AE 421, Spring 2004, R.D. Hale
Final Design Project - Due 5:00 PM, Thursday, May 13, 2004

We are working with the National Science Foundation to develop requirements for a UAV remote sensing aircraft for operation in Polar regions (Antarctica). A preliminary vehicle arrangement is shown below. An AeroCADD file containing this geometry is available.

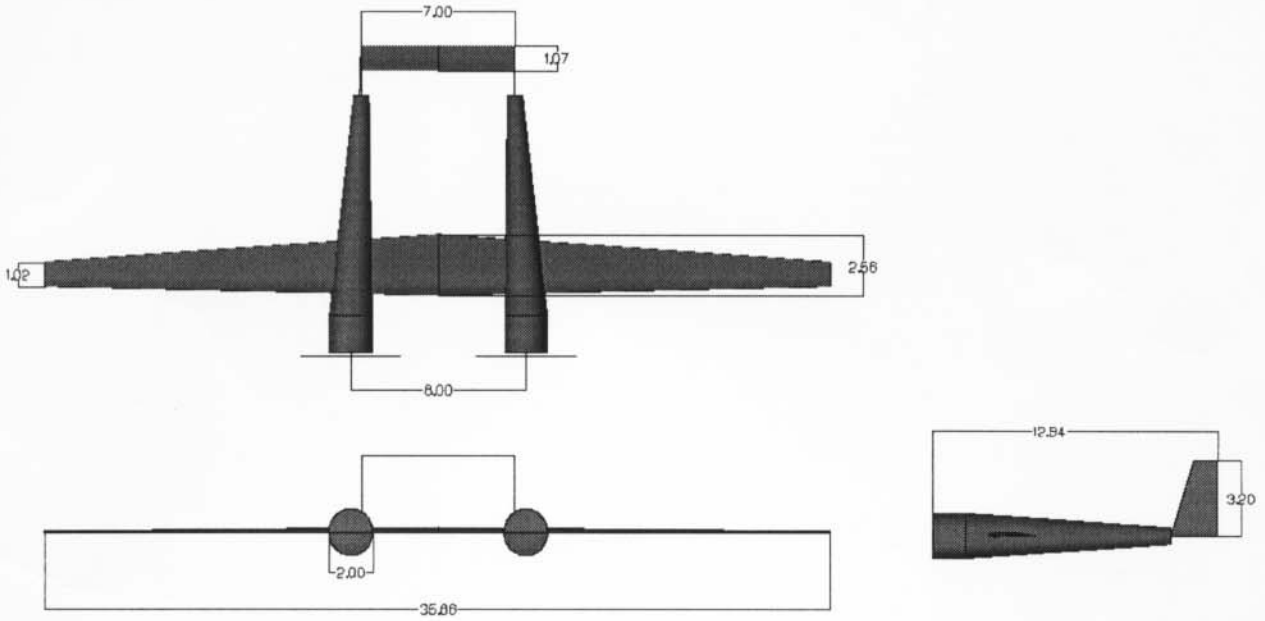

Figure 1. Vehicle Conceptual Design

Your task is to complete the vehicle configuration design by adding missing details and local features. At a minimum, this shall include integrating appropriate horizontal and vertical tail airfoil sections, terminating at the twin booms. You are also required to provide a detailed structural layout of the wing structure, suitable for structural sizing and optimization trade studies. You are encouraged to address engine integration with the twin booms.

Finally, you are responsible for developing the structural design of the vehicle, and to integrate the preliminary structural arrangement into a manufacturable concept. Landing gear integration may be expected to incorporate skis. You may wish to incorporate features such that this landing concept is more survivable. You should recall that as a designer, you have the flexibility to modify any structural (or configuration) arrangement should you identify a driving reason for the change (weight, system integration, aerodynamic or structural efficiency, manufacturing ease or reduced cost…). All proposed changes must be presented to management and to *the appropriate technical disciplines* for approval at design reviews. Any change you feel will affect a primary aerospace discipline (aerodynamics, control, structures, propulsion, manufacturing…) or any change you feel will affect performance (range, speed, takeoff distance, climb, payload, cost, supportability, low observables…) must be justified and must be approved by an appropriate discipline representative.

The structural concept is likely to be basic, exploiting manufacturing equipment available at the University of Kansas. I encourage you to consider your options, and meet with your structures and manufacturing representative for guidance. Of primary concern to you is an appropriate assembly concept, as you have limited tooling available in your manufacturing facility and a limited budget. Your

assembly concept may significantly affect your manufacturing techniques and structural arrangement. Numerous wing and fuselage prototypes have been developed in recent years, which may provide some insight into available manufacturing capabilities.

Note that your structural arrangement will be reviewed by project strength, and you can expect that they will provide modifications to your basic configuration based upon expected loads, which are still being developed. Any questions you may have prior to such time should be directed to project strength (Dr. Hale will wear many hats for this project). This is typical at this stage of design, wherein you are working closely with all engineering disciplines to ensure an integrated concept. If you do not have a good basis for engineering judgment, ask a representative from the appropriate engineering discipline. You will be expected to document these engineering decisions in your final report. As you make geometry decisions you must keep all disciplines informed, as this affects their designs and analyses.

Your specific tasks shall be:

T1) Develop a detailed schedule for your design activities to ensure that you meet the final product deliverable date of 13 May, 2004. You should have **detailed** milestones for each remaining class period, and you should include *several* scheduled design reviews.

T2) Model the wing geometry, blends and internal arrangement. Your design documentation will eventually be required to support manufacture of the components, and thus must include appropriate dimensions and tolerances.

T3) Model the twin boom internal arrangement. Your design documentation will eventually be required to support manufacture of the components, and thus must include appropriate dimensions and tolerances. Engine integration is recommended.

T4) Model the horizontal and vertical tail geometry, blends and internal arrangement. Your design documentation will eventually be required to support manufacture of the components, and thus must include appropriate dimensions and tolerances.

T5) Establish an internal mating arrangement for wing-boom, wing-wing and wing-tail intersections.

T6) Incorporate a concept for landing gear integration.

Your final submitted package shall consist of a written report documenting your geometry, and your design decisions. This report shall constitute 75% of your team grade. The explicit requirements for the final written report are summarized as follows:

R1) Introduction: a statement of the design problem, critical design issues, and your solution

R2) Body:

- Discussion and documentation of design geometry (drawings as required to illustrate design features, and references to specific aspects of your CAD model that you wish us to examine)
- Multi-disciplinary issues you addressed while defining geometry
- Integration of geometric details, to include comments on clearances
- Design decisions for wing structure, and final design
- Design decisions for twin boom structure, and final design
- Design decisions for empennage structure, and final design
- Design integration decisions for the wing-fuselage splice
- Design integration decisions for the wing-wing splice
- Design integration decisions for the wing-tail splice
- Design integration decisions for landing gear integration

R3) Conclusions:

- Merits of design concept

- Issues for future consideration or integration

R4) Appendices:

A) Design schedule:

- The scheduled milestones you developed, and team progress towards those milestones (actual and anticipated delivery dates)
- Breakdown of tasks and deliverables by team member

B) Other supplemental information as required

As always, I will be assessing the organization of the report, and the perceived integration of the team. I also will be interested in a clear, concise, grammatically correct text. Give yourself time to proofread the final text prior to submission, you will be pleased with the result. You will also be expected to deliver a CAD model of the final concept. This geometric model will be included as an integral portion of your documentation, and shall provide all necessary detail to facilitate manufacture and assembly of these components to your specifications (with the exception of material specification).

You are allowed to work in teams of up to three persons (with one team of four), and I will accept one design report per team. ***You must reorganize from previous teams*** -- you may not partner with any teammate from the previous design exercises. Change is common in aerospace, and you cannot expect to rely on the same teammates for all activities. I will expect as a deliverable an identification of the responsibility of each team member, and milestones for each team member as well as for the team. During intermediate design reviews you will be expected to address progress to tasks, as well as potential schedule modifications or recovery plans. Thus, at team meetings you should address and continually update your plan and your progress towards that plan.

I will expect each team member to "grade" the performance of themselves and their peers, and I will take this into consideration during final grading. Your team will receive one grade based upon completeness and accuracy of your design. Individual performance, as assessed by your own ratings, will be used as a weighting factor to reward (or punish) individual performance.

Obviously, the final deliverable date cannot be modified for any reason. We will hold a final design review on Thursday, 13 May, 2004 where you will be expected to present your final design to the class. I expect a 15 minute oral presentation from each team presenting the following:

O1) Introduction: a statement of problem as you understand it

O2) Design concepts, documentation of concepts, design decisions, and your final concept

O3) Conclusions (merits of design concept)

I will further assess the apparent organization of your team, and the effectiveness of your presentation (clarity, uniformity, quality of graphics, quality of oration, response to customer). This oral report shall constitute 25% of your team grade.