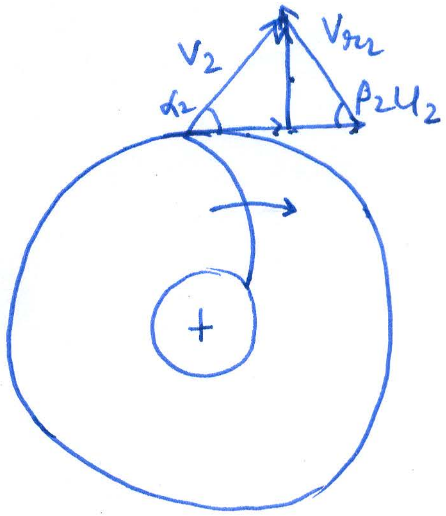
$w = (u_1 V_{u_1} - u_2 V_{u_2})$



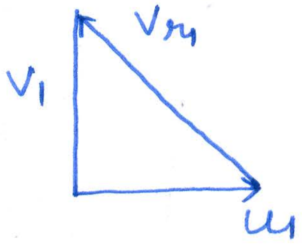
Radial flow m/c

at inlet, radially.

~~α_1~~ $\alpha_1 = 90^0$

~~tt~~ $V_{u_1} = 0$

$w = -u_2 V_{u_2}$



$V_{u_2} = u_2 - V_{n_2} \cot\beta_2$

Q volume flow rate

A_2 area at outlet

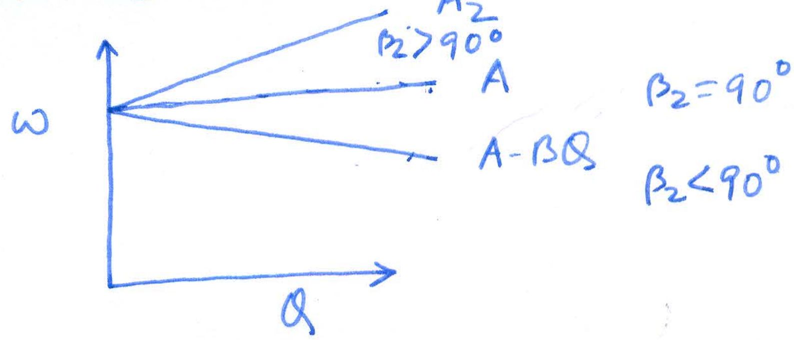
$V_{n_2} = \frac{Q}{A_2}$

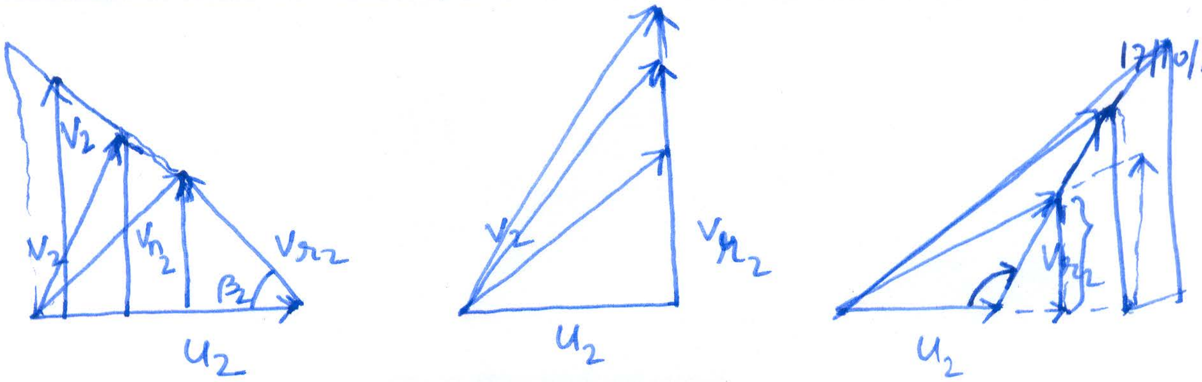
$w = u_2 (u_2 - V_{n_2} \cot\beta_2)$

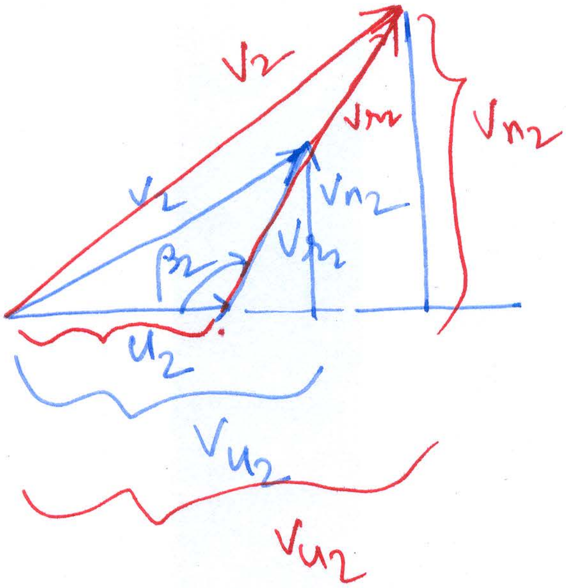
$= u_2^2 - u_2 \frac{Q}{A_2} \cot\beta_2$

N constant, A_2 constant, β_2 constant

$w = A - BQ$ $\quad A = u_2^2$, $B = \frac{u_2 \cot\beta_2}{A_2}$

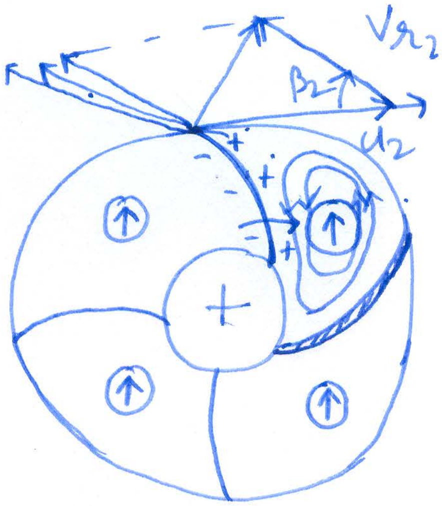






$P = \rho Q g H$

$= \dot{m} \omega$



$\beta_2 < 90$

Backward-curved vanes

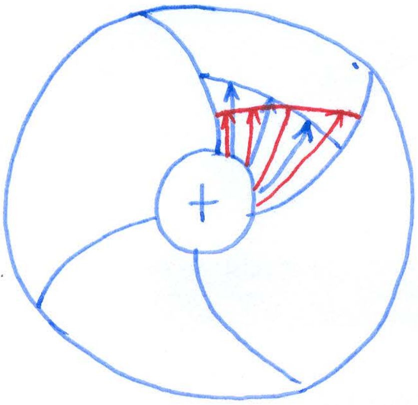
Vane-congruent flow

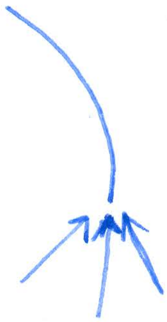
<u>Losses</u>

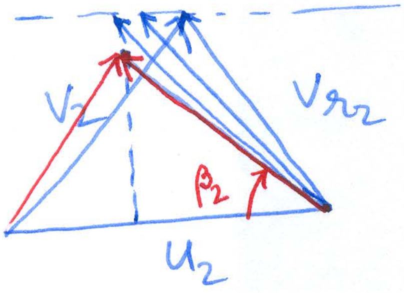
Pressure

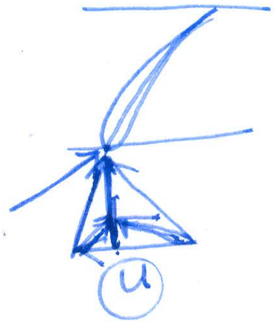
~~inertia~~ inertia

decrease of normal component of velocity

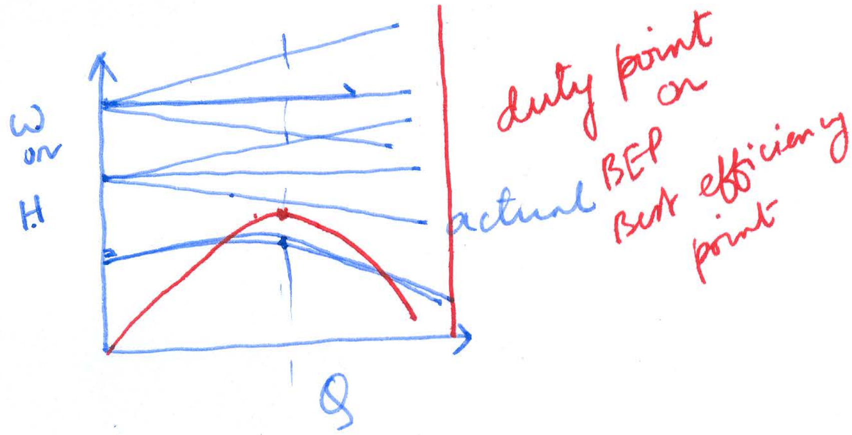






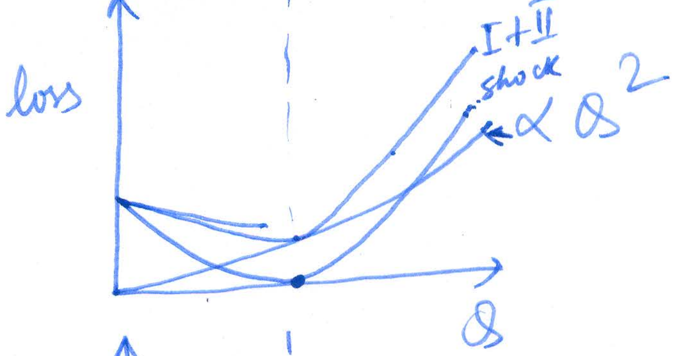


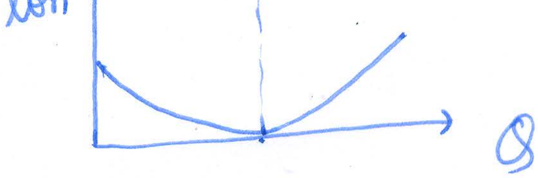
$\omega = \mu(U_2 V_{U2})$ μ = slip factor Q changing



① Frictional losses $\propto V^2$

② Shock losses

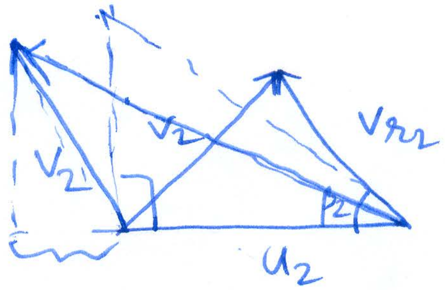




$\omega = 0$?

$\alpha_1 = 90^\circ \Rightarrow V_{u_1} = 0$

$V_{u_2} = 0 \quad \alpha_2 = 90^\circ.$



Class Test 2
14/11/17

$\omega = u_1 V_{u_1} - u_2 V_{u_2}$

$= - u_2 V_{u_2}$

$= +ve$

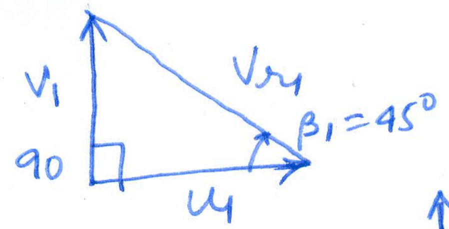
$D_2/D_1 = 2$

$u_2/u_1 = 2$

$\beta_1 = 45^\circ.$

$V_1 = V_{n_1} = u_1$

$V_{n_2} = V_{n_1}$



$\omega = u_2 V_{u_2}$

$= u_2 (u_2 - V_{n_2} \cot\beta_2)$

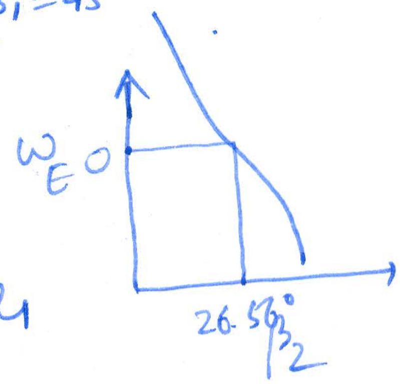
$= u_2 (u_2 - V_{n_1} \cot\beta_2)$

$= u_2 (u_2 - u_1 \cot\beta_2)$

$= 2u_1 (2u_1 - u_1 \cot\beta_2)$

$= 2u_1^2 (2 - \cot\beta_2)$

$u_2 = 2u_1$



$2 = \cot\beta_2$

$\tan\beta_2 = \frac{1}{2}$

$\beta_2 = \tan^{-1}\left(\frac{1}{2}\right)$

Chap 4

Pai 1

$D_1 = 4.5$ cm

$D_2 = 10$ cm

$\beta_2 = 65^\circ$

$\alpha_1 = 90^\circ$

$V_1 = 10$ m/s

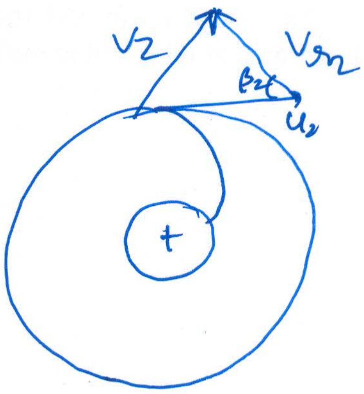
$V_{n_2} = 0.6 V_{n_1}$

$N = 2500$ rpm.

$\dot{m} = 30$ kg/s.

$u_1 = \frac{2\pi N}{60} \times \frac{D_1}{2} = \frac{2\times\pi\times2500}{60} \times \frac{4.5}{200} = 5.9$ m/s

$u_2 = \frac{2\times\pi\times2500}{60} \times \frac{10}{200} = 13.1$ m/s



$V_{n_1} = ~~u_1~~ = ~~5.9~~\ 10$ m/s

$V_{n_2} = 0.6 V_{n_1} = 0.6 \times ~~5.9~~\ 10$ m/s $= ~~3.54~~\ 6$ m/s.

$V_{n_2} \cot\beta_2 = ~~3.54~~\ 6 \times \cot 65 = ~~1.65~~\ 2.8$ m/s

$V_{u_2} = u_2 - V_{n_2}\cot\beta_2$

$= 13.1 - ~~1.65~~\ 2.8$

$= ~~11.45~~\ 10.3$ m/s

$W_E = u_2 V_{u_2} = 13.1 \times ~~11.45~~\ 10.3 = ~~150~~\ 134.93$ J/kg

$W = 0.97 \times ~~150~~\ 134.93 = ~~145.5~~\ 130.9$ J/kg.

$P = \frac{\dot{m} W}{\eta_0} = \frac{30 \times ~~145.5~~\ 130.9}{0.875}$ W $= ~~4.365~~$ kW. 4.48 kW.

$V_2 = \sqrt{6^2 + 10.3^2} = ~~14.6~~$ m/s 11.9 m/s

$R = \frac{W - \frac{V_2^2 - V_1^2}{2}}{W} = \frac{130.9 - \frac{~~14.6~~\ 11.9^2 - 10^2}{2}}{130.9} = 0.84$