the wing the air flows outward.
The air slide from the end of the wing and create wing tip vortex.
Wing taper toward the tip reduce the induced drag by 20% .
Induced drag : decrease at high speed and increase with aircraft weight.
The induced drag is inversely proportional to the square of the speed.
All other drag is directly proportional to the square of speed.
Wave drag : a force that delay the forward movement of an aircraft In subsonic and transonic flight, as a consequence of the formation of the shock wave.
Wave drag is caused by the formation of shock wave in :
1 : supersonic flight around the aircraft
2 : transonic flight around some surfaces

Shock wave are associated with :
1 : supersonic aircraft
2 : aircraft traveling at less than the speed of the sound.

Shock wave happens on the aircraft where the local airflow accelerated to sonic speed and then decreases back to subsonic speed.
A shock wave forms when airflow becomes subsonic