Design, Build, and Fly Competition

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Project Overview

Clarkson University has assembled a team of undergraduate students to enter into a national competition with other colleges and universities. The competition entails the design, construction and competition of a radio-controlled aircraft by the student members.

The competition is held annually and is sponsored by the American Institute of Aeronautics and Astronautics (AIAA), Cessna Aircraft Company and the Office of Naval Research (ONR.) The 2000 competition will be held in Wichita, Kansas on April 15. Students must construct a fixed-wing, electric-powered aircraft that weighs less than fifty-five pounds and has less than a seven-foot wingspan. The aircraft is to carry up to eight liters of water through a predetermined course.

This project provides students interested in aeronautical design and construction an opportunity to participate in a team environment to produce a product that meets a specific set of requirements as outlined by competition rules, much as a commercial venture would produce a proposal based on the customer's needs. Undergraduates, from freshman to senior, are exposed to the concept of group design. Students learn how to integrate the many aspects of design and to balance the advantages and disadvantages of various design possibilities. For many, this is the first opportunity to see the design process as it is in many corporations. Sub-teams work on specific areas of aircraft design, such as aerodynamics, structures or controls. The sub teams then have to integrate their designs into the vehicle so that it meets the requirements set by other design teams. The students must size an aircraft based on the requirements set by competition rules. Then they evaluate possible aircraft configurations to best fulfill the requirements. Finally, they must construct the entire aircraft and submit a written report, outlining the decisions made and methods used in the design, to the contest coordinators. Knowledge gained through this process is applicable to any engineering problem encountered in industry.

The mission of the Design, Build and Fly project is to provide an opportunity to work together as a team, in a professional atmosphere to solve an engineering problem. This will enable participating students to supplement an academic background with practical application, giving them the skills that today's industry demands.

Design and Development

The production of adequate lift to minimize takeoff distance and maximize payload capacity was the major driving design parameter. To produce an aircraft that has a limited wingspan and limited amount of power available, lifting surface configurations took the highest priority in the design research. Larger wing area would reduce the wing loading, thereby decreasing the stall speed. Since a lower stall speed

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decreases the takeoff speed, less power is required during the takeoff run. Takeoff is the active constraint when sizing motor power so a smaller motor can be used. The decrease in weight results in less required lift.

Several configurations were chosen for evaluation based on historical cases, namely the tandem wing, canard, conventional biplane, conventional monoplane and flying wing. Primary concerns were lifting area, flight stability, airframe strength, ease of construction and propulsion integration. Other lesser concerns included maneuverability and drag. The team selected the canard configuration during the conceptual design. The possibility was left open for a three-surface configuration. It was believed that a stable, controllable aircraft could be made with the canard or three-surface aircraft. Historical examples of these types of aircraft were cited, particularly ones that use a large canard. Both model and full size aircraft in these configurations have been flown successfully. Andy Lennon's Wild Goose and Henry Mignet's Flying Flea are examples of successful large-canard configurations.

Final Aircraft Configuration

The final aircraft configuration and systems layout are shown in the rendered figure below. The design employs a canard with identical fuselages attached to the ends of the wings. The empennage consists of two vertical tails that attach to each fuselage. Twin tractor motors located in the nose of each fuselage provide power. Two nose-wheels and two main wheels make up the landing gear. The aircraft has a wingspan of 6 feet, 10 inches, an overall length of 4 feet, 3 1/2 inches and an overall height of 1 foot, 11 1/2 inches. Estimated aircraft empty weight is 9 lbs. Estimated take-off weight is 32 lbs. (fully loaded.) The aircraft configuration is shown in figure 1.

Figure 1 – Aircraft Configuration