Wing Data:			
Airfoil	NACA	64x	
Λ_{LE}	0	deg	
λ	1.00		
t/c	0.12		
T-O Mach No.	0.01		
β	1.00		
A	7		
$\Lambda_{t/c}$	0.0	deg	
$C_{l\alpha}$ (no flap)	0.1	1/deg	
$C_{L\alpha}$ (no flap)	0.0827664	1/deg	
α_{0L}	-4	deg	
C_{lmax}	1.5		
α_s	15	deg	

Trailing-edge Flap Design:

Flap type	slot	plane	
S_f/S_w	*0.60*		
δ_f	*40*	deg	
c_f/c	*0.25*		

Delta α0L:

Plane Flap

K'	5.75		Fig. 9.3
$dC_l/d\delta_f$	*0.5*		Fig. 9.4
$\Delta\alpha_{0l}$	*-20.07129*	deg	

Single Slotted & Fowler Flap

$d\alpha/d\delta_f$	-0.4		Fig. 9.5
$\Delta\alpha_{0l}$	-16	deg	

Split Flaps

k	1.1		Fig. 9.6
ΔCl	0.8		Fig. 9.7
$\Delta\alpha_{0l}$	-8.8	deg	

Aspect Ratio Criterion:

C_1	0		Fig. 9.8
High A criteria	4.00	High	

Basic Wing -- High Aspect Ratio: .

Δy	0.8	%	Fig. 9.10
C_{Lmax}/C_{lmax}	1.3		Fig. 9.9
C_{Lmax}	1.95		
$\Delta\alpha_{CLmax}$	12.5	deg	Fig. 9.11
α_s	32.060272	deg	

Basic Wing -- Low Aspect Ratio:

(C1 + 1)…	7.00035		
$(C_{Lmax)base}$	1.2		Fig. 9.12
C_2	0		Fig. 9.14
(C2 + 1)…	0		
ΔC_{Lmax}	-0.015		Fig. 9.13

C_{Lmax}	1.185		
$(\alpha_{CLmax)base}$	34	deg	Fig. 9.15
A cos(…	21		
$\Delta\alpha_{CLmax}$	1	deg	Fig. 9.16
α_s	35	deg	

Effect of Trailing-edge Flap:

Flap type	slot	slot, plane or split	
α_{0l}	-20		
Basic 3-D α_s	32.060272	deg	
Basic 3-D C_L	1.95		
2–D $\Delta\alpha_s$	-2.5	deg	Fig. 9.18
2–D $\alpha_{s\ flapped}$	12.5	deg	
$(C_{lmax)\ flapped}$	3.25		
ΔC_{lmax}	1.75		
$K\Delta$	0.92		
ΔC_{Lmax}	0.966		
C_{Lmax}	2.916		
3-D $\alpha_{s\ flapped}$	29.560272	deg	

Leading-edge flap CL Max:

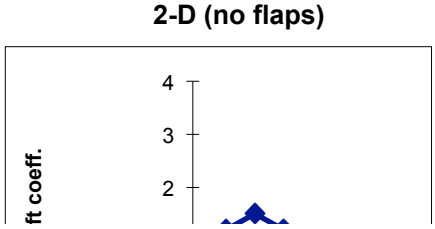
ΔC_{lmax}	0.3		Table 9.1
ΔC_{Lmax}	0.18		
C_{Lmax}	3.096		

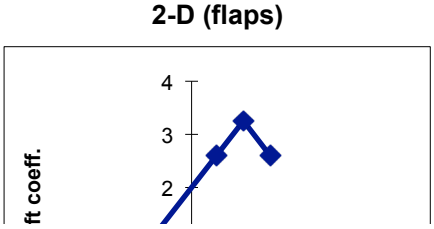
Trailing-edge flap Added drag:

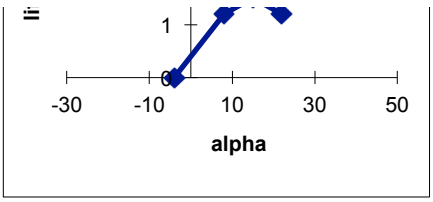
k_1	1.4		Fig. 9.20
k_2	0.075		Fig. 9.21
ΔC_{D0}	0.063		

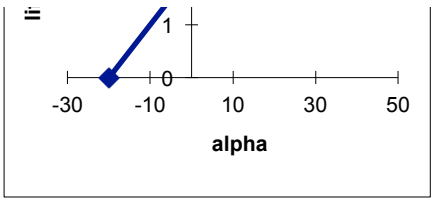
Lift Curve Plotting:

2-D (no flaps)		2-D (flaps)		3-D (no flaps)		3-D (fla
α	C_l	α	C_l	α	C_L	α
-4	0	-20	0	-4	0	-20
8	1.2	6	2.6	14.848218	1.56	8.1853346
15	1.5	12.5	3.25	32.060272	1.95	29.560272
22	1.2	19	2.6	49.272326	1.56	50.935209

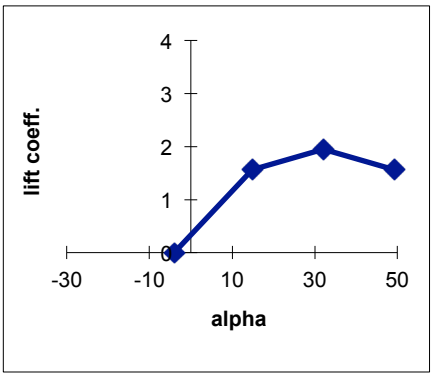




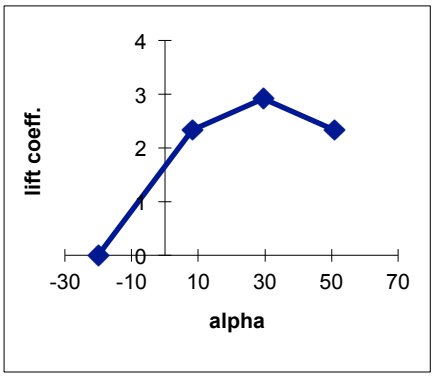




3-D (no flaps)



3-D (flaps)



aps)
C_L
0
2.3328
2.916
2.3328

Wing Weight

Fighter	*Transport*	*Gen. Av.*			
0.0103	0.0051	0.0360	**A**	7	
0.7680	1.0000	1.0000	**K_dw**	0.768	
1.0000	1.0000	1.0000	**K_vs**	1	
0.5000	0.5570	0.4900	**n**	2	
0.5000	0.5770	0.4900	**q**	2.2933098	lb/f^2
0.6220	0.6490	0.7580	**S_w**	6.3843036	f^2
0.7850	0.5000	0.6000	**(Sf/Sw)**	0.6	
-0.4000	-0.4000	-0.3000	S_f	3.8305822	f^2
1.0000	1.0000	0.0000	**t/c**	0.12	
0.0500	0.1000	0.0040	**W_dg**	5.4634459	lbs
-1.0000	-1.0000	0.3000	**W_fw**	0.10	lbs
0.0400	0.1000	0.0000	**Λ**	0	deg
0.0000	0.0000	0.0060	**λ**	1	
0.0000	0.0000	0.0035			

Fighter	0.97	lbs
Transport	0.49	lbs
Gen. Av.	2.87	lbs

Horizontal Tail Weight

Fighter	*Transport*	*Gen. Av.*			
0.5503	0.0379	0.0092	**A_ht**	5	
-2.0000	-0.2500	0.0000	**b_ht**	2.2061181	f
0.2600	0.6390	0.4140	**F_w**	6	f
0.2600	0.1000	0.4140	K_y	0.78	f
0.8060	0.7500	0.8960	**L_ht**	2.6	f
0.0000	-1.0000	0.0000	n	2	
0.0000	0.7040	0.0000	q	2.2933098	lbs/f^2
0.0000	-1.0000	0.0340	**S_ht**	1	f^2
0.0000	0.1160	0.0430	**(t/c)ht**	0.12	
0.0000	0.0000	-0.1200	W_dg	5.4634459	lbs
0.0000	0.0000	-0.0200	**(Λ)ht**	0	deg
0.0000	0.0000	0.1680	**(λ)ht**	1.00	

Fighter	0.07	lbs
Transport	0.03	lbs
Gen. Av.	0.04	lbs

Vertical Tail Weight

Fighter	*Transport*	*Gen. Av.*			
0.4520	0.0026	0.0076	**A_vt**	1.5	
1.0000	1.0000	0.2000	**H_ht**	0	f
0.5000	0.2250	1.0000	**H_vt**	0.9042393	f
0.4880	0.5560	0.3760	**K_z**	2.6	f
0.4880	0.5360	0.3760	**K_rht**	1	
0.7180	0.5000	0.8730	**L_vt**	2.6	f
0.3410	0.0000	0.0000	**M**	0.04	
-1.0000	-0.5000	0.0000	n	2	
0.3480	0.0000	0.0000	q	2.2933098	lbs/f^2

0.2230	0.3500	0.3570	**S_r/S_vt**	0.3	
1.0000	0.0000	0.0000	S_r	0.1635298	f^2
0.2500	0.0000	0.0390	**S_vt**	0.5450992	f^2
-0.3230	-1.0000	-0.2240	**(t/c)_vt**	0.04	
0.0000	-0.5000	-0.4900	W_dg	5.4634459	lbs
0.0000	0.8750	0.0000	**(Λ)vt**	0	deg
0.0000	0.0000	0.1220	**(λ)vt**	0.80	

Fighter	0.17	lbs
Transport	0.06	lbs
Gen. Av	0.07	lbs

Fuselage Weight

Fighter	*Transport*	*Gen. Av.*			
0.4990	0.3280	0.0520	**b_w**	5.5497748	f
1.0000	1.0000	1.0000	**D**	0.333	f
1.0000	1.0000	1.0000	K_ws	0	
0.3500	0.5000	0.1770	**K_dwf**	1	
0.2500	0.5000	0.1770	**K_door**	1	
0.5000	0.3500	-0.0720	**K_lg**	1	
0.0000	0.0000	-0.0510	**L_f**	2.997	f
0.8490	-0.1000	0.0720	L_t	2.6	f
0.0000	0.3020	1.0860	n	2	
0.6850	0.0000	0.0000	q	2.2933098	
0.0000	0.0400	0.0000	**S_f**	2	f^2
0.0000	0.0000	0.2410	S_vt	0.5450992	f^2
0.0000	0.0000	11.9000	**W_f**	0.333	f
			V_pr	0	f^3
			W_p	11.9	
			W_dg	5.4634459	lbs
			Λ	0	deg
			λ	1	

Fighter	0.34	lbs
Transport	2.19	lbs
Gen. Av	12.07	lbs

Main Landing Gear Weight

Fighter	*Transport*	*Gen. Av.*			
1.0000	0.0106	0.0344	**K_cb**	1	
1.0000	1.0000	1.0000	**K_mp**	1	
1.0000	1.0000	1.0000	**K_tpg**	1	
0.2500	0.8880	0.7680	**L_m**	0	in
0.2500	0.2500	0.7680	n	2	
0.9730	0.4000	0.4090	**N_mw**	1	wheels
0.0000	0.3210	0.0000	**N_mss**	1	struts
0.0000	-0.5000	0.0000	**V_s**	10	f/s
0.0000	0.1000	0.0000	**W_l**	5	lbs

Fighter	0
Transport	0

Gen. Av.	0

Nose Landing Gear Weight

Fighter	*Transport*	*Gen. Av.*			
1.0000	0.0320	1.0000	**K_np**	1	
1.0000	1.0000	0.0153	**L_n**	0	in
0.2900	0.6460	0.5660	n	2	
0.2900	0.2000	0.5660	**N_nw**	2	wheels
0.5000	0.5000	0.8450	W_l	5.1853784	lbs
0.5250	0.4500	0.0000			

Fighter	0.00	lbs
Transport	0.00	lbs
Gen. Av.	0.00	lbs

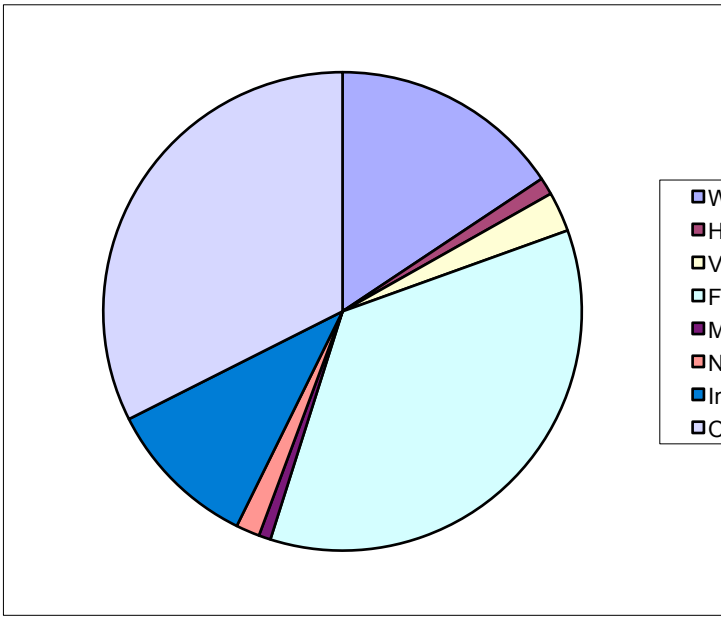
Summary

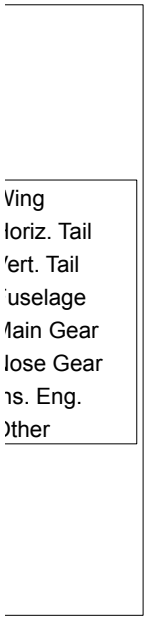
	Fighter	Transport	Gen. Av.
Wing	0.97	0.49	2.87
Horiz. Tail	0.07	0.03	0.04
Vert. Tail	0.17	0.06	0.07
Fuselage	0.34	2.19	12.07
Main Gear	0	0	0
Nose Gear	0.00	0.00	0.00
Total	1.56	2.78	15.04

Case Study

Wstr	2	lbs

Parts	**Weights**	**W/Wstr**	
Wing	0.97	44.546368	%
Horiz. Tail	0.07	3.3160702	%
Vert. Tail	0.17	7.6604708	%
Fuselage	2.20	100.66907	%
Main Gear	0.05	2.2879333	%
Nose Gear	0.10	4.5758667	%
Ins. Eng.	0.64	29.253516	%
Total		**192.30929**	%
Other	-2.02	-92.30929	%
Target	0.93	42.5	%




Wing
Horiz. Tail
Vert. Tail
Fuselage
Main Gear
Nose Gear
Pns. Eng.
Other

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