A&AE 451 Aircraft Design
Aerodynamics Preliminary Design Review #1

Aircraft Geometry

Airfoil section for wing, vertical and horizontal tails.

Wing and tail geometry including sweep angle, taper ratio, dihedral angle.

Aircraft wetted area, Aspect ratio of wing

3-view drawing drawn to scale and dimensioned.

Aerodynamic mathematical model

Please provide numerical values of all the coefficients listed below. Take account of three-dimensional effects and be sure to include the effects of the horizontal tail.

Lift Coefficient
$C_L = C_{Lo} + C_{L\alpha} * \alpha + (C_{L\delta e} * \delta e \text{ (optional)})$

Drag Polar
$C_D = C_{Do} + k * C_L * C_L$

C_{Lmax}

Optional items

Incidence of the wing and horizontal tail.
Control surface size and aerodynamic effectiveness (aileron, elevator, rudder).
Launch conditions (angle of attack, speed, flight path angle)
Endurance
L/D max

Pitching Moment Coefficient about the quarter chord point
$C_M = C_{Mo} + C_{M\alpha} * \alpha + (C_{M\delta e} * \delta e \text{ (optional)})$

A&AE 451 Aircraft Design
Structures and Weights Preliminary Design Review

Geometric layout of your wing structure
- **geometry of wing spar(s)**
- **location of wing ribs (if any)**
- **location of wing stringers (if any)**
- **wing coverings (if any)**
- **materials of wing components**

Material properties of all structural materials (balsa, spruce, plywood, foam, etc.)

Analysis of wing loads
- **What are the maximum bending and torsional loading conditions?**
- **What are the properties (area, skin thickness, width, height) of the wing box (assumed uniform with span?) to insure that the wing tip rotates by less than 1 degree?**
- **Load distribution at maximum wing loading.**
- **Maximum wing root bending moment.**
- **What are the properties (area, skin thickness, width, height) of the wing box (assumed uniform with span?) to insure that the wing box can handle the maximum bending loads?**
- **Based on these two analyses, what are the final properties (area, skin thickness, width, height) of the wing box (assumed uniform with span?).**
- **Clearly state any simplifying assumptions you make.**

Landing Gear
- **Location, configuration, special structure, and load analysis**
- **Longitudinal tip-over analysis**
- **Lateral tip-over analysis**
- **Tail-strike analysis**

Optional items
- **loading condition for which the wing will fail.**
- **maximum wing tip vertical deflections.**
- **analysis of the wing-fuselage attachment (e.g., how many rubber bands?).**
- **Geometric layout of your fuselage structure.**
- **Geometric layout of your horizontal tail structure.**
- **Geometric layout of your vertical tail structure.**

Weight Estimate
- **center of gravity**
- **moments and products of inertia**
- **complete listing of all parts, location, weight**

Results of any structural testing you may have done.

A&AE 451 Aircraft Design
Dynamic Modeling Preliminary Design Review
For Vehicle and Avionics

Description of the loop closure to be implemented in your feedback control system
- **Block diagram**
  - **pitch rate feedback to the elevator,**
  - **roll rate feedback to the aileron,**
  - **yaw rate feedback to the rudder)**
- **Objective of the feedback loop (e.g., to increase the damping ratio of the short period mode from _ to _.)**

Dynamic models for each block in your block diagram
- **Aircraft transfer function (expressed symbolically, e.g., in terms of M_α)**
- **Rate gyro transfer function**
- **Actuator transfer function**
- **Control law transfer function**

Numerical values for all physical constants that appear in the transfer functions (e.g., M'_α)

Root locus of your control system as a function of the rate gyro feedback gain

Nominal feedback gain

Flow cart showing how you will implement the control of the rate gyro gain and the log-data on/off function of the data logger. NOTE: ALL TEAMS MUST IMPLEMENT THESE FUNCTIONS IN THE IDENTICAL MANNER SO THAT THE PILOT PERFORMS THESE CONTROL TASKS IN THE SAME MANNER.