LEZIONE 7-8

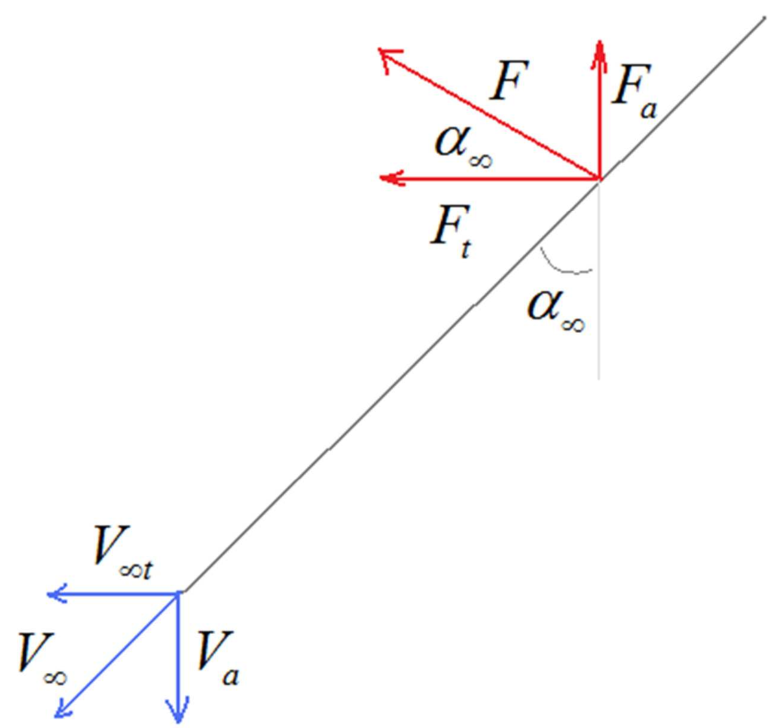
3

Schiere di pale

$\Delta p_0 = 0$ ipotesi perdite nulle

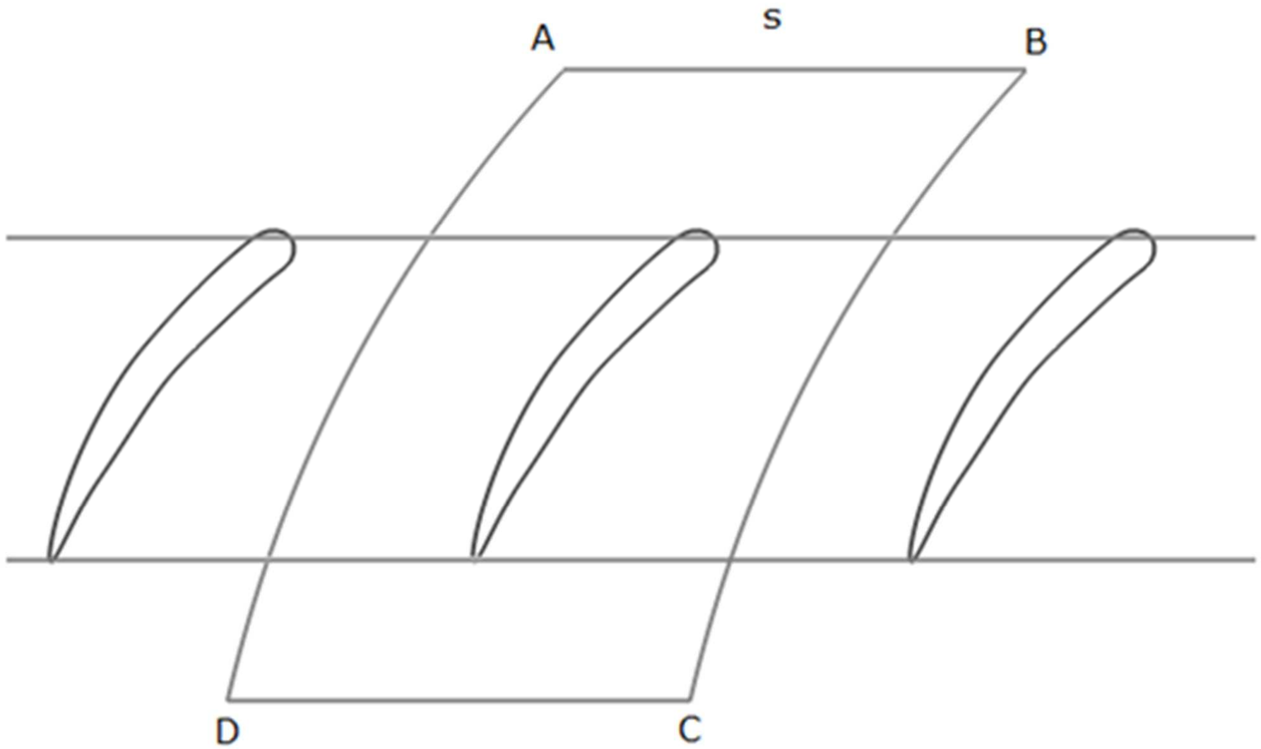
$$F_a = s\rho V_{\infty t}\left(V_{2t} - V_{1t}\right)$$
$$F_t = s\rho V_a\left(V_{1t} - V_{2t}\right)$$

$$\frac{V_{\infty t}}{V_a} = -\frac{F_a}{F_t} = \tan\alpha_\infty$$



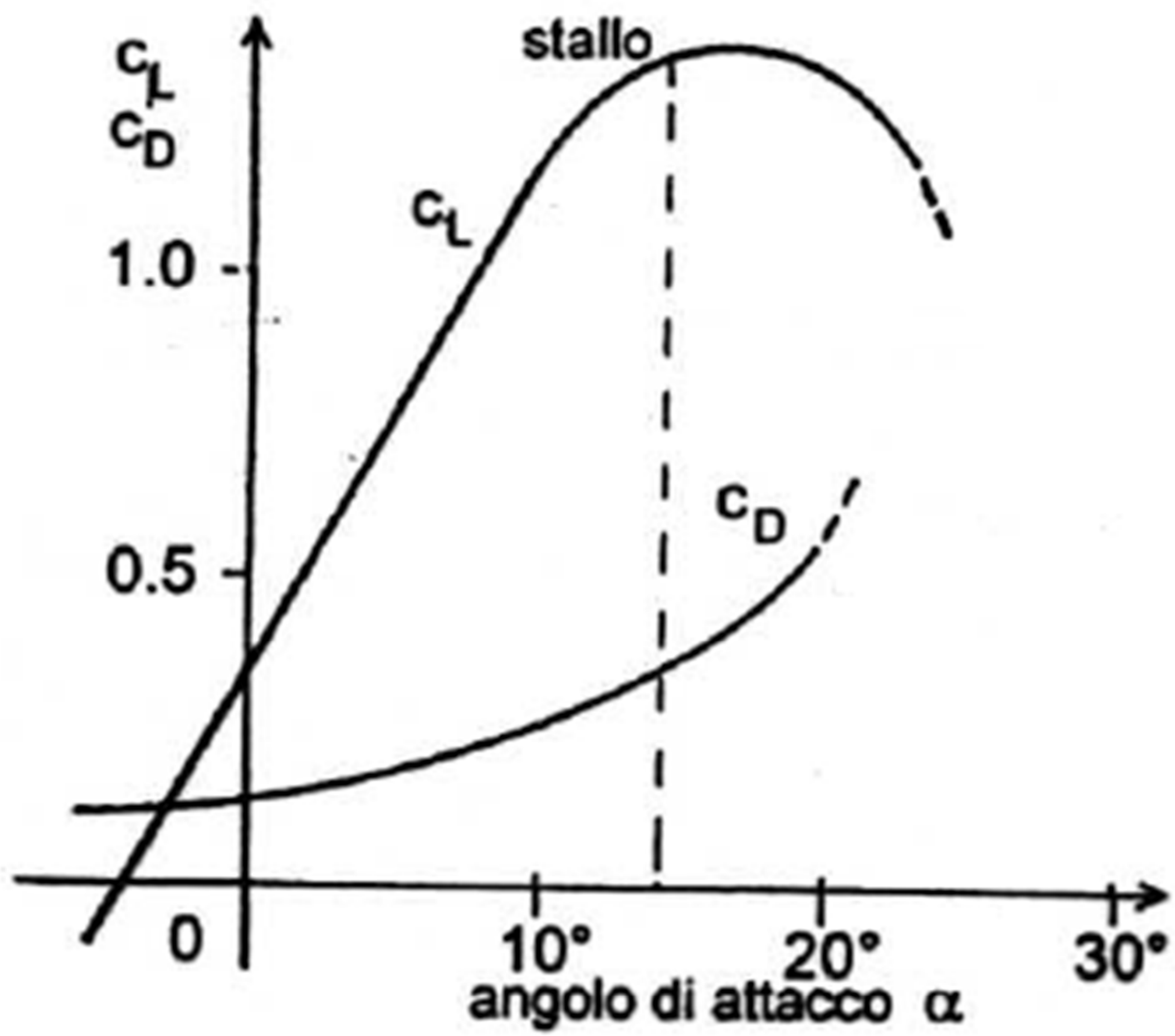
$$F = \frac{F_t}{\cos\alpha_\infty} = \rho\frac{V_a}{\cos\alpha_\infty}s\left(V_{1t} - V_{2t}\right) = \rho V_\infty s\left(V_{1t} - V_{2t}\right) = L$$

Schiere di pale

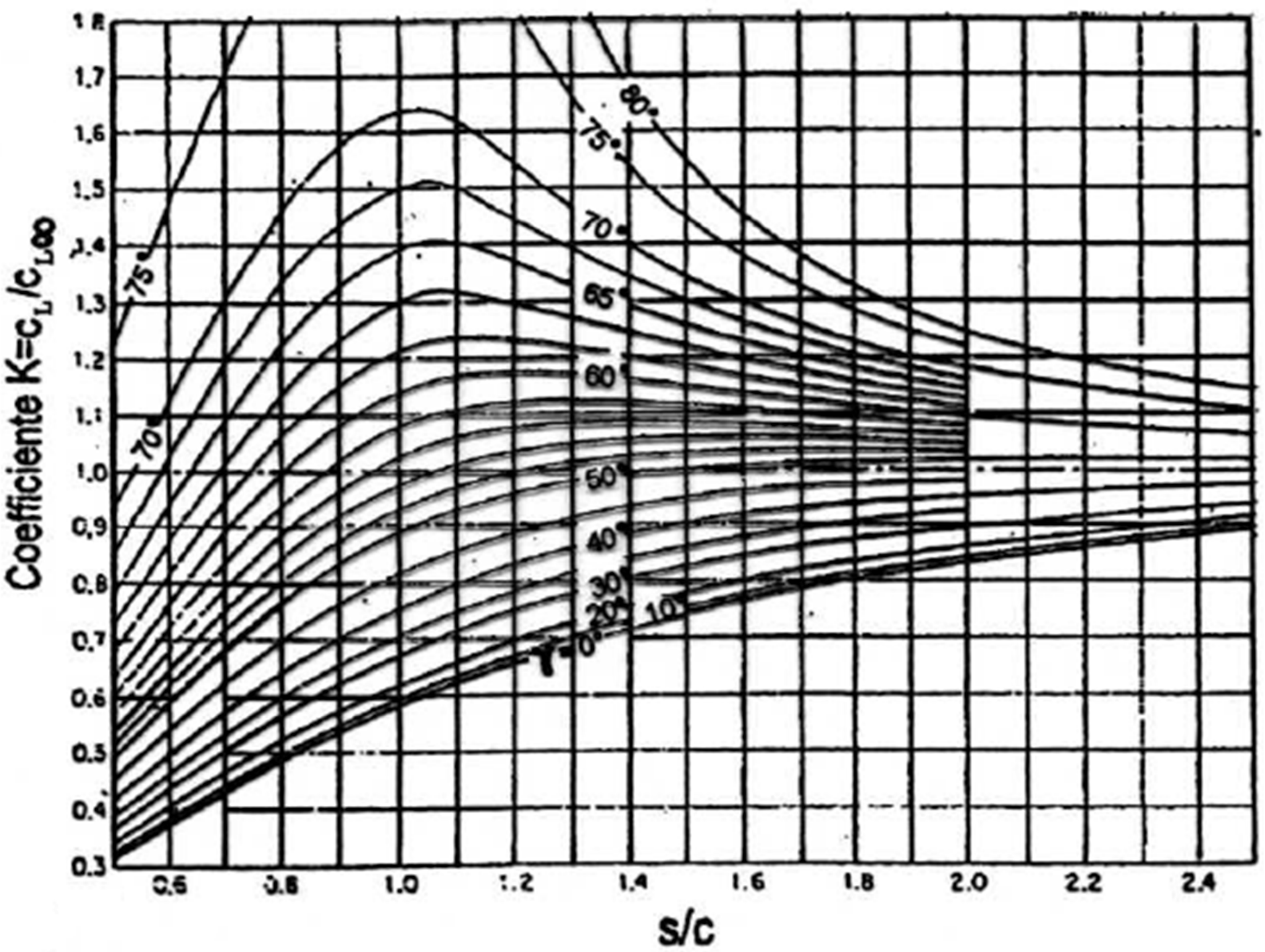


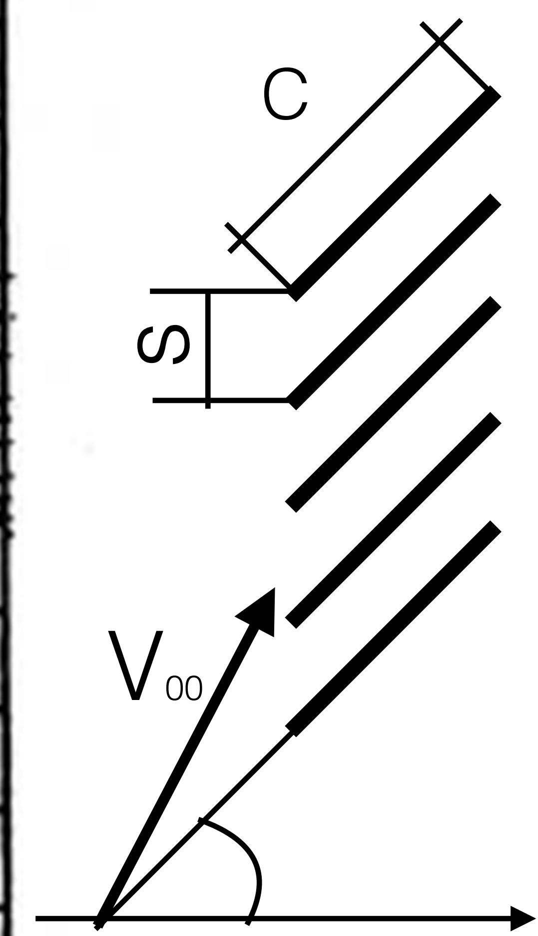
$$\Gamma = s\left(V_{1t} - V_{2t}\right) \quad \rightarrow \quad L = \rho V_{\infty}\Gamma$$

Effetto schiera sulle prestazioni del profilo



Effetto schiera sulle prestazioni del profilo





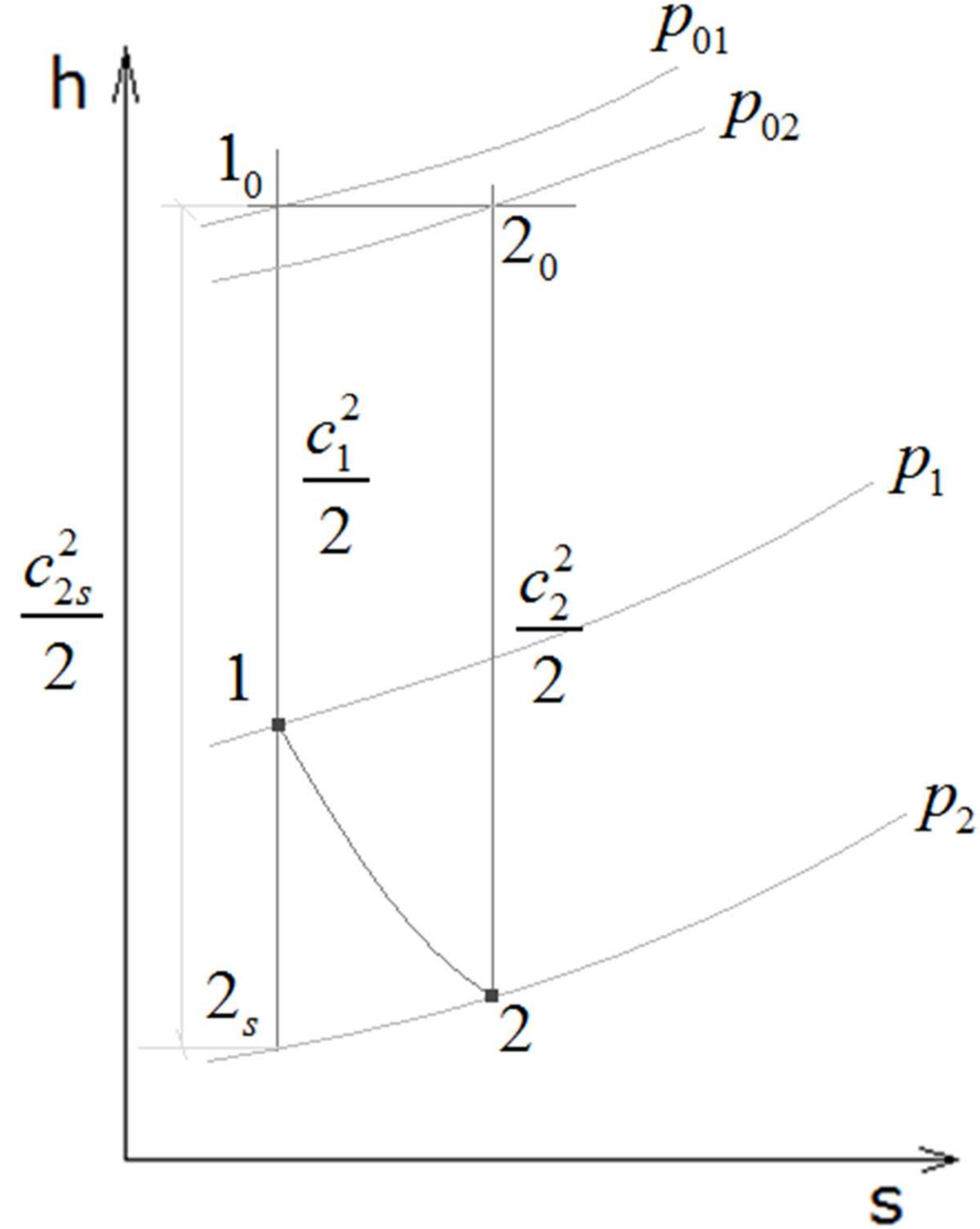
ugelli e diffusori

Distinguiamo due casi:

1) Nell’elemento abbiamo un incremento di velocità a spese di una riduzione di pressione. Questi saranno gli *ugelli*.
2) Nell’elemento l’energia cinetica diminuisce ed aumenta la pressione. Questi saranno i *diffusori*.

ugelli

$$\eta_{is} = \frac{h_1 - h_2}{h_1 - h_{2s}} = \frac{\dfrac{c_2^2}{2} - \dfrac{c_1^2}{2}}{\dfrac{c_{2s}^2}{2} - \dfrac{c_1^2}{2}} = \frac{c_2^2 - c_1^2}{c_{2s}^2 - c_1^2}$$



ugelli

(Ma<0,3)

$$p_{01} = p_1 + \frac{1}{2}\rho c_1^2 \quad \rightarrow \quad c_1^2 = \frac{2}{\rho}\left(p_{01} - p_1\right)$$

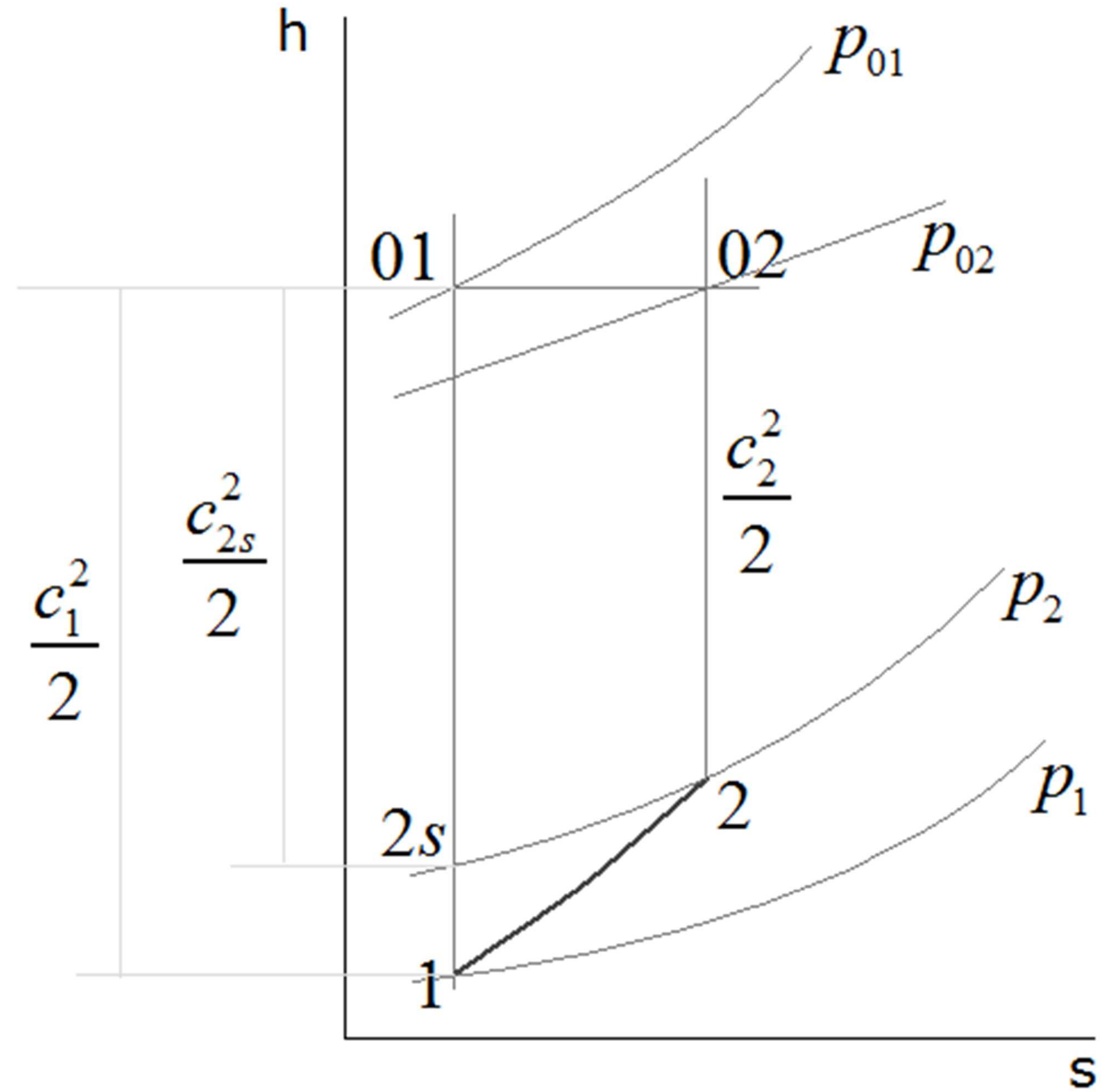
$$p_{01} = p_2 + \frac{1}{2}\rho c_{2s}^2 \quad \rightarrow \quad c_{2s}^2 = \frac{2}{\rho}\left(p_{01} - p_2\right)$$

$$p_{02} = p_2 + \frac{1}{2}\rho c_2^2 \quad \rightarrow \quad c_2^2 = \frac{2}{\rho}\left(p_{02} - p_2\right)$$

$$\eta_{is} = \frac{p_{02} - p_2 - \left(p_{01} - p_1\right)}{\cancel{p_{01}} - p_2 - \left(\cancel{p_{01}} - p_1\right)} = \frac{p_{02} - p_2 - \left(p_{01} - p_1\right)}{p_1 - p_2} = 1 - \frac{\Delta p_0}{p_1 - p_2}$$

Diffusori

$$\eta_{is} = \frac{h_{2s} - h_1}{h_2 - h_1} = \frac{c_1^2 - c_{2s}^2}{c_1^2 - c_2^2}$$



Diffusori

(Ma<0,3)

$$\eta_{is} = \frac{p_{01} - p_1 - \left(p_{01} - p_2\right)}{p_{01} - p_1 - \left(p_{02} - p_2\right)} = \frac{p_2 - p_1}{p_2 - p_1 + \left(p_{01} - p_{02}\right)} = \frac{1}{1 - \frac{\Delta p_0}{p_2 - p_1}}$$

coeff. recupero di pressione: $c_p = \dfrac{p_2 - p_1}{p_{01} - p_1}$

Diffusori

(Ma<0,3)

Legame tra c_p e η_{is}

$$\eta_{is} = \frac{p_2 - p_1}{p_2 - p_1 + \left(p_{01} - p_{02}\right)}$$

$$\frac{1}{\eta_{is}} = \frac{p_2 - p_1 + \left(p_{01} - p_{02}\right)}{p_2 - p_1} = \frac{p_{01} - p_1 - \left(p_{02} - p_2\right)}{p_2 - p_1} = \frac{1}{c_p} - \frac{p_{02} - p_2}{p_2 - p_1}$$

$$c_{pi} = \frac{p_2 - p_1 + \left(p_{01} - p_{02}\right)}{p_{01} - p_1}$$

Diffusori

(Ma<0,3)

$$p_2 = p_{02} - \frac{1}{2}\rho c_2^2$$

$$p_1 = p_{01} - \frac{1}{2}\rho c_1^2$$

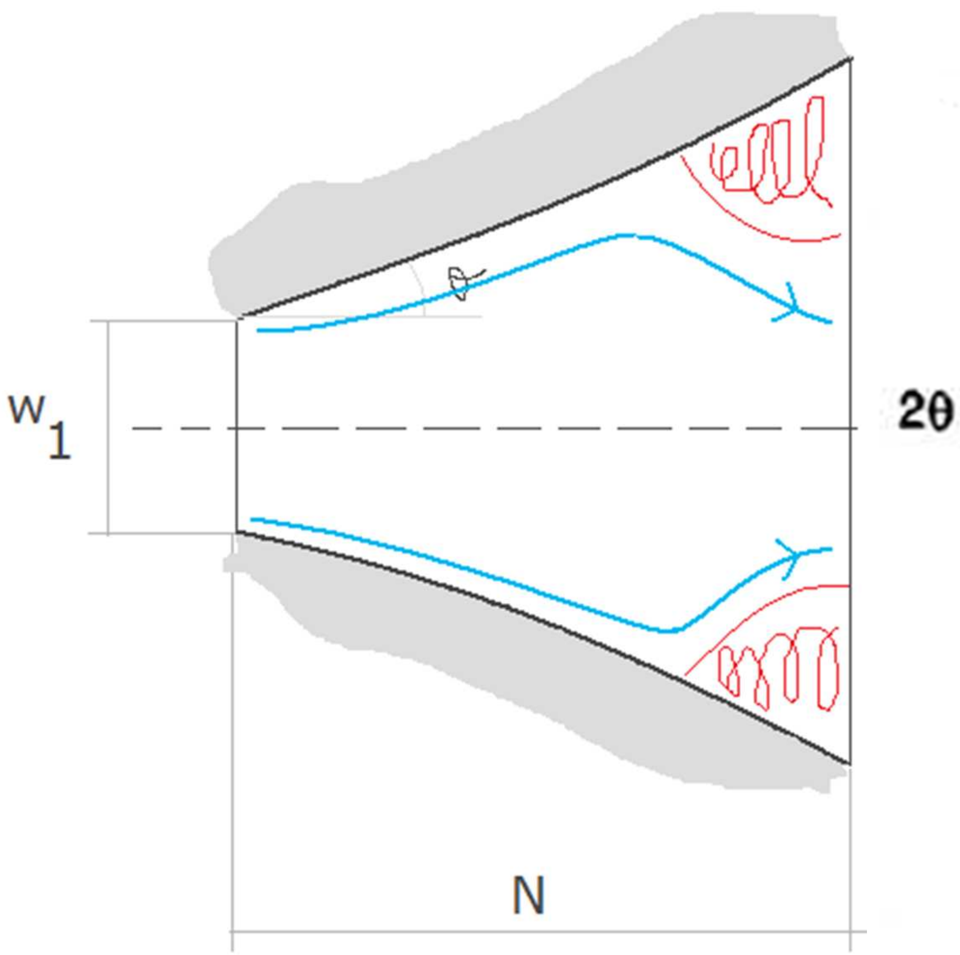
$$c_{pi} = \frac{c_1^2 - c_2^2}{c_1^2} = 1 - \left(\frac{c_2}{c_1}\right)^2 = 1 - \left(\frac{A_1}{A_2}\right)^2 = 1 - \frac{1}{A_R^2}$$

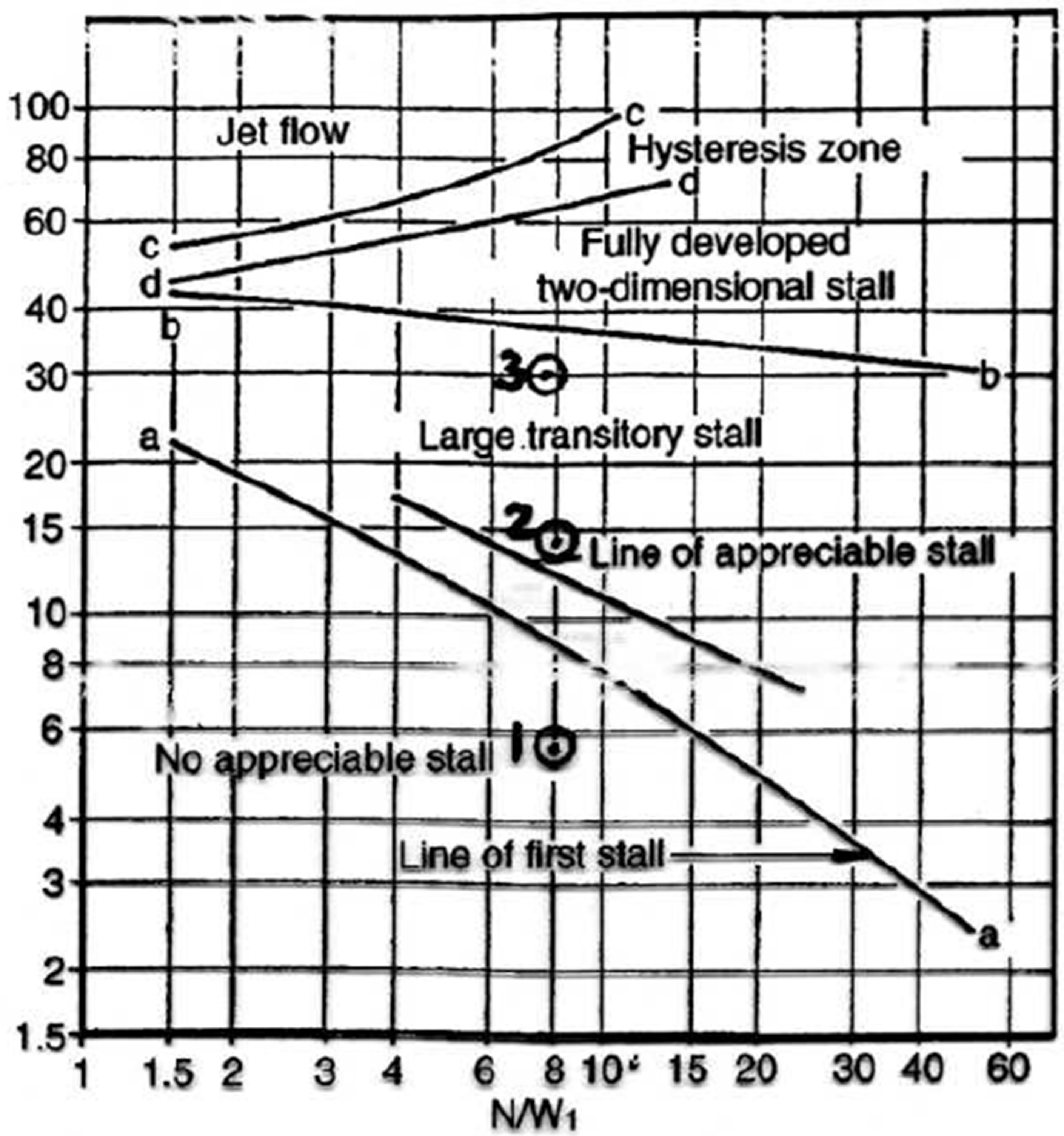
Diffusori

Legame tra c_p, η_{is} *e* c_{pi}

$$\frac{c_p}{c_{pi}} = \frac{p_2 - p_1}{p_{01} - p_1} \cdot \frac{p_{01} - p_1}{\left(p_2 - p_1\right) + \left(p_{01} - p_{02}\right)} = \eta_{is}$$

Diffusori


W1
2θ
N


Jet flow
Hysteresis zone
Fully developed two-dimensional stall
Large transitory stall
Line of appreciable stall
No appreciable stall
Line of first stall
N/W1

Diffusori

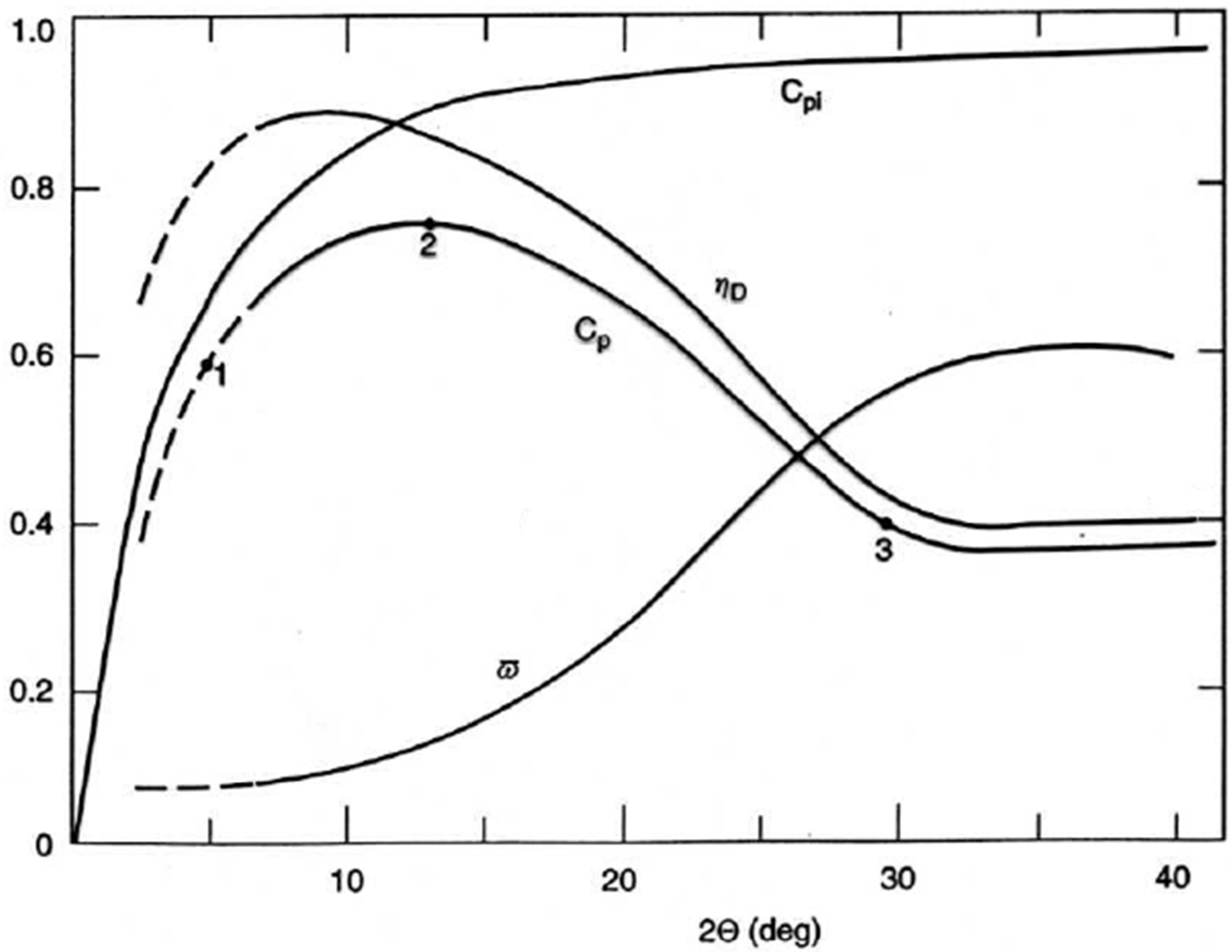


FIG. 2.16. Typical diffuser performance curves for a two-dimensional diffuser, with $L/W_1 = 8.0$ (adapted from Kline *et al.* 1959).

https://www.youtube.com/watch?v=JhlEkEk7igs&list=PL0EC6527BE871ABA3&index=8