Home Work #2

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Question 1

Data:

$$\bar{x}_{ac} - \bar{x}_{cg} = 0.05, \quad C_{m_{ac_{wb}}} = -0.016, \quad C_{L_{wb}} = 0.45$$

$$C_m = C_{m_{ac_{wb}}} + C_{L_{wb}}(\bar{x}_{ac} - \bar{x}_{cg}) \tag{1}$$

From equation 1 we have:

$$C_m = -0.016 + 0.45(0.05) = 0.0065 \rightarrow C_m = 0.0065$$

Question 2

(a)

We assume that C_L have linear beheaver between $-1.5°$ and $8°$.

At (-1.5) degree C_L is 0 and at 5 degree C_L is 0.52.

$$\frac{\Delta C_L}{\Delta \alpha} = C_{L_\alpha} \rightarrow C_{L_\alpha} = \frac{0.52 - 0.0}{5 - (-1.5)} = 0.08$$

$$C_L = C_{L_0} + C_{L_\alpha}\alpha = 0.12 + 0.08\alpha \tag{2}$$

From equation 2 at 1 degree angle of attack $C_L = 0.2$ and at 7.88 degree angle of attack $C_L = 0.75$.

$$C_m = C_{m_0} + C_{m_\alpha}\alpha \tag{3}$$

$$C_{m_{wb}} = (C_{m_{ac_{wb}}} + C_{L_{0_{wb}}}(\bar{x}_{cg} - \bar{x}_{ac_{wb}})) + C_{L_{\alpha_{wb}}}(\bar{x}_{cg} - \bar{x}_{ac_{wb}}) \tag{4}$$

From equation 4:

1. at 1 degree angle of attack:

$$-0.01 = C_{m_{ac_{wb}}} + 0.2(0.35 - \bar{x}_{ac_{wb}})$$

2. at 7.88 degree angle of attack:

$$0.05 = C_{m_{ac_{wb}}} + 0.75(0.35 - \bar{x}_{ac_{wb}})$$

There is 2 equation and 2 unknowns.

$$x_{ac_{wb}} = 0.24, \quad C_{m_{ac_{wb}}} = -0.032$$