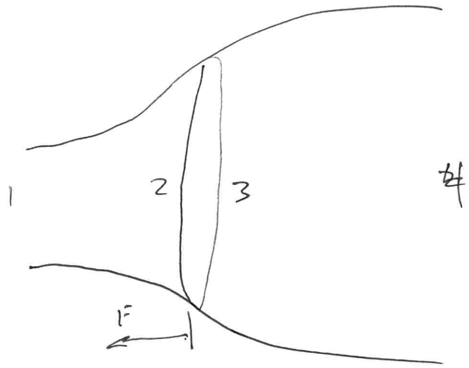

Given: A, ρ, v_1

Vars: $\boxed{v_2,\ v_4,\ F,\ P_2,\ P_3}$

Assume: $v_2 = v_3$

$\dot{m} = \rho A v = \rho A v_2 = \rho A v_3$

Relations:

Bernoulli	1 – 2	(1)
Bernoulli	3 – 4	(2)
Mom Bal	1 – 4	(3)
Mom Bal	2 – 3	(4)
$\frac{\partial \dot{w}}{\partial v_4} = 0$		(5)

(1), (2) : P ito v

$\rightsquigarrow$ v_2 v_4 F, (3), (4), (5)

(3) = (4) ito F.

$\rightsquigarrow$ v_2, v_4, (3) = (4), (5)

(3) = (4) $\rightarrow$ v_2 ito v_4

(5) $\rightarrow$ v_4 ito v_1

$$\dot{W} = \frac{1}{2}\dot{m}(V_1^2 - V_4^2)$$

Know V_1 = wind

- Don't know V_4, or $\dot{m}$
- $\dot{m}$?

$$\dot{m} = \rho A V$$

Mom Bal 1 → 4

$$\frac{\cancel{\rho A}}{2}(V_1^2 - V_4^2) = \cancel{\rho A} V (V_1 - V_4)$$

$$\frac{\cancel{(V_1 - V_4)}(V_1 + V_4)}{2} = V\cancel{(V_1 - V_4)}$$

$$V = \frac{V_1 + V_4}{2}$$

$$\dot{W} = \frac{1}{2}\rho A (V_1 + V_4)(V_1^2 - V_4^2)$$

$$\frac{\partial \dot{W}}{\partial V_4} = \cancel{\tfrac{1}{2}\rho A}(V_1^2 - V_4^2) + \cancel{\tfrac{1}{2}\rho A}(V_1 + V_4)(-2V_4) = 0$$

$$V_1^2 - V_4^2 = 2V_4(V_1 + V_4)$$

$$(V_1 - V_4)\cancel{(V_1 + V_4)} = 2V_4\cancel{(V_1 + V_4)}$$

$$V_1 - V_4 = 2V_4$$

$$3V_4 = V_1 \rightarrow V_4 = V_1/3$$

$$\dot{W}_{max} = \frac{8}{27}\rho A V_1^3$$

$$W_{avail} = \frac{1}{2}\rho A V_1^3$$

$$C_p = \frac{\dot{W}_{max}}{\dot{W}_{avail}} = \frac{16}{27} = 0.5926$$