空气动力学 HW5

4.10

解:

At $\alpha = -6°$, $C_l = -0.39$, $C_{m.\frac{c}{4}} = -0.045$

$\alpha = 4°$, $C_l = 0.65$, $C_{m.\frac{c}{4}} = -0.037$

$$\frac{dC_{m.\frac{c}{4}}}{d\alpha} = \frac{-0.037+0.045}{4+6}$$

$$\frac{dC_l}{d\alpha} = \frac{0.65+0.39}{4+6}$$

$$\frac{X_{ac}}{C} = -\frac{\frac{dC_{m.\frac{c}{4}}}{d\alpha}}{\frac{dC_l}{d\alpha}} = \frac{0.037-0.045}{0.65+0.39} = -\frac{1}{130}$$

$\therefore X_{ac} = -\frac{1}{130}C$, $\bar{X}_{ac}C = 0.25C - \frac{1}{130}C$

$= 0.2423C$

the location of AC point is $0.2423C$ from the leading edge. ANS

4.11

解: $L' = C_l \frac{1}{2}\rho_\infty V_\infty^2 \cdot C = 0.65 \times \frac{1}{2} \times 0.90926 \times 60^2 \times 2$

$\rho_\infty = 0.90926\ kg/m^3$

$= 2127.7\ N$ ANS

4.12

解: $T = \frac{L'}{\rho_\infty V_\infty}$

$= \frac{2127.7}{0.90926 \times 60}$

$= 39\ m^2 \cdot s$ ANS

4.13

解：

有升力圆柱绕流

$$\psi = V_\infty r \sin\theta \left(1 - \frac{R^2}{r^2}\right) + \frac{\Gamma}{2\pi} \ln\frac{r}{R}$$

$$V_r = \frac{1}{r}\frac{\partial\psi}{\partial\theta} = V_\infty\left(1 - \frac{R^2}{r^2}\right)\cdot\cos\theta$$

$$V_\theta = \frac{-\partial\psi}{\partial r} = -V_\infty \sin\theta\left(1 + \frac{R^2}{r^2}\right) - \frac{\Gamma}{2\pi r}$$

At the surface

$$V_r = 0$$

$$V_\theta = -2V_\infty \sin\theta - \frac{\Gamma}{2\pi R} = Rw$$

$$\therefore w = \frac{-2V_\infty \sin\theta - \frac{\Gamma}{2\pi R}}{R}$$

$$\Gamma = \frac{L'}{\rho_\infty V_\infty} = 39\ m^2\cdot s$$

取 $\theta = 90°$

$$w = \frac{-2\times 60 - \frac{39}{2\pi}}{1} = -126.2\ rad/s$$

4.14

解: $\alpha_{L=0} = -3^0$, $a_0 = 0.1 /^0$

a) $C_L = a_0(\alpha - \alpha_{L=0}) = 0.1 \times (5+3) = 0.8$ ANS

b) upside down.

$\alpha'_{L=0} = 3^0$

$C_L' = a_0(\alpha - \alpha'_{L=0}) = 0.1 \times (5-3) = 0.2$ ANS

c) same lift

same C_L.

$$a_0 = \frac{C_L}{\alpha - \alpha_{L=0}'}$$

$$\alpha = \alpha'_{L=0} + \frac{C_L}{a_0}$$

$$= 3^0 + \frac{0.8}{0.1} = 11^0$$ ANS