ALIRAN MELALUI LUBANG PELUAP

Koefisien kontraksi (Cc)

Koefisien Kecepatan (Cv)

Koefisien debit (Cd)

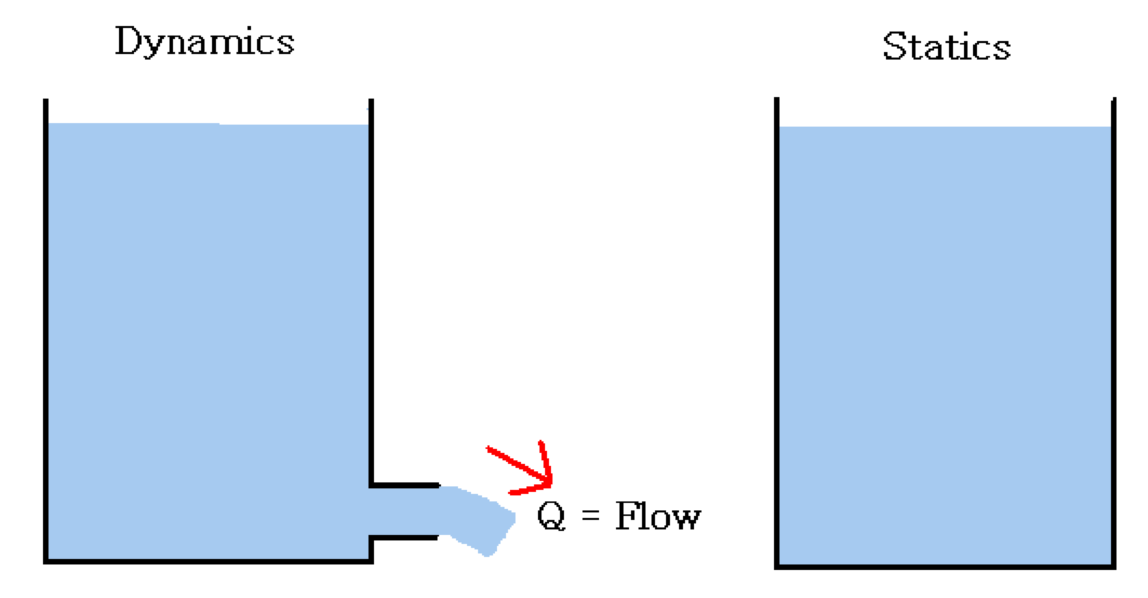
Berdasarkan persamaan Bernoulli

- $C_c = \frac{a_c}{a}$
- $C_v = \frac{V}{V_1}$
- $C_d = \frac{Q}{Q_1} = C_v C_c$

- a_c = luas penampang (pada vena kontrakta)
- a = luas penampang lubang
- V = kec.riil (pada vena kontrakta)
- V_t = kec.teoritis
- Q = debit riil
- Q_t = debit teoritis

persamaan Bernoulli

Hukum Statika yang telah kita pelajari tidak dapat menyelesaikan Masalah Dinamis. Tidak ada cara untuk memecahkan laju alir, atau T. Oleh karena itu, kita memerlukan pendekatan dinamis baru untuk Mekanika Cair

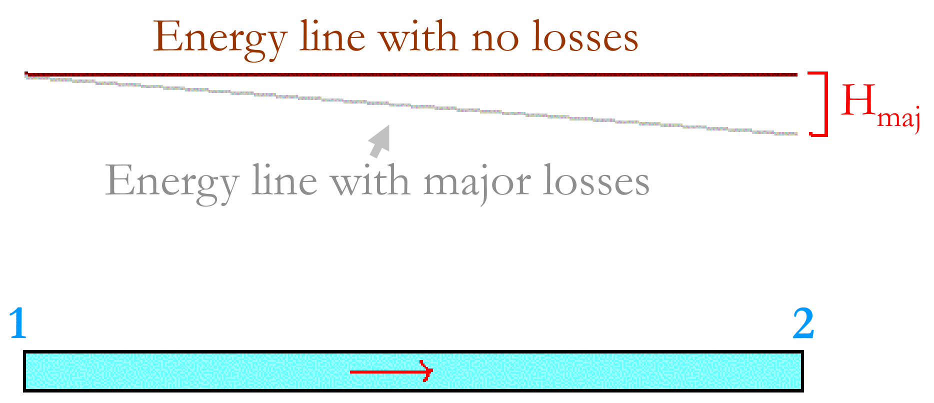


Pipe Flow and the Energy Equation

For pipe flow, the Bernoulli equation alone is not sufficient. Friction loss along the pipe, and momentum loss through diameter changes and corners take head (energy) out of a system that theoretically conserves energy. Therefore, to correctly calculate the flow and pressures in pipe systems, the Bernoulli Equation must be modified.

$$P_1/\gamma + V_1^2/2g + z_1 =$$

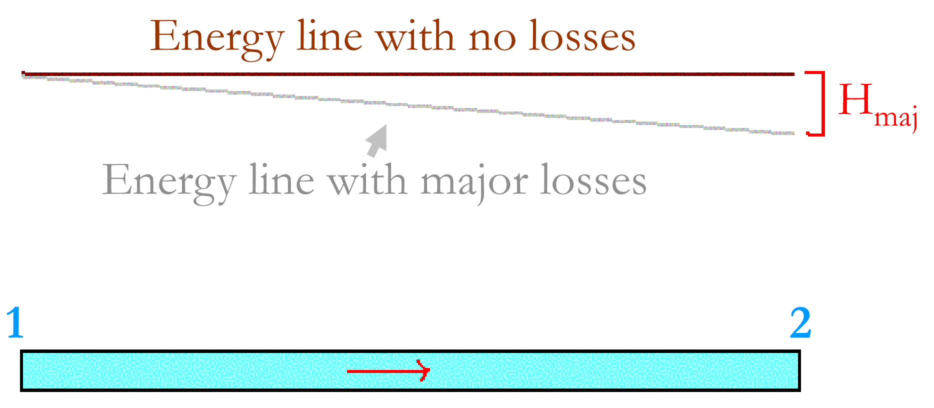
$$P_2/\gamma + V_2^2/2g + z_2 + H_{maj} + H_{min}$$



Major Losses

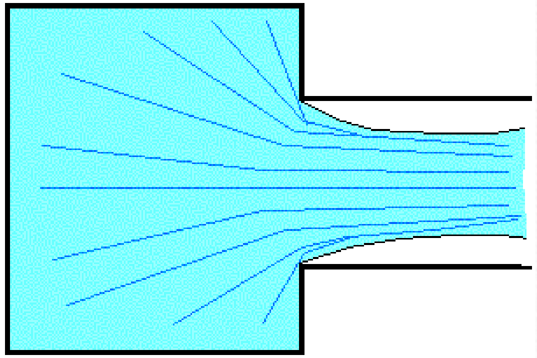
Major losses occur over the entire pipe, as the friction of the fluid over the pipe walls removes energy from the system. Each type of pipe as a friction factor, **f**, associated with it.

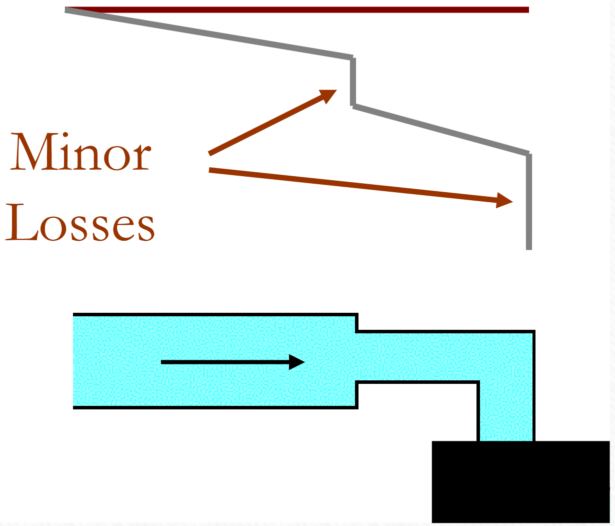
$$H_{maj} = f\ (L/D)(V2/2g)$$

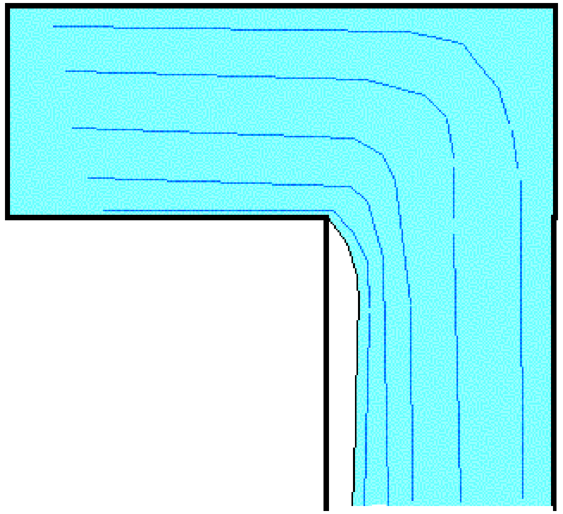


Minor Losses

Unlike major losses, minor losses do not occur over the length of the pipe, but only at points of momentum loss. Since Minor losses occur at unique points along a pipe, to find the total minor loss throughout a pipe, sum all of the minor losses along the pipe. Each type of bend, or narrowing has a loss coefficient, K_L to go with it.







Major and Minor Losses

Major Losses:

$H_{maj} = f\ (L/D)(V2/2g)$

f = friction factor L = pipe length D = pipe diameter
V = Velocity g = gravity

Minor Losses:

$H_{min} = K_L(V^2/2g)$

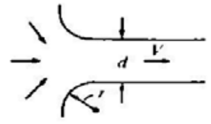
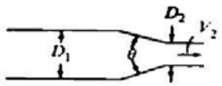
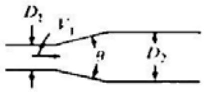
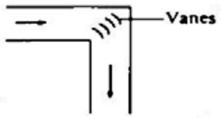
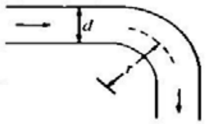
K_l = sum of loss coefficients V = Velocity g = gravity

When solving problems, the loss terms are added to the system at the second analysis point

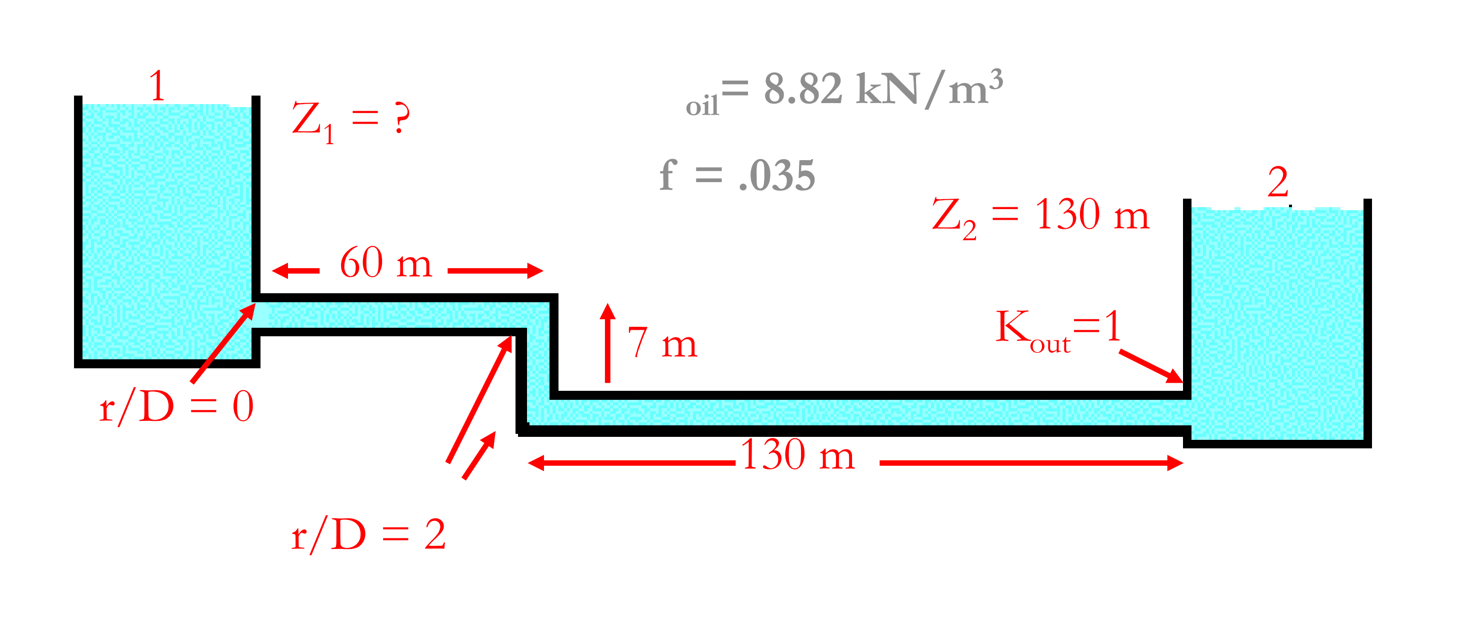
$P_1/\gamma + V_1^2/2g + z_1 =$
$P_2/\gamma + V_2^2/2g + z_2 + H_{maj} + H_{min}$

Loss Coefficients

TABLE 10-2 LOSS COEFFICIENTS FOR VARIOUS TRANSITIONS AND FITTINGS

Description	Sketch	Additional Data	K	K	Source
Pipe entrance		r/d	K_e		(1)
		0.0	0.50		
		0.1	0.12		
$h_L = K_e V^2/2g$		>0.2	0.03		
Contraction		D_2/D_1	K_C $\theta = 60°$	K_C $\theta = 180°$	(1)
		0.0	0.08	0.50	
		0.20	0.08	0.49	
		0.40	0.07	0.42	
		0.60	0.06	0.32	
		0.80	0.05	0.18	
$h_L = K_C V_2^2/2g$		0.90	0.04	0.10	
Expansion		D_1/D_2	K_E $\theta = 10°$	K_E $\theta = 180°$	(1)
		0.0		1.00	
		0.20	0.13	0.92	
		0.40	0.11	0.72	
		0.60	0.06	0.42	
$h_L = K_E V_1^2/2g$		0.80	0.03	0.16	
90° miter bend		Without vanes	$K_b = 1.1$		(26)
		With vanes	$K_b = 0.2$		(26)
90° smooth bend		r/d			(3) and (13)
		1	$K_b = 0.35$		
		2	0.19		
		4	0.16		
		6	0.21		
		8	0.28		
		10	0.32		
Threaded pipe fittings	Globe valve—wide open		$K_v = 10.0$		(26)
	Angle valve—wide open		$K_v = 5.0$		
	Gate valve—wide open		$K_v = 0.2$		
	Gate valve—half open		$K_v = 5.6$		
	Return bend		$K_b = 2.2$		
	Tee		$K_t = 1.8$		
	90° elbow		$K_b = 0.9$		
	45° elbow		$K_b = 0.4$		

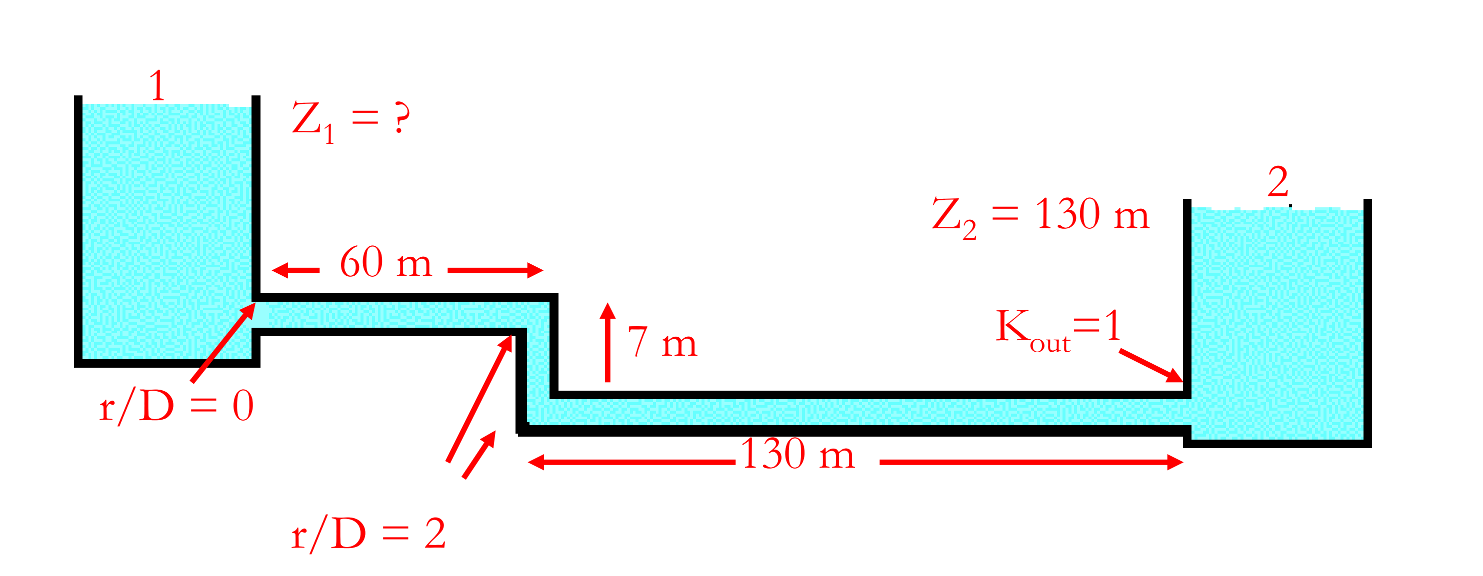
Pipe Flow Example



If oil flows from the upper to lower reservoir at a velocity of 1.58 m/s in the D= 15 cm smooth pipe, what is the elevation of the oil surface in the upper reservoir?

Include major losses along the pipe, and the minor losses associated with the entrance, the two bends, and the outlet.

Pipe Flow Example



Apply Bernoulli's equation between points 1 and 2:

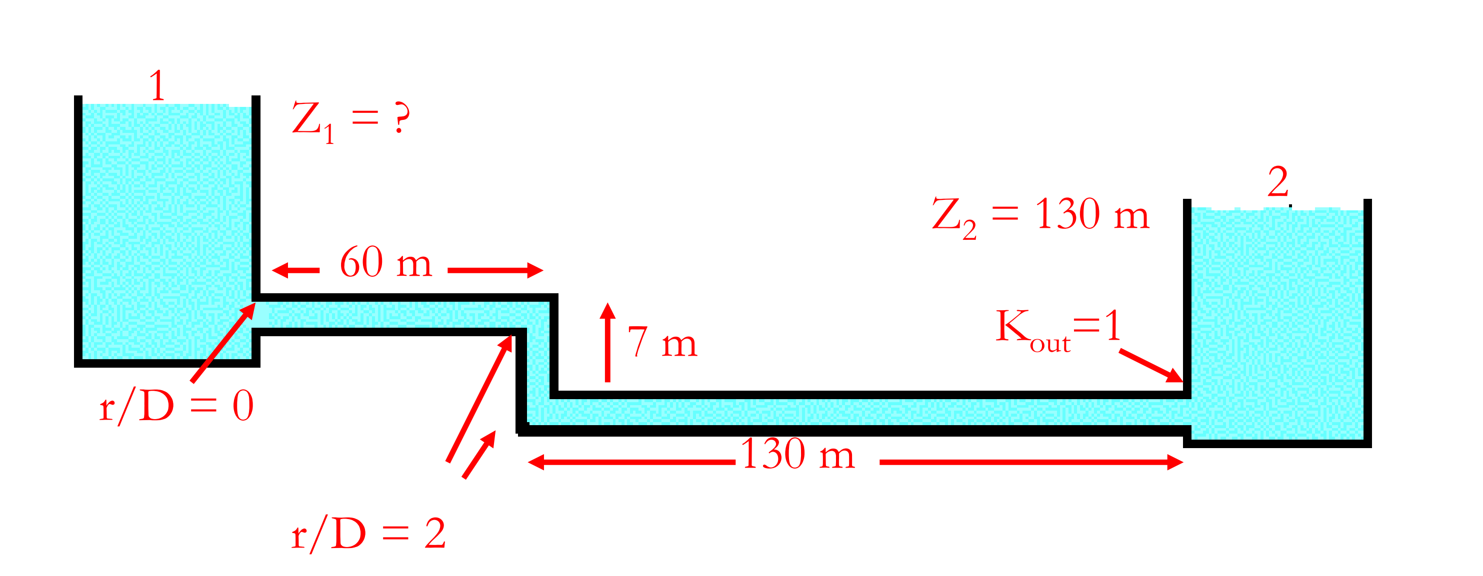
Assumptions: $P_1 = P_2 = \text{Atmospheric} = 0$ $\quad V_1 = V_2 = 0$ (large tank)

$$0 + 0 + Z_1 = 0 + 0 + 130\text{m} + H_{maj} + H_{min}$$

$$H_{maj} = (f\ L\ V^2)/(D\ 2g) = (.035 \times 197\text{m} * (1.58\text{m/s})^2)/(.15 \times 2 \times 9.8\text{m/s}^2)$$

$$\mathbf{H_{maj} = 5.85m}$$

Pipe Flow Example



$$0 + 0 + Z_1 = 0 + 0 + 130m + 5.85m + H_{min}$$

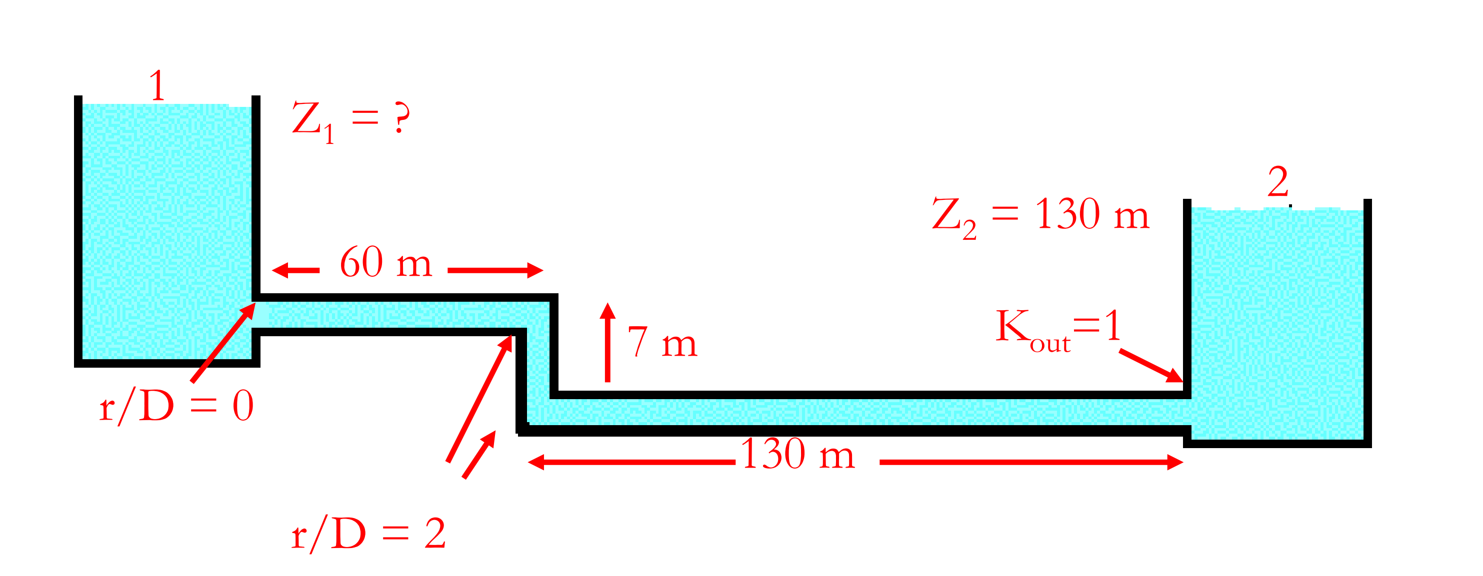
$$H_{min} = 2K_{bend}V^2/2g + K_{ent}V^2/2g + K_{out}V^2/2g$$

From Loss Coefficient table: $K_{bend} = 0.19$ $K_{ent} = 0.5$ $K_{out} = 1$

$$H_{min} = (0.19x2 + 0.5 + 1) * (1.58^2/2*9.8)$$

$$\mathbf{H_{min} = 0.24\ m}$$

Pipe Flow Example



$$0 + 0 + Z_1 = 0 + 0 + 130m + H_{maj} + H_{min}$$

$$0 + 0 + Z_1 = 0 + 0 + 130m + 5.85m + 0.24m$$

Z_1 = 136.1 meters