KRILA

1. Avion ima eliptična krila površine 20 m^2 i raspona 10 m izrađena od ravne ploče. Promatra se let na visini 2000 m brzinom 400 km/h pod geometrijskim napadnim kutom od 4^o. Odrediti:
   a) kako se mijenja kut inducirane brzine za eliptično krilo,
   b) silu uzgona,
   c) silu otpora,
   d) snagu potrebnu za savladavanje induciranog otpora.

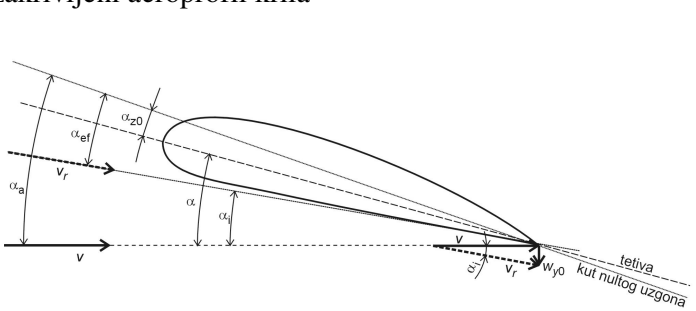
Napomena: smatrati da su lokalne vrijednosti koeficijenta uzgona za aeroprofil u obliku ravne ploče jednake idealnoj vrijednosti: $c_z = 2 \cdot \pi \cdot \alpha$.

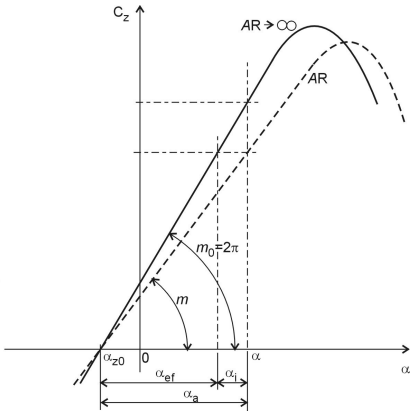
Rješenje: $H = 2000$ m $\rightarrow$ $\rho = 1{,}00646$ kg/m^3

$v = 400$ km/h = 111,1 m/s

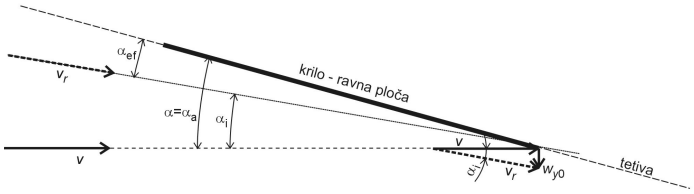
$S = 20$ m^2; $b = 10$ m $\rightarrow$ $AR = \frac{b^2}{S} = \frac{10^2}{20} = 5$

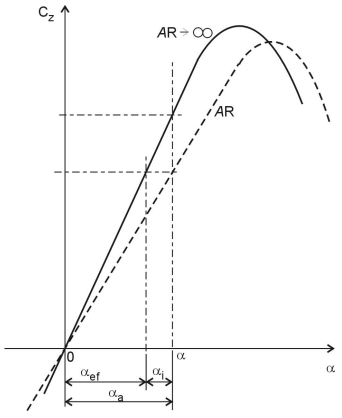
– zakrivljeni aeroprofil krila





– simetrični profil krila





a) $AR \rightarrow \infty$ $\rightarrow$ $c_z = m_0 \cdot \alpha_a = 2 \cdot \pi \cdot \alpha_a$ ($m_0 = 2 \cdot \pi$)

AR $\rightarrow$ $m = \frac{m_0}{1 + \frac{m_0}{\pi \cdot AR}} = \frac{2 \cdot \pi}{1 + \frac{2 \cdot \pi}{\pi \cdot AR}} = \frac{2 \cdot \pi \cdot AR}{2 + AR} = \frac{2 \cdot \pi \cdot 5}{2 + 5} = 4{,}488$

$$C_z = m \cdot \alpha_a = 4{,}488 \cdot \alpha_a$$

$$\alpha_i = \frac{C_z}{\pi \cdot AR} = \frac{4{,}488 \cdot \alpha_a}{\pi \cdot 5} = 0{,}2857 \cdot \alpha_a$$

b) $\alpha_a = \alpha = 4^o = 4 \cdot \frac{\pi}{180}$ rad

$$C_z = 4{,}488 \cdot \alpha_a = 4{,}488 \cdot 4 \cdot \frac{\pi}{180} = 0{,}3133$$

$$Z = C_z \cdot \frac{1}{2} \cdot \rho \cdot v^2 \cdot S = 0{,}3133 \cdot \frac{1}{2} \cdot 1{,}00646 \cdot 111{,}1^2 \cdot 20 = 38929 \text{ N}$$

c) $C_{xi} = \frac{C_z^2}{\pi \cdot AR} \cdot (1 + \delta) = \frac{C_z^2}{\pi \cdot e \cdot AR}$

$e = \frac{1}{1+\delta}$ - Oswaldov koeficijent (za eliptično krilo: $e = 1;\ \delta = 0$)

$$C_{xi} = \frac{C_z^2}{\pi \cdot AR} = \frac{0{,}3133^2}{\pi \cdot 5} = 0{,}00625$$

$$X_i = C_{xi} \cdot \frac{1}{2} \cdot \rho \cdot v^2 \cdot S = 0{,}00625 \cdot \frac{1}{2} \cdot 1{,}00646 \cdot 111{,}1^2 \cdot 20 = 776{,}4 \text{ N}$$

d) $P_i = X_i \cdot v = 776{,}4 \cdot 111{,}1 = 86272 \text{ W} \approx 86{,}3 \text{ kW}$

<u>II način:</u> $\alpha_i = 0{,}2857 \cdot \alpha_a = 0{,}2857 \cdot 4 = 1{,}1428^o$

$$\alpha_{ef} = \alpha_a - \alpha_i = 4 - 1{,}1428 = 2{,}8572^o$$

$$C_z = m_0 \cdot \alpha_{ef} = 2 \cdot \pi \cdot 2{,}8572 \cdot \frac{\pi}{180} = 0{,}3133$$