AE 440A
Constraint Analysis
Due Sept. 25, 2008 in class

1) 20 points Perform a constraint analysis based on the following take-off, stall, best and specified cruise, loiter and ceiling constraints for a jet aircraft. For the ceiling constraint, assume the coefficient of lift is that for a minimum power loiter. Present a table of $(T/W)_o$ and $(W/S)_o$ for each condition. Plot the constraint diagram and included a suggested design point.

Aircraft Performance:

Stall speed of 80 kts
Take-off from 50 ft clearance in 3,000 ft for an airfield at 5,500 ft altitude
Specified Cruise at M=0.85 at 30,000 ft
Best Cruise at M=0.85
Specified Loiter at 15,000 ft, M=0.5
Service Ceiling at 40,000 ft with R/C=130 fpm

Aircraft Data:

C_{Do}=0.015, AR=7, e_o=0.85, C_{Lmax}=3.0, $C_{LmaxT/O}$=2.0

Altitude corrections (up to 20 km):

$\rho/\rho_o=\sigma=[1-\alpha h/(288^oC]^{(-1+g/R\alpha)}$, α=6.5^{o}C/km, R= 287m^2/(^{o}C sec^2)

Thrust correction:

$T/T_o=[0.88+0.245(|M-0.6|)^{1.4}](\rho/\rho_o)^{0.7}$

2) 15 points Consider a blended-wing body concept for the AIAA 150-passenger aircraft.

a) For this aircraft, list the <u>four</u> most important constraint types (i.e. landing, take-off, etc.) and justify your choice.
b) Determine appropriate values for these constraints. (i.e. cruise at 15000 ft, take-off values, etc.).
c) Estimate "Aircraft Data" (AR, e, etc.) <u>based on</u> historical information and published design studies of relevant aircraft.

You should look at published design studies of relevant aircraft, and may also reference aircraft design textbooks. Be sure to list <u>all</u> references used and explain/justify your assumptions. Use standard AIAA reference notation in your report Your results should be presented in a table, with accompanying prose as necessary to justify your values and estimates.

3) 10 points Based on part 2 above, perform a constraint analysis for your blended-wing body, listing all equations and showing all values used and computed. Present a table of $(T/W)_o$ and $(W/S)_o$ for each condition you selected. Plot the constraint diagram and include a suggested design point.

Note: Plots should not be by hand. Use symbols for data points and use lines for trends or curve fits. Label axis with a symbol and put units in parentheses, e.g. L (Nt), then add a caption below (not a title above) that explains plot, e.g. “Lift as a function of aspect ratio for three different Mach numbers”. Do not use internal grid lines in plot; do not use color symbols unless printing in colour, and do not place boxes around figure. Make sure all font size of axes and legend is at least 12 point.