CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

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Project Number
S0101

Project Title
A Breakthrough in Aerodynamic Technology

Abstract

Objectives/Goals
Finding a method of parasitic drag reduction by altering the flow of aerodynamic boundary layers. The experiment will determine which method will result in the greatest amounts of drag reduction.

Methods/Materials
The experiment was conducted by constructing three identical airplane wings with the use of balsa wood. Different forms of a boundary layer bleed were applied to each individual wing. The first wing did not contain any boundary layer bleed. The second wing contained a boundary layer bleed at the transition. The third wing had a boundary layer bleed constructed at the transition point and every so often until the trailing edge. A boundary layer bleed is a suction method. After each form of boundary layer bleed was constructed on a wing, each wing was placed inside the wind tunnel for testing. Oil was placed on a portion of the trailing edge. The movement of the oil was observed during the testing.

Results
After wind tunnel experimentation, the results showed that Wing A had an transition point of 3.83 cm from the leading edge. Wing B's results, the wing with a boundary layer bleed constructed at the transition point, showed that the transition point had been extended and was now 5.83 cm from the leading edge. Wing C, with the boundary layer bleed at the transition point and every so often until the trailing edge, had a transition point of 7.23 cm from the leading edge, respectively.

Conclusions/Discussion
After successfully completing the experimentation, we found that the best method for drag reduction is by conducting a boundary layer bleed at the transition point and every two centimeters thereafter. This method, theoretically, is the best method to achieve highest amounts of drag reduction. We also conclude that, configuring a boundary layer bleed will always contain less drag then with the wing in motion without any bleed. Although skin friction and parasitic drag are unavoidable, they may be prevented to a certain extent. We found that using a suction method to suck out the boundary layer during a boundary layer bleed, which spans from the transition point and every two centimeters afterwards until the trailing edge, theoretically, contains the greatest amounts of drag reduction. By utilizing our findings much enhancement can be made on aircraft. Recommendation would include to measure the actual drag. We would also strive to find the effects of our findings at different angles of attack.

Summary Statement
Finding a method of parasitic drag reduction by altering the flow of aerodynamic boundary layers

Help Received
We used the lab equipment at Ribet Academy under the supervision of Mr. John Shiradjian.