Centrifugal Compressors

→ Slip factor (ϕ_s or σ) = $\frac{C_{w_2}}{C_{bl_2}}$

→ Actual Work input to the compressor = $\frac{\phi_w \phi_s C_{bl_2}^2}{1000}$

where ϕ_w (or ψ) → work input ratio.

→ Actual work ~~ratio~~ input., = $C_p(T_2 - T_1) = C_p(T_{02} - T_{01})$

→ $\frac{\phi_w \phi_s C_{bl_2}^2}{1000} = \frac{C_p T_1}{\eta_{isen}} \left[r_p^{\frac{\gamma-1}{\gamma}} - 1 \right]$

→ $T_{01} = T_1 + \frac{C_1^2}{2C_p}$

→ Pressure Coeffecients, $\phi_p = \frac{C_p(T_{02s} - T_{01})}{C_{w_2} C_{bl_2}}$

→ $\dot{V} = 2\pi r_1 b_1 C_{f_1} K_b = 2\pi r_2 b_2 C_{f_2} K_b$

where K_b = blade area coeffecient.

→ $W_{in} = C_{w_2} C_{bl_2} - C_{w_1} C_{bl_1}$

→ To determine the Eye diameter

$\dot{m} = \frac{\pi}{4}(d_h^2 - d_e^2) C_{a_1} \rho$; $\dot{V} = \frac{\pi}{4}(d_h^2 - d_e^2) \times C_{f_b}$

→ Axial thrust = $\dot{m}(C_{f_1} - C_{f_2})$

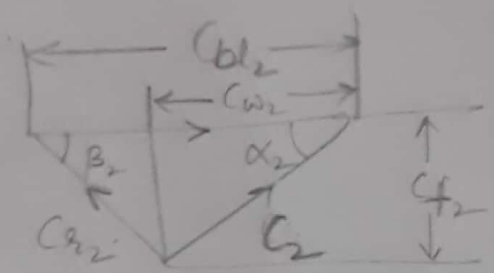
Impeller blade angle, β_1 at the inlet — $\tan\beta_1 = \frac{C_{f_1}}{C_{b_1}}$

Diffuser blade angle, α_2 at the inlet — $\tan\alpha_2 = \frac{C_{f_2}}{C_{w_2}}$ ← $(\phi_s C_{b_2})$

Impeller blade angle at, β_2 the outlet — $\tan\beta_2 = \frac{C_{f_2}}{C_{b_2} - C_{w_2}}$

$$\tan\alpha_2 = \frac{C_{f_2}}{C_{w_2}}$$

$$\tan\beta_2 = \frac{C_{f_2}}{C_{bl_2} - C_{w_2}}$$



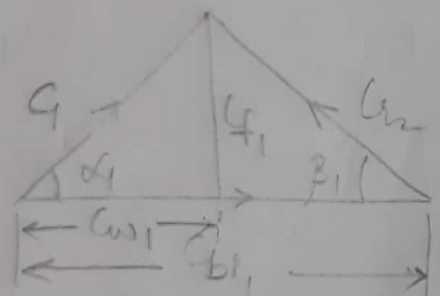
Outlet velocity Δ^{le}

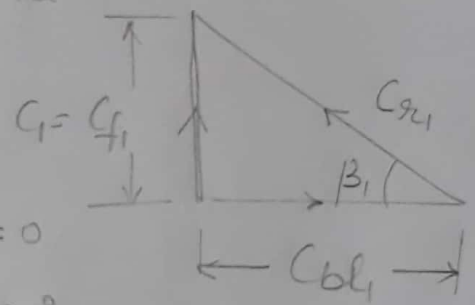
$C_{w_2} < C_{bl_2}$.

$\beta < 90°$

$\beta_1 \rightarrow$ Impeller blade angle at inlet

$\alpha_1 \rightarrow$ Diffuser " "





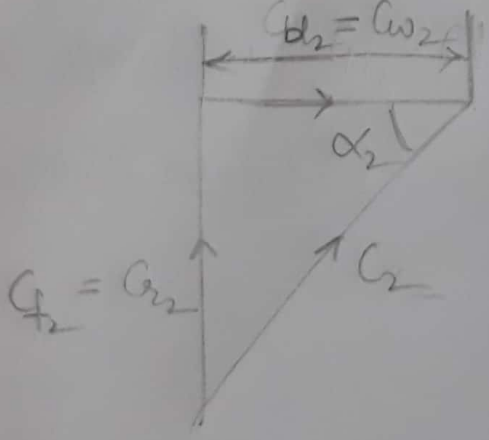
Inlet velocity Δ^{le}

$C_{w_1} = 0$

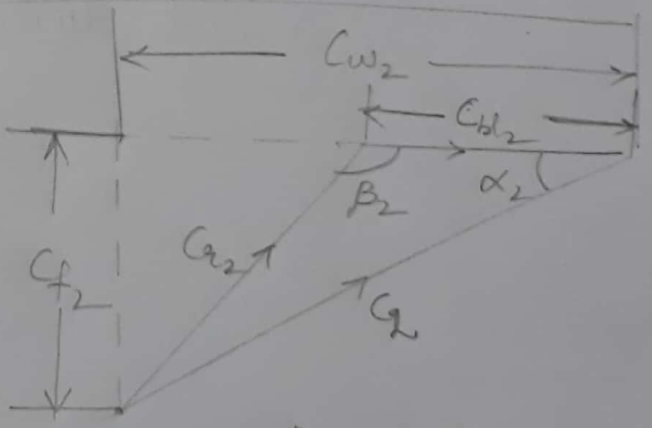
$\alpha_1 = 90°$

No pre whirl.

with pre-whirl..



$\beta_2 = 90°$



$\beta_2 > 90°$

$C_{w_2} > C_{bl_2}$.

tan