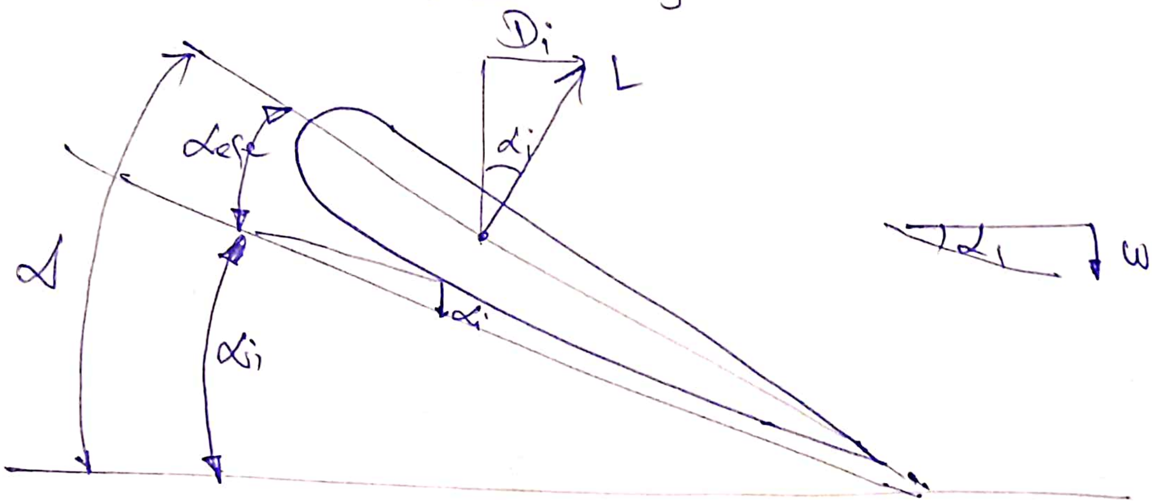
* Calculations for induced Drag:-



α – Geometric angle of attack

α_i – Induced angle of attack.

α_{eff} - effective angle of attack . $\alpha_{eff} = \alpha - \alpha_i$

$\therefore D_i = L \sin\alpha_i$ $\sin\alpha_i \approx \alpha_i$

$D_i = L\alpha_i$

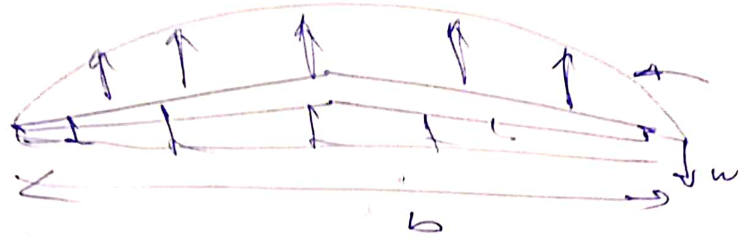
$L = \frac{1}{2}\rho V^2 S C_L$, $D = \frac{1}{2}\rho V_\infty^2 S C_D$

$D_i = \frac{1}{2}\rho V_\infty^2 S C_{Di}$

$\therefore C_{Di} =$

$\frac{1}{2}\rho V_\infty^2 S C_{Di} = \frac{1}{2}\rho V_\infty^2 S C_L \times \alpha_i$

$C_{Di} = C_L \alpha_i$



$\alpha_i = \frac{C_L}{\pi AR}$

$AR = \frac{b^2}{S}$.

properties of a wing with elliptical lift distribution.

* Same airfoil shape
* no twist
* an elliptical wing planform.

Exp: British spitfire ww-II.

$\alpha_i = \frac{C_L}{\pi AR e'}$

e' = span efficiency factor

e' = 1 → elliptical.

e' < 1 other (0.85 – 0.95)

$\therefore C_{Di} = C_L . \alpha_i$

$C_{Di} = C_L \times \frac{C_L}{\pi AR e'}$

$C_{Di} = \frac{C_L^2}{\pi AR e'}$.

$\therefore C_{Di} \propto C_L^2$ ✓

$C_{Di} \propto \frac{1}{AR}$ ✓