AOE 3134 Stability and Control Problem Sheet Five

Due 19 March, 2002

Read Etkin and Reid Chapter 3, sections 1 & 2 for detail, 3-7 for general ideas.
Chapter 5, 5.4
An aircraft (business jet - Jetstar) has the following aerodynamic properties:

Mach 0.2 @ sealevel and Mach 0.8 @ 40,000 ft

M_a	C_L	C_D	C_{L_α}	C_{D_α}	C_{m_α}	C_{L_q}	C_{m_q}	$C_{L_{\delta_e}}$	$C_{m_{\delta_e}}$
1) 0.2	0.737	0.095	5.0	0.75	-0.8	0.0	-8.0	0.4	-0.81
2) 0.8	0.4	0.04	6.5	0.6	-0.72	0.0	-0.92	0.44	-0.88

Its physical characteristics are given by:

W = 38,200 lbs h = 0.25 S = 545.5 ft^2 $\bar{c}$ = 10.93 ft b = 53.75 ft

18. Determine the following: at each flight condition:
    a) L/D
    b) Thrust Required
    c) Stick fixed neutral point
    d) Elevator angle / g
    e) Stick-fixed maneuver point

19. What is the change in elevator angle to from Mach 0.2 in condition one to Mach = 0.4? Assume that there are no Mach number effects on the aerodynamic properties and that the flight is straight and level.

20. In the last homework the horizontal tail was located at the tip of the vertical fin (a T tail). In our developments we neglected the contribution to the moment due to the z offset. Likewise for a wing. This offset will contribute to the pitch moment slope to some extent and hence modify the pitch stability parameter, C_{m_α}. Develop an expression for the additional term to be added to our current expression for C_{m_α}.

    a) That is find the ΔC_{m_α} due to the z location of the wing. State any assumptions that you make.

    b) Using your expression, determine if a high wing (negative z location) is stabilizing or destabilizing with regard to pitch static stability. Explain.