Aircraft wing design considerations

Engineering

Airplane wings generate lift by conservation of momentum. The main purpose of the wing to deflect air downward, giving it a down-ward momentum component. The increased backward momentum of the gases as they are expelled is accompanied by an increased for momentum of the plane. The aeroplane wings moves in air using drag force which are exerted by air due to differences in pressure. This is made possible because the relative velocity of air and airplane are different creating a stream flow around the aeroplane in a form of laminar. This is critical for any aircraft. The drag force that is formed when the air craft is moving is always proportional to the speed of the aeroplane. In order to have large relative speeds a large drag force is exerted due to turbulence of the movement. This is necessary to ensure that an aircraft is kept in a certain direction without changing due to external forces. When the aircraft is landing it produces a net force that is equivalent to zero due to the drag force which is produced due to the terminal velocity. The net force of zero is due to zero acceleration that is experienced during the landing. The aircraft continues to move at a negative acceleration which is critical in the successful landing. If the aircraft uses constant motion or constant velocity landing will not take place. However, it will continue coming down due to air resistance and gravitational force. This will lead to a crash in any of physical features on earth whether man made or natural. DiscussionThe common misconception about lift is that air is reflected downwards leading to a situation of upward force which causes a lift. The other misconception is the application of the law of conservation of momentum, which is Newton’s third law. The other misconception is that the shape of the ring is important, however it has been proved that the edge of the wing must be sharp and the trailing edge should be angled downward

therefore the shape is not necessarily critical. There is also a misconception in to lifting force whereby it is assumed that there must be an application of Newton’s law of motion meaning that all wings of aeroplanes should be tilted in order to enable lifting due to differences in pressure on the surfaces of the wings. Lastly the third misconception is the application of Bernoulli’s Law disregarding Newton’s Law, that’s incorrect. Both Bernoulli’s and Newton’s Law should be applied equally. According to Bernoulli’s Law of continuity, movement of an airplane in air is restricted and slowed down by flow of air. This is because the airplane will need to increase energy to reduce the resistance. However, according to the law the pressure between the forward of airfoil is different from the pressure the other side. This means the pressure is low where the speed is very high and high where the speed is low thus pushing the aircraft forward. An airfoil creates a lift as shown in the figure below. The lines in the figure represent streamlines of air flowing past the aircraft since it has wings that act as wind tunnels. As it can be noted, the streamlines has some bends which is as a result of the wing deflecting air downward enabling the movement. Applying Newton’s third law of motion whereby conservation of momentum is used we will state that the wind will push the air upward when the aircraft want to land, this causes a lift. If the wing pushes air upwards then an upward lift is generated enabling the air craft perform its functions as required. If this theory is taken on the phase value one would assume that the wing of an aircraft will just bounce of due to air deflection, but energy needs to be applied for this to be made possible. The oncoming forms angle of an attack of an aircraft. If the angle of attack is great it means there will be a great lift. This means the angle of attack determines the lift of an aircraft. However, it should be noted that an aircraft

fly at a certain attitude due to the negative angle of attack of the aerofoil enabling the aircraft to have a zero lift. This is shown by diagram 2 below. (Lee Dempsey/HowStuffWorks. com)Applying Bernoulli’s equation to understand how the movement of air an aircraft wing operates we will note the equation asThe aerofoil is rounded and not pointed at the front in order to create pressure differences when the aircraft is moving. Other shapes that can create lift is Saucer. DragWhen an airplane pilot makes a turn in the air, the pilot makes use of a banking angle. The airplane itself is tilted as if it were travelling over an inclined surface. Because of the shape of the wings, an aerodynamic force called lift acts upward when the plane is in level flight. To go round a turn, the wings are titled; the lift force stays perpendicular to the wings and therefore, now has a horizontal component. Just as the normal force has a horizontal component supplies the necessary radial acceleration, while the vertical components of the lift hold the pane up.

Therefore, AndWhere the x-axis is horizontal and the y-axis is vertical. The lift force is different in its physical origin from the normal force, but its components split up the same way, so a plane in a turn banks its wings at the same angle that a road would be banked for the same speed and radius of curvature when they turn. The boundary layer of wings is formed on the airfoil to ensure that effect of pressure does not deviate the geometry of the aircraft. CL versus AlphaCD versus Alpha, A drawing of the aerofoilFrom the diagrams below it can be noted that the angle of attack of 11 degrees and below have a lower lift that is decreasing at the similar pace. However, the critical angle of attack appears to be 14-15 degrees where air is bend due to viscosity, that is, air is separated from the wings. The wings of an aeroplane will extend downward during airplane taking off and landing. This changes

the appearance of the wing for the purpose of creating a lift. From the plots above it can be noted that angle of zero lift is 0o and the angle gives maximum lift is 120. If it flies upside down, the maximum lift is 1. 2o, and at what angle is 25Using the Newton’s law of forces and moments acting on an airfoil, we find the following equations necessary Where Y is pressure force per unit span. This can further reduced by subtracting p¥ for both sides of the foil i. e upper and lower side pressure values, leaving , This equation will then be non-dimensionalized as Where c is chord and the other is dynamic pressure then, Lift and Drag: Lift and drag are related to the X- and Y- forces as follows: Where Cl the lift, and Cd is drag coefficientsConclusionsThe eventual effect of this is that the streamlines of that is lift in the wings will end up upward force. If the drag force coincides with the centre of one of the wings, the correct peak level is displayed. If, however, the drag force is not at the centre of wings, then a reduced level is displayed.