Barrages ⇨ Turbine Dimensionless curves

$$n_{11}^* = \frac{\Omega D}{\sqrt{gH}} \qquad Q_{11}^* = \frac{Q}{D^2\sqrt{gH}}$$

we use a "*" to denote dimensionless values and distinguish for other works

The dimensionless numbers are constructed using

$\rho \quad D \quad \sqrt{gH}$

$$P = \eta \rho g h Q$$

$$\frac{P}{D^2\sqrt{gH}\,\rho g H} = \eta \frac{\rho g H}{\rho g H} \frac{Q}{D^2\sqrt{gH}}$$

$$\underbrace{\frac{P}{\rho D^2 (gH)^{3/2}}}_{P_{11}} = \eta \frac{Q}{D^2\sqrt{gH}}$$

$$P_{11} = \eta\, Q_{11}$$

$$\boxed{\eta = \frac{Q_{11}}{P_{11}}}$$

$$P_{shaft} = \eta \cdot \rho D^2 (gH)^{3/2} \Rightarrow \frac{kg}{m^3} \cdot m^2 \left(\frac{m^2}{s^2}\right)^{3/2}$$

$$\frac{kg}{m}\frac{m^3}{s^3} = \frac{kg\,m^2}{s^3} \Rightarrow \text{Units of Power}$$

$H \rightarrow n_{11}^* = \dfrac{\Omega D}{\sqrt{gH}}$ (fixed) $\rightarrow$ from the turbines curves we get $Q_{11}^* = \dfrac{Q}{D^2\sqrt{gH}}$ and η

$$Q = Q_{11}^* \, D^2 \sqrt{gH} = \underbrace{\left(D^2\sqrt{g}\right)}_{C_{T1}} Q_{11}^* \sqrt{H}$$

$$P_{shaft} = \eta \, \rho \, D^2 (gH)^{3/2} = \eta \underbrace{\left(\rho D^2 g^{3/2}\right)}_{C_{T2}} H^{3/2}$$

$$\frac{1}{2}\rho v^2 C_D = \Delta p = \rho g h$$

$$v^2 = \frac{2gh}{C_D} \Leftrightarrow vA = \frac{A}{\sqrt{C_D}} \sqrt{2gh}$$

$$Q = \underbrace{\frac{1}{\sqrt{C_D}}}_{\varepsilon} \cdot A\sqrt{2gh} \Leftrightarrow Q = \varepsilon A \sqrt{2gh}$$

A ↓ Sluice gate area

$\varepsilon \simeq 1{,}0$

$$P = \eta \rho g h Q = \eta \rho g h \, Q_{11}^*$$