Condotte in pressione

***Ipotesi*: moto permanente**

Equazione di Bernoulli

$$\Delta H = L \cdot J + \sum P_c$$

Equazione di Darcy-Weisbach

$$J = \lambda \frac{V^2}{2g\,D} = \lambda \frac{Q^2}{2g\,D\,A^2}$$

Colebroke-White

$$\frac{1}{\sqrt{\lambda}} = -2 \cdot \log_{10}\left(\frac{2.51}{\mathrm{Re} \cdot \sqrt{\lambda}} + \frac{1}{3.71} \frac{\varepsilon}{D} \right)$$

Cozzo

$$\frac{1}{\sqrt{\lambda}} = -2 \cdot \log_{10}\left(\frac{5.8}{\mathrm{Re}^{0.9}} + \frac{1}{3.71} \frac{\varepsilon}{D} \right)$$

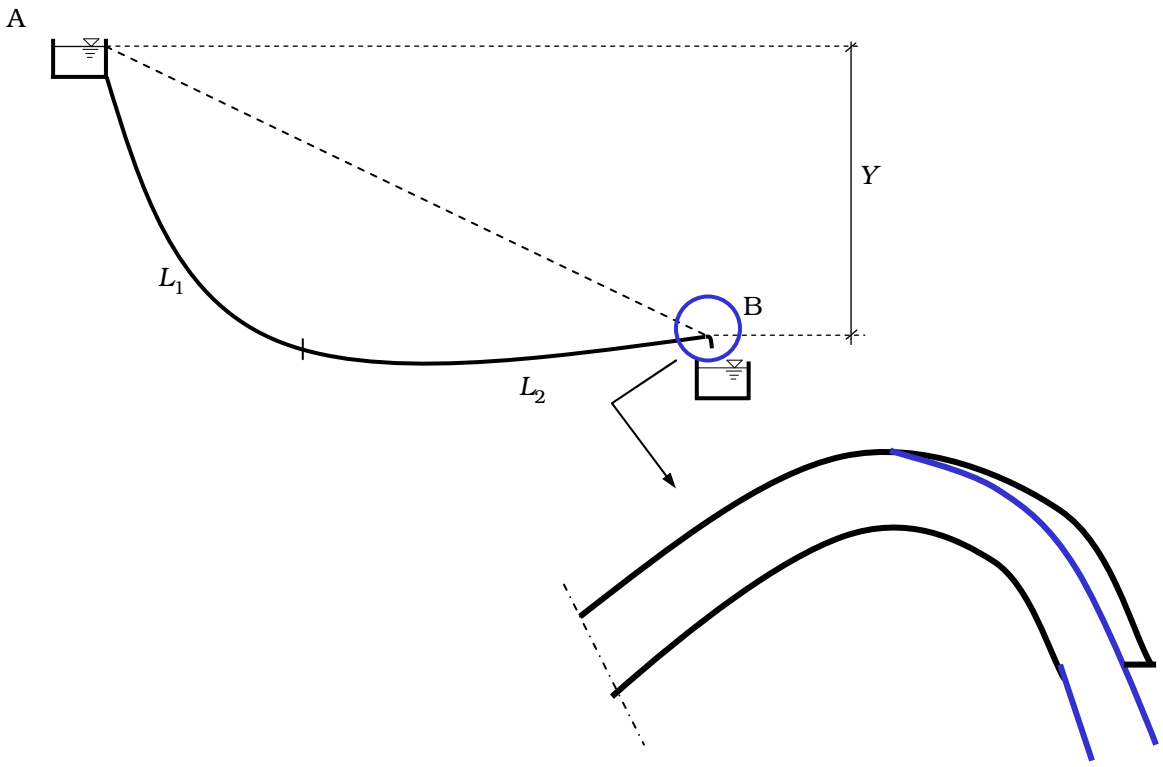
Equazione di Chezy (moto p. turbolento)

$$J = 4 \cdot \frac{V^2}{\chi^2 \cdot D}$$

Equazione di Chezy -Strickler

$$J = \frac{10.29}{K_s^2} \cdot \frac{Q^2}{D^{5.33}}$$

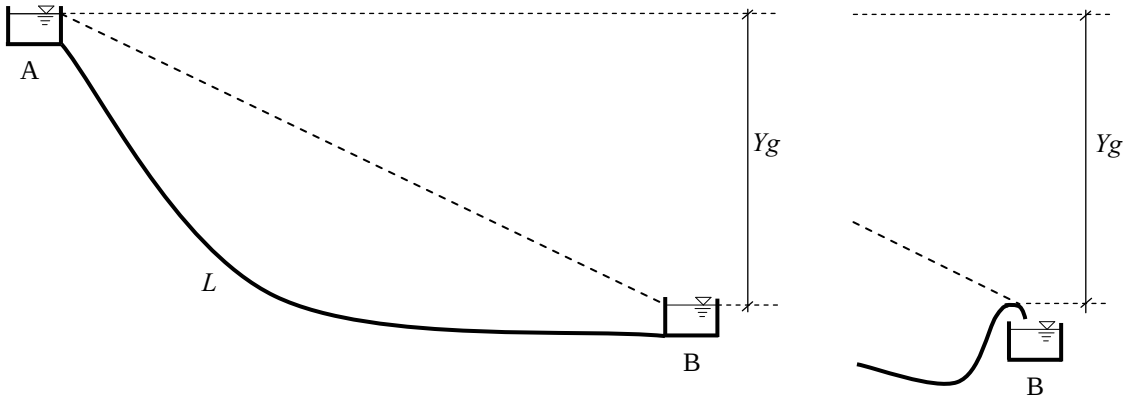
Condotta semplice: a) Verifica



$$Y = z_A - z_B = L \cdot J = L \cdot \frac{10.29}{K_s^2} \cdot \frac{Q^2}{D^{5.33}}$$

Noti Y, D, L e K_s si ricava Q

Verifica di una condotta semplice sempre inferiore alla congiungente i due serbatoi

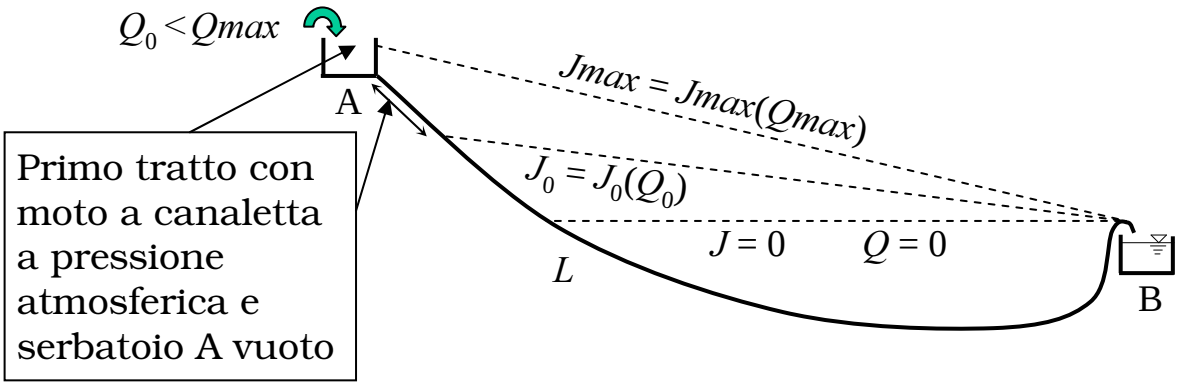


1) Calcolo della $Qmax$ $\qquad Yg = L \cdot J \rightarrow Qmax$

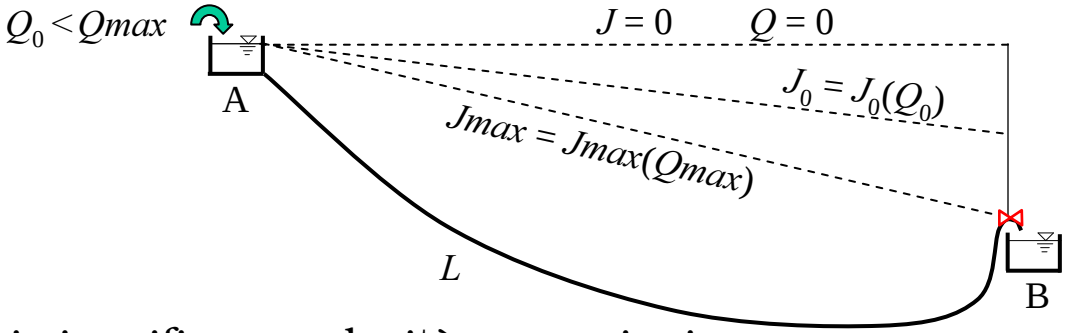
Condotte nuove e usate con piezom. e J identiche.

$$J = K \cdot \frac{Q^{\alpha}}{D^{m}}$$ Cambia la scabrezza (e quindi K), a volte pure il diametro D, e dunque la portata Q.

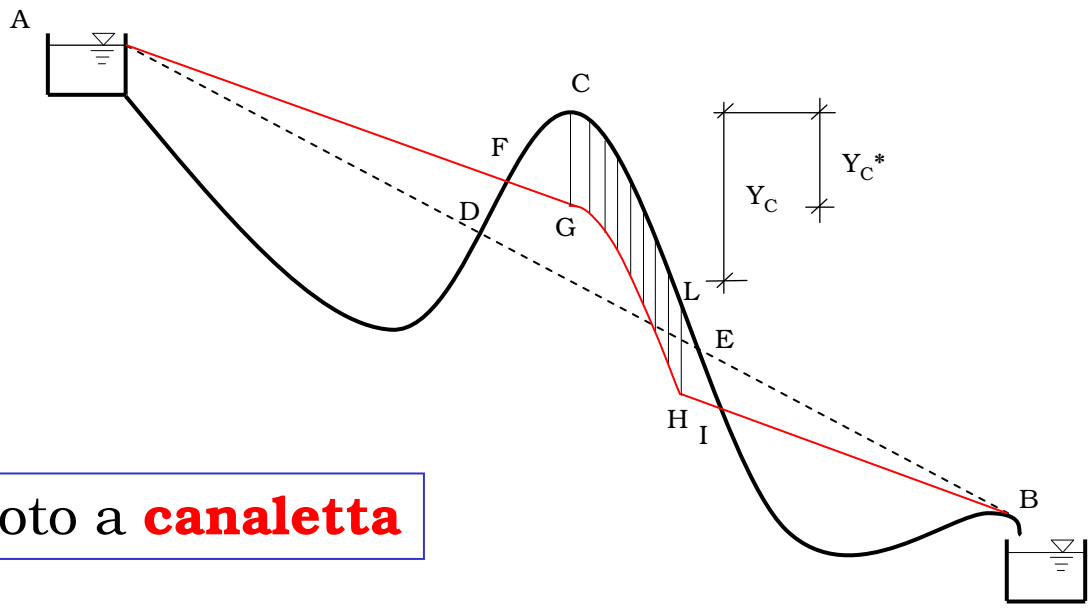
2) Calcolo piezometrica per una imposta $Q_0 < Qmax$



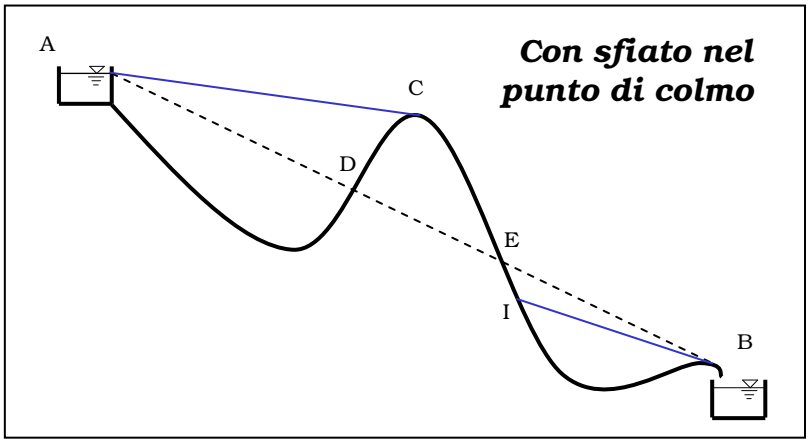
Per evitare ciò viene inserita una valvola dissipatrice:

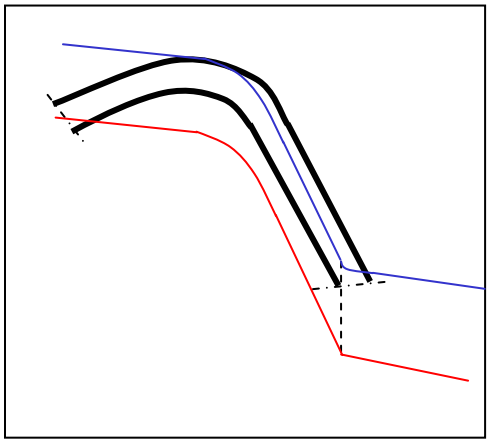


Poi si verificano velocità e pressioni.



Moto a **canaletta**





Condizione limite:

$$\frac{P}{\gamma} > -10\,m$$ (*in teoria*)

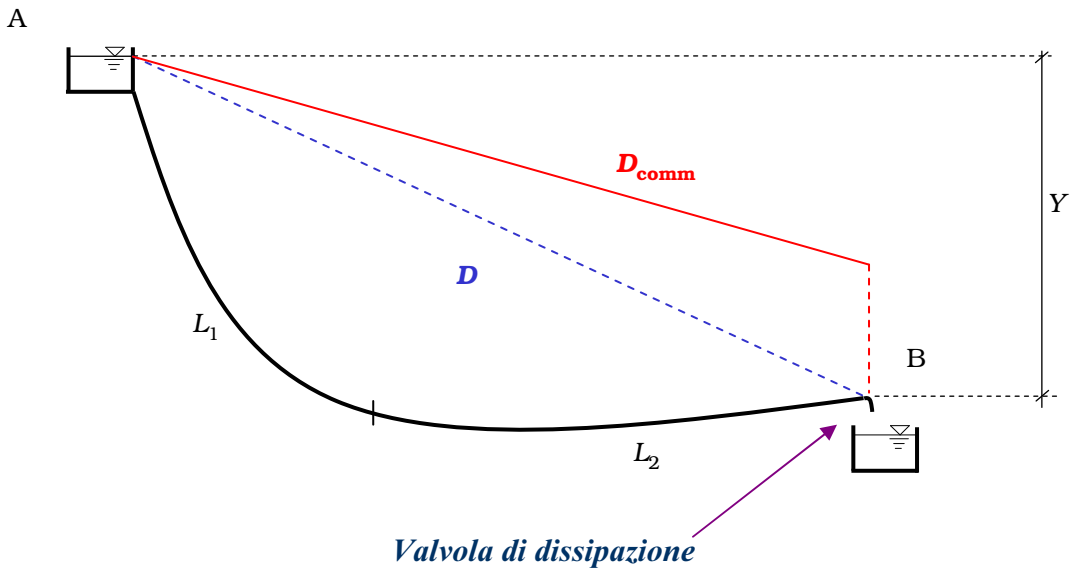
$$\frac{P}{\gamma} > -7 \div 8\,m$$ (*in pratica*)

Condotta semplice: b) progetto

Noti Y, Q e L e si ricava ***D***

Si considera la condizione di tubi usati: ⇨ K_s

$$Y = z_A - z_B = L \cdot J = L \cdot \frac{10.29}{K_s^2} \cdot \frac{Q^2}{D^{5.33}}$$



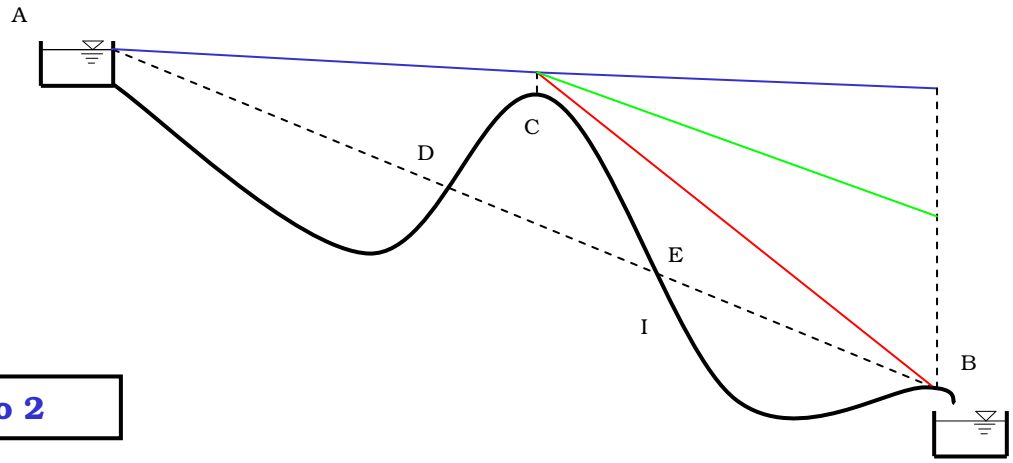
Vincoli ingegneristici ⇨

$$D_{comm} \geq D$$

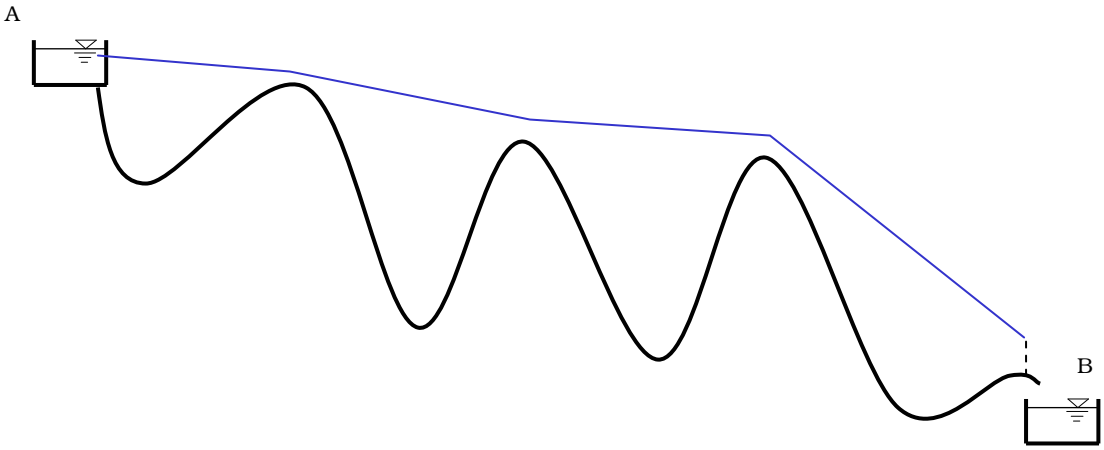
$$0.5 \leq V \leq 2 \quad m/s$$

$$\frac{P}{\gamma} > 5 \div 10 \; m$$

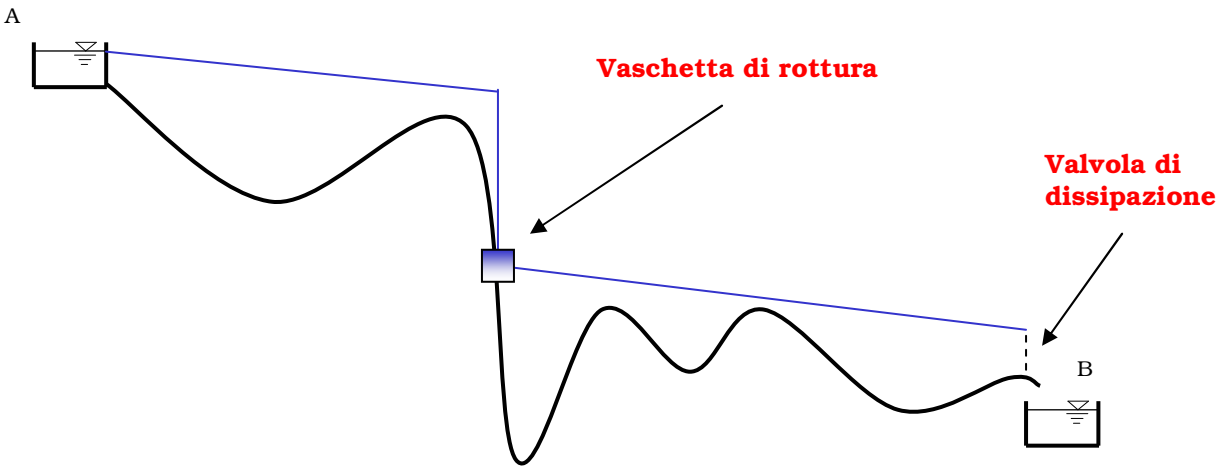
Caso 1



Caso 2

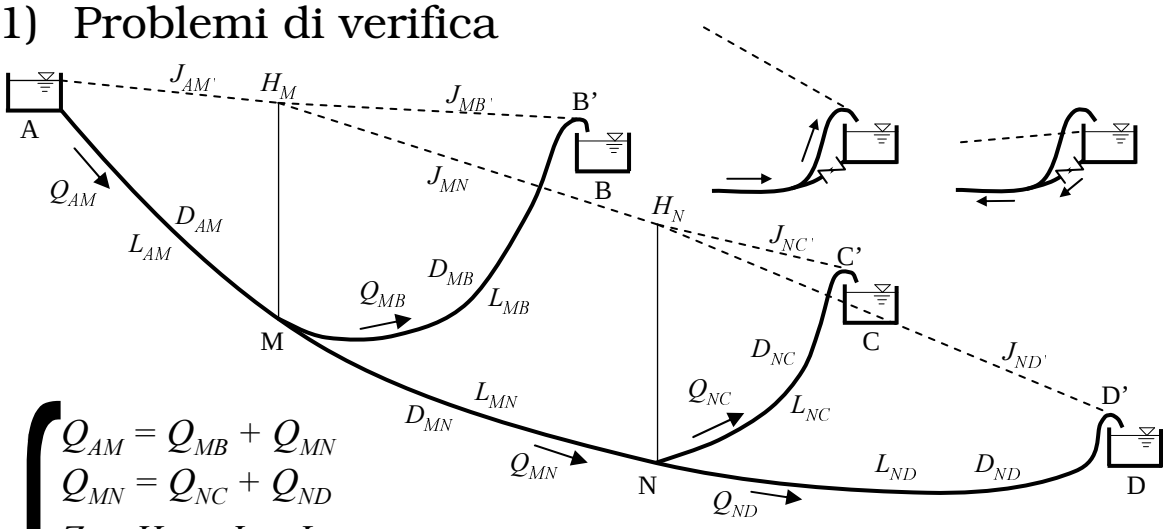


Caso 3



Sistemi di condotte a rami aperti

1) Problemi di verifica



$$\begin{cases} Q_{AM} = Q_{MB} + Q_{MN} \\ Q_{MN} = Q_{NC} + Q_{ND} \\ Z_A - H_M = J_{AM} \cdot L_{AM} \\ H_M - Z_{B'} = J_{MB'} \cdot L_{MB} \\ H_M - H_N = J_{MN'} \cdot L_{MN} \\ H_N - Z_{C'} = J_{NC'} \cdot L_{NC} \\ H_N - Z_{D'} = J_{ND'} \cdot L_{ND} \end{cases}$$

n carichi *H* incogniti sugli *n* nodi
l portate *Q* incognite negli *l* lati

n equazioni di continuità per gli *n* nodi
l equazioni del moto per gli *l* lati

2) Problemi di progetto

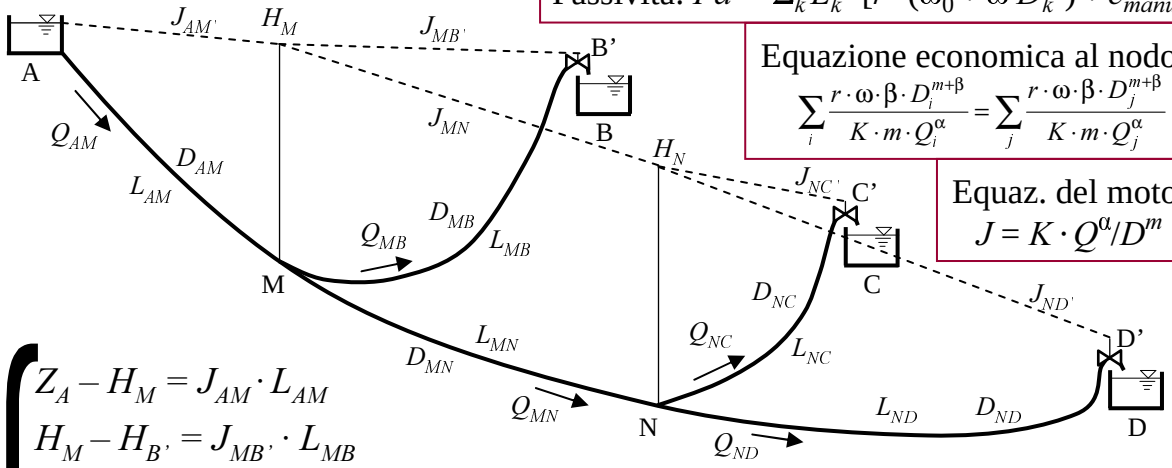
Costo unitario di costruzione: $c_i = \omega_0 + \omega \cdot D^{\beta}$

Passività: $Pa = \Sigma_k L_k \cdot [r \cdot (\omega_0 + \omega \cdot D_k^{\beta}) + c_{manut}]$

Equazione economica al nodo:

$$\sum_i \frac{r \cdot \omega \cdot \beta \cdot D_i^{m+\beta}}{K \cdot m \cdot Q_i^{\alpha}} = \sum_j \frac{r \cdot \omega \cdot \beta \cdot D_j^{m+\beta}}{K \cdot m \cdot Q_j^{\alpha}}$$

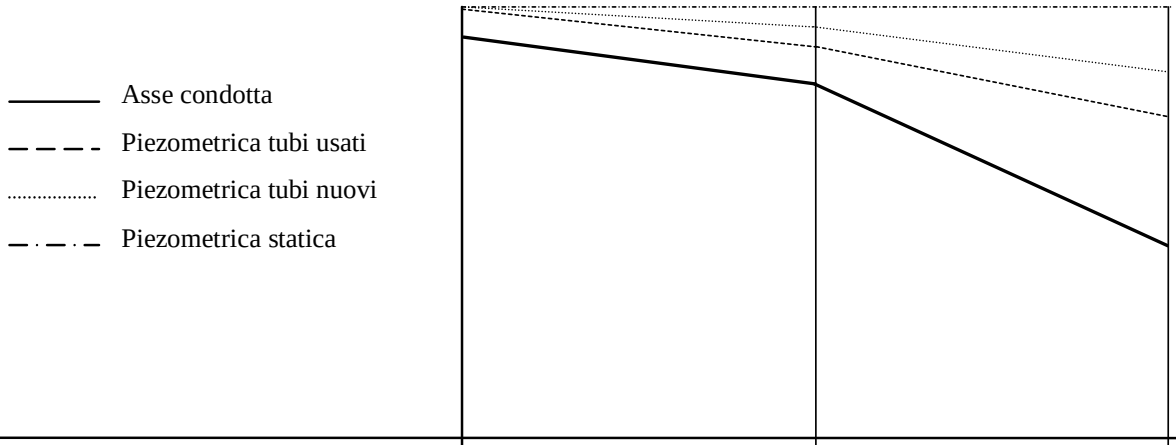
Equaz. del moto: $J = K \cdot Q^{\alpha}/D^{m}$



$$\begin{cases} Z_A - H_M = J_{AM} \cdot L_{AM} \\ H_M - H_{B'} = J_{MB'} \cdot L_{MB} \\ H_M - H_N = J_{MN'} \cdot L_{MN} \\ H_N - H_{C'} = J_{NC'} \cdot L_{NC} \\ H_N - H_{D'} = J_{ND'} \cdot L_{ND} \\ D_{AM}^{m+\beta}/Q_{AM}^{\alpha} = D_{MB}^{m+\beta}/Q_{MB}^{\alpha} + D_{MN}^{m+\beta}/Q_{MN}^{\alpha} \\ D_{MN}^{m+\beta}/Q_{MN}^{\alpha} = D_{ND}^{m+\beta}/Q_{ND}^{\alpha} + D_{NC}^{m+\beta}/Q_{NC}^{\alpha} \end{cases}$$

n carichi *H* incogniti sugli *n* nodi
l diametri *D* incogniti negli *l* lati

n equaz. economiche negli *n* nodi
l equaz. del moto per gli *l* lati



SEZIONI			①	②	③
QUOTE [m s.l.m.]	Terreno		449.2	447.2	
	Asse condotta		448.0	446.0	
	Piezometrica tubi nuovi		451.0	448.0	
	Piezometrica tubi usati		451.0	447.5	
	Piezometrica statica		451.0	451.0	
DISTANZE [m]	Parziali		120	135	
	Progressive		0	120	255
	Manufatti speciali	Parziali	350		
		Progressive	0		
DIAMETRI			ϕ 300		
MATERIALI					