

6.7 Effect of flaps on take-off ground run (Secs. 6.7.2 and 6.7.3)

$$\bar{h} = 3.34 - 1.31 \sin \delta_F \quad b_w = 34.4 \text{ ft}$$

$$A_W = 5.10 \cdot 0.00211 - 0.0003(A_W - 3) = 0.001507$$

$$G_D = 1.111 + 5.55 \frac{\bar{h}}{b_w} - \left[29.8 \left(\frac{\bar{h}}{b_w} + 0.02 \right)^2 + 0.817 \right]^{1/2}$$

$$G_L = 1.0 + 0.001507 \exp \left[5.2 \left(1 - \frac{\bar{h}}{b_w} \right) \right]$$

δ_F (deg)	\bar{h}/b_w	G_D	G_L
0	.0971	.5428	1.162
10	.0905	.5266	1.1676
20	.08406	.5100	1.173
30	.0781	.4937	1.179
40	.0726	.4783	1.184

$$C_L = G_L C_{L\alpha} (\alpha - \alpha_{0L}) + \Delta C_{LF} \quad C_{L\alpha} = (C_{L\alpha})_{M=0}$$

$$4.08 \quad 0 - \frac{-1.5}{57.3} + \Delta C_{LF}$$

δ_F (deg)	ΔC_{LF}	$G_L C_{L\alpha} (\alpha - \alpha_{0L})$	C_L
0	0	.1241	.1241
10	.1732	.1247	.2979
20	.2941	.1253	.4194
30	.3586	.1259	.4845
40	.3908	.1264	.5172

$$C_D = C_{D0} + \Delta C_{D2g} + \Delta C_{DF} + G_D \frac{K}{f} (C_L - \Delta C_{LF})^2$$

$$.023 \quad .02746$$

δ_F (deg)	ΔC_{DF}	$.05046 + \Delta C_{DF}$	f	$G_D \frac{K}{f} ()^2$	C_D	$C_D - \mu C_L$
0	0	.05046	1	.0006103	.0511	.0486
10	.00553	.05599	1	.0005978	.0566	.0506
20	.01106	.06152	.98	.0005965	.0621	.05371
30	.01659	.06705	.93	.0006143	.0677	.0580
40	.02211	.07671	.84	.0006647	.0732	.0629

6.7 Cont'd

$$V_{LO} = 1.2 \sqrt{\frac{2W}{\rho S C_{Lmax}}} = \frac{260.6}{\sqrt{C_{Lmax}}}$$

δ_F (deg)	C_{Lmax}	V_{LO} (ft/s)
0	1.157	242.2
10	1.289	229.5
20	1.451	216.3
30	1.516	211.6
40	1.548	209.4

$$X_f = - \frac{W}{\rho g S (C_D - \mu C_L)} \ln \left[1 - \frac{\rho S (C_D - \mu C_L) V_{LO}^2}{2(T - \mu W)} \right]$$

$$X_f = - \frac{732.1}{C_D - \mu C_L} \ln \left[1 - 5.022 E-5 (C_D - \mu C_L) V_{LO}^2 \right]$$

δ_F (deg)	\ln	$-\frac{732.1}{C_D - \mu C_L}$	X_f (ft)	Change from previous value (ft)
0	-.1545	-15,067	2,329	
10	-.1438	-14,460	2,079	250
20	-.1350	-13,626	1,839	240
30	-.1397	-12,628	1,764	75
40	-.1491	-11,641	1,736	28

$\delta_F = 20$ deg: There is a big change between $\delta_F = 0$ deg and $\delta_F = 20$ deg (490) but not much change after. $\delta_F = 20$ deg would enable the pilot to get the flaps up quicker after leaving the ground.