16.030-16.040 Unified Engineering
Department of Aeronautics & Astronautics
Massachusetts Institute of Technology

**Spring 2004**

# Systems Problem 6
# Design I
# Wing & Tail

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|---|---|
| Handed out: | Thursday, 18 March 2004 |
| Answers due: | Thursday, 1 April 2004, 5:00 p.m. |

**Objectives**
At the end of this systems problem you should be able to:
- Perform system module and component design by redesign
- Report system module and component designs against requirements and strategy.

**Discussion**
It's time to start bringing all the pieces of your system (People, Process, Product) together as we approach the aerial competition. In this assignment you will design the wing and tail.

This is a design by redesign effort. You have assembled and tested a baseline out-of-the-box model aircraft. Your task now is to redesign the wing and tail in such a way that your flight performance in the competition will be maximized, subject to the constraints imposed by the competition rules.

**Assignment**
This is a group assignment. Division of labor will be key to completing this system problem within the allotted time budget. For any computations or estimates you must describe your procedure in order to earn full credit.

You may redesign a wing from scratch and find your own airfoil geometry. An alternative approach is to take into account manufacturability early and select the most suitable airfoil from the database of airfoils that has been preprogrammed in the CNC foam cutter. If you choose the latter option you should rationalize your airfoil selection.

## Deliverables

### Wing

1. Discuss the goals of your wing design effort. Tie your discussion to aspects related to your functional requirements document, your strategy for competing successfully in the contest, and any other practical considerations. There should be both qualitative and quantitative aspects of your discussion. You do not need to give exact numbers for this part, but give the ballpark estimates for relevant parameters and the implications of such number (e.g. Explain what a chosen aspect ratio of 7 to 8 would imply in performance).
2. Define your wing design by providing:
    a. An engineering drawing including the planform of the wing (defining such parameters as span and taper) and, if appropriate, a front view showing dihedral angles and a side view showing twist.
    b. The cross section of the wing at the root and tip.
    c. Designation of material to be used and manufacturing process.
3. Justify your choices regarding your wing design in 2. Tie your choice of parameters such as area and aspect ratio to the design goals through engineering calculations and other rational means. Your discussion should include all relevant aspects of engineering that you have learned in Unified (aerodynamic, structural, etc.).
4. Estimate the weight of the wing.
5. Estimate the maximum tip deflection of the wing. You may use simplified assumptions such as a cantilevered beam with constant cross section and an intelligent approximation of the distributed load.

### Tail

1. Discuss the goals of your tail design effort. Tie your discussion to aspects related to your functional requirements document, your strategy for competing successfully in the contest, and any other practical considerations. There should be both qualitative and quantitative aspects of your discussion.
2. Define your tail design by providing an engineering drawing.
3. Justify your choices regarding your tail design in 2. Tie your choice of parameters to the design goals through engineering calculations and other rational means.
4. Based on your wing and tail design, estimate the location of the neutral point(s) of the aircraft.
5. Define a procedure to experimentally confirm your estimate of the neutral point location(s) defined in 4.

Original: CPColeman, Spring 2001
Modified: GBarter, CEJohnson, PWYoung, CPColeman, Spring 2002
CPColeman, OdeWeck, PWYoung, JPixley, Spring 2003
CPColeman, Spring 2004

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| **Group Number** | **Group Name** |
|---|---|
| **Name** | **Time Spent** |
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