Longitudinal Stability

Fuselage Length

L (f)	2.997

Wing Center of Lift

L_ctr (x/L)	0.1
m.a.c. (ft)	0.792825

Load Summary (fuselage)

Load Type	Magnitude (lbs)	x/L_start	x/L_end	resultant x/L	M @C_lift f-lb (+ cw)	dw
Fuel	0.1	0.2	0.4	0.3	0.05994	0.02
Payload	0	0.4	0.5	0.45	0	0
Fus.Struct.	2	0	1	0.5	2.6198316	0.1040656
Engine(s)	0.64	0	0.1	0.05	-0.095799	0.2131
Wing Struct.	0.35	0.4	0.6	0.5	0.41958	0.07
Horiz. Tail	0.07	0.85	1	0.925	0.1791806	0.0181172
Vert. Tail	0.17	0.85	1	0.925	0.4139261	0.0418526
Other	-2.02	0	1	0.5	-2.418348	-0.096062
Σ L	1.49725			Σ M	1.1783112	
Tail Lift (req)	0.4765619	0.85	1	0.925	1.1783112	0.1191405

Center of Gravity

X_cg / L	0.3625905	
X_cg (ft)	1.0866836	f

Static Margin

S.M.	-0.992632	unstable

Longitudinal Stability Coefficient:

Wing Parameters:

S_w	6.3843036	f^2
$(C_{L_\alpha})_w$	0.0827664	(deg)^-1
x_w	0.7869836	f
cbar	0.792825	f

Horiz. Tail Paramters:

$(C_{L_\alpha})_{ht}$	0.111	(deg)^-1
$d\varepsilon/d\alpha$	0.3	Fig. 11.3
η_{ht}	1	
l_ht	1.6855414	f
S_ht	0.9733914	f^2

Engine Parameters

mdot	0.1	lbm/s
l_i	1.6	f
rho	0.0092	lbm/f^3

V	1925.7	f/s		
dβ/dα	1			

Calculations

V_bar_hs	0.3241426			
inlet effect	3.283E-05	unstable		
wing effect	4.7072288	unstable	**check:** C_M_α =-S.M.*C_L_α	4.7072288
h. tail effect	1.4430445	unstable		
C_M_α	**3.2641514**	unstable		

Directional Stability Coefficient:

Wing Parameters:

A_w	7	
Λ	0	deg
λ	1	
S_w	6.3843036	f^2
b	5.5497748	f
z_w	-4	f
C_L (cruise)	0.201	

Fuselage Parameters:

h	0.333	f
w	0.333	f
Vol_f	1	f^3

Vertical Tail Parameters:

(C_L_α)_vs	0.111	(deg)^-1
l_vs	1.6855414	f
S_vs	0.5450992	f^2
Λ_vs	0	deg

Calculations

V_bar_vs	0.0259314		
(1+dσ/dβ)q/q	-3.887172	Eq[11.42]	
v. tail effect	-0.64107	Eq[11.40]	unstable
fuse. effect	-0.036691	Eq[11.44]	unstable
wing effect	0.0004593	Eq[11.43]	stable
C_n_β	**-0.677301**	unstable	
C_*L*_β	**0.6773012**	unstable	

Rudder Sizing

Input Parameters

δ_r	20	deg
β	10	deg
Asym. T	0	lbs
S_w	6.3843036	f^2
b	5.5497748	f
C_n_β	-0.677301	

diam_e	0.9	f	
V_T-O	22.778695	f/s	
rho_T-O	0.076474	lbm/f^3	

Calculations

1.2V_T-O	27.334434	f/s	
0.2V_T-O	4.555739	f/s	
q	0.8872543	lbs/f^2	
D_e	0.6773361	lbs	

C_n_δR:

Asy. Power	0.0617248	[rad]^-1	Eq[11.47]
Cross Wind	0.3386506	[rad]^-1	Eq[11.50]
dα_0L/dδ_r	2.2815903		Eq[11.51]
C_R/C_VS	10	%	Fig. 11.9