$C_{l_{\delta a}}$

Summary

$Y_1 = 14\ in$

$Y_2 = 30\ in$

$S = 668.36\ in^2$

$b = 72.5\ in$

$\lambda = 0.5445$

$C_r = 11.9375\ in$

Mach #	C_{L_α}
0	4.874/rad
0.029	4.876/rad
0.04408	4.878/rad
0.05878	4.881/rad
0.07348	4.884/rad
0.08817	4.889/rad

Mach	$C_{l_{\delta a}}$
0	0.3255/rad
0.029	0.3256/rad
0.04408	0.3258/rad
0.05878	0.3260/rad
0.07348	0.3261/rad
0.08817	0.3265/rad

$$\frac{C_{aileron}}{C_{wing\ @\ aileron}} = \frac{2\ in}{10.5\ in} = 0.19047 \rightarrow \tau = 0.395$$

@ Mach = 0

$$C_{l_{\delta a}} = \frac{2\,C_{L_\alpha}}{S\,b}\,\tau\,C_r \int_{Y_1}^{Y_2} \left[\left(Y + \left(\frac{\lambda - 1}{b/2}\right)Y^2\right)\right] dy$$

$$C_{l_{\delta a}} = \frac{2\,(4.874/rad)}{(668.36in^2)(72.5in)}(0.395)(11.9375)\left[\left(\frac{(30)^2}{2} + \left(\frac{0.5445-1}{36.25}\right)(30)^2\right) - \left(\frac{(14)^2}{2} + \left(\frac{0.5445-1}{36.25}\right)(14)^2\right)\right]$$

$$C_{l_{\delta a}} = (0.000948588)(343.1539)$$

$$\boxed{C_{l_{\delta a}} = 0.3255/rad}$$

$C_{m_{\delta e}}$

@ Mach = 0

$$C_{m_{\delta e}} = -\eta \bar{V} \tau_e C_{L_{\alpha_t}}$$

Summary

$\bar{V} = 0.72106$

$\eta = 0.85$

$C_{elevator} = 2.45in$

$C_{wing\ @\ elevator} = 7in$

$$C_{m_{\delta e}} = -(0.85)(0.72106)(0.58)(4.012)$$

$$C_{m_{\delta e}} = -1.426/rad$$

Mach	$C_{L_{\alpha,t}}$
0	4.012 /rad
0.029	4.012/rad
0.04408	4.014/rad
0.05878	4.016/rad
0.07348	4.018/rad
0.08817	4.021/rad

Mach	$C_{m_{\delta e}}$
0	-1.426 /rad
0.029	-1.426 /rad
0.04408	-1.427 /rad
0.05878	-1.428 /rad
0.07348	-1.4283 /rad
0.08817	-1.4294/rad

$$\frac{C_{elevator}}{C_{wing\ @\ elevator}} = \frac{2.45}{7} = 0.35$$

$\tau_e = 0.58$

$C_{n_{\delta r}}$

Summary

$C_{L_{\alpha,v}} = 1.61375/rad$ @ mach 0

$K = 0.8$

$\bar{c}_{wing\,@\,rudder} = 8.0\,in$

$\bar{c}_{rudder} = 3.0\,in$

$\frac{C_{rudder}}{C_{wing\,@\,rudder}} = \frac{3}{8} = 0.375$

$\eta_v = 0.9$

$\tau = 0.59$

$\bar{V}_v = 0.0304106$

Mach #	$C_{L_{\alpha,v}}$
0	1.61375/rad
0.029	1.61375/rad
0.04408	1.614409283/rad
0.05878	1.615326105/rad
0.07348	1.616508207/rad
0.08817	1.617955863/rad

@ $M = 0.029$

$$C_{n_{\delta r}} = -K\, C_{L_{\alpha,v}}\, \tau\, \eta_v\, \bar{V}_v$$

$$C_{n_{\delta r}} = -(0.8)(1.61375)(0.59)(0.9)(0.0304106)$$

$C_{n_{\delta r}} = -0.020847/rad$

Mach	$C_{n_{\delta r}}$
0.029	1.61375/rad
0.04408	-0.020855622/rad
0.05878	-0.020867466/rad
0.07348	-0.020882737/rad
0.08817	-0.020901438/rad