

AOE 3134 Homework #2

Assigned: January 30, 2007

Due: February 6, 2007 (Place your homework in the box outside my office by 5 PM.)

Problem 1. Wind tunnel tests yield the following data for lift and pitch moment about the quarter chord line of a given wing:

C_L	$C_{m_{1/4}}$
0.3	-0.039
0.6	-0.036

1. Find h_{n_w} .
2. Find $C_{m_{ac}}$.
3. Find h_{cp} when $C_L = 0.4$.

Problem 2. Consider an airplane with the following characteristics

$$\begin{aligned}C_L &= 0.07 \alpha + 0.002 \delta e \\C_m &= 0.10 - 0.02 \alpha - 0.03 \delta e \\C_{L_t} &= 0.06 \alpha_t + 0.004 \delta e\end{aligned}$$

where all angles are measured in degrees. These equations are valid below stall. The lift coefficient at stall is $C_{L_{\max}} = 1.4$. The center of gravity is located at the point $x_{cg} = 1.5$ meters, where x is measured positive aft of the wing apex. Other relevant parameters are

$$b = 15 \text{ m}, \quad S = 45 \text{ m}^2, \quad \bar{c} = 3 \text{ m}, \quad V_H = 1, \quad W = 120 \text{ kN}.$$

1. Determine the equilibrium angle of attack and elevator deflection corresponding to steady, wings-level flight at speed $V = 70$ m/s in air of density $\rho = 1$ kg/m³.
2. Compute the stick-fixed static margin.
3. Suppose that elevator deflections are limited to the range $-15^\circ \leq \delta e \leq 15^\circ$. Find the forward limit on the CG location defined by requiring that the minimum equilibrium elevator deflection δe_{\min} correspond to the stall lift coefficient $C_{L_{\max}}$.

Problem 3. Problem #2.8 in Etkin and Reid. Although we did not cover this topic in lecture, the problem is quite straight forward after a bit of reading and independent thought.

Problem 4. Problem #2.11 in Etkin and Reid. The discussion must be typed and should not exceed one page.