

Design of an Unusually Shaped Totally Awesome Aircraft with Flair and Style AAE451, Aircraft Design, Fall 2007

Background: Remotely piloted unmanned aerial vehicles are today finding an increasing number of useful military, commercial and consumer roles. With increasing competition from toymakers around the globe, it is imperative that today's toymakers design unique products that capture the interest and imagination of young people. As a result the design emphasis in this project is in creating a safe, robust and unusual air vehicle capable of controlled flight by a young person in a restricted airspace.

Design Mission: The U-Staafs aircraft must be designed for the following mission. Within the confines of Grissom 180, the vehicle must safely takeoff, climb, loiter for 5 minutes, and land. At some point in this flight the vehicle must drop a small plastic doll onto a 4x10 foot drop zone. In order to be visually appealing and to capture the imagination of young people, the air vehicle should be unusually shaped. Typical young people should likely describe the vehicle as "totally awesome", and typical old people should likely describe the vehicle as having "flair and style".

Design Constraints: Flight of this remotely piloted vehicle must be safely demonstrated in Grissom 180. The toy doll can be a plastic soldier, transformer, Barbie or other suitable lightweight object. It is desirable that the shape of the vehicle be consistent with the character of the dropped toy. For instance, a military-looking vehicle would be consistent with a soldier, and a pink and fluffy vehicle would be consistent with a Barbie.

The aircraft must have typical aircraft modes of motion that have damping ratios that satisfy the military requirements for flying qualities of manned aircraft. The vehicle must be stable under all flight conditions.

The vehicle must be robust to crashes, easy to fly (i.e., have exceptional flying qualities). In all aspects of design and construction cost must be minimized. The cost to build the fixed-wing aircraft must not exceed \$200 (excluding radio-control gear, speed controller). The powerplant must be electric (battery powered). The aircraft will be marketed to existing companies who sell and manufacture model aircraft as toys to young people. The vehicle should be visually appealing to young people.

The aircraft should be as small and light as practical and possess the following performance abilities.

- Take-off distance and landing distance ≤ 10 ft of ground roll,
- Climbing right-angle turn following take-off with minimum climb angle 35 degrees ($\gamma_{\text{climb}} \geq 35$ degrees),
- $V_{\text{Stall}} \leq 15$ ft/sec, where V_{Stall} is the level flight speed at $C_{L_{\text{max}}}$,
- Demonstrate the mission safely in Grissom 180.

Any deviation from the design constraints must be formally requested in writing to the customer (Professor Andrisani) and justified using sound engineering and business logic.