CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Alec N. Mnatzakanian

Project Number

38616

Project Title

An Uplifting Discovery: What Is the Optimal Angle of Attack for Maximum Lift?

Abstract

Objectives/Goals

The purpose of this experiment is to prove that if the angle of the wing relative to the ground is increased over a certain range, then the lift will increase proportionally, because CL (coefficient of lift) is directly proportional to the angle of the wing.

Methods/Materials

Assemble and build the airtight wind tunnel, with a fan in the front and an exit vent in the back. Use duct tape to seal inner edges of tunnel. Confirm airtight seal by testing for leaks around the wind tunnel. Correct if necessary. Build an airfoil shape (NACA 2411) out of a block of lightweight foam. Support the wing on beams connected to a scale, which will be used to measure lift. Place the wing at 0 degrees (parallel to ground) facing incoming air inside wind tunnel. The wind should flow parallel to the bottom of the wing. Keep fan speed constant during testing. Begin first control test by starting fan and measuring weight delta generated by wing at 0 degrees. Adjust the wing by one degree and measure lift force. Repeat until 22 degrees. This will be a full set of tests, beginning at 0 degrees and ending at 22 degrees. Repeat each set of tests 6 times. Because the unit measured is force, we must divide each result by 100, then multiply by 9.8 (the gravitational constant) to get lift force, so use the equation F=9.8W to convert, then log the results and graph force vs angle of attack. Average for each degree and find greatest lift force.

Results

It was found that as the wing#s angle of attack grew, the climb in lift force also grew. It was also found that the critical angle of attack for maximum lift force is around 18-20 degrees, after which the numbers began to plateau then drop.

Conclusions/Discussion

when the angle of attack is increased over a certain range, then the lift will increase proportionally, because CL is directly proportional to the angle of attack, and there has to be an optimal angle of attack because CL cannot increase indefinitely with the angle of attack.

Summary Statement

The purpose of this experiment is to prove that if the angle of attack is increased over a certain range, then the lift will increase proportionally.

Help Received