

X	Y	Z
1	7	2

1. Diketahui

- Prisma tegak segienam $S = 4,75 \text{ cm}$
- Tegangan permukaan $0,0812 \text{ N/m}$
- Air raksa = 140°

Kenaikan pipa?

Jawab $P \cdot \sigma \cdot \cos \theta = A \cdot h \cdot \gamma$

$$h = \frac{P \cdot \sigma \cdot \cos \theta}{A \cdot \gamma}$$

$$h = \frac{(6 \cdot S) \cdot \sigma \cdot \cos \theta}{\frac{3}{2} \sqrt{3} S^2 \cdot \rho \cdot g}$$

~~$$h = (6 \cdot 0,0812)$$~~

$$h = \frac{(6 \cdot 4,75 \text{ cm}) \cdot 0,0812 \cdot \cos 140^\circ}{\frac{3}{2} \sqrt{3} \cdot (4,75 \text{ cm})^2 \cdot 1000 \cdot 9,81}$$

$$h = \frac{(6 \cdot 0,0475 \text{ m}) \cdot 0,0812 \cdot \cos 140^\circ}{\frac{3}{2} \sqrt{3} \cdot (0,0475 \text{ m})^2 \cdot 1000 \cdot 9,81}$$

$$h = -3,082809884 \times 10^{-4} \text{ m} \Rightarrow 0,0003 \text{ m} \Rightarrow 0,03 \text{ cm}$$

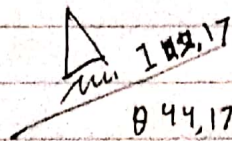
2. Diketahui

$r = 1,27 \text{ m}$ $\nu = 0,32$

$m = 98,71 \text{ kg}$

$\theta = 44,17^\circ$

$z_0 = 2,17 \text{ mm} \rightarrow 2,17 \times 10^{-3}$



Jawab: $F_s = W$

$F_s = m \cdot g \cdot \sin \theta$

$F_s = 98,71 \cdot 9,81 \cdot \sin 44,17^\circ$

$F_s = 674,733 \text{ N}$

Tegangan geser = $\frac{F_s}{A}$

$= \frac{674,06485}{\pi \cdot r^2}$

$= \frac{674,06485}{3,14 \cdot 1,27^2}$

$\Rightarrow 133,0959 \text{ kg/m}^2$

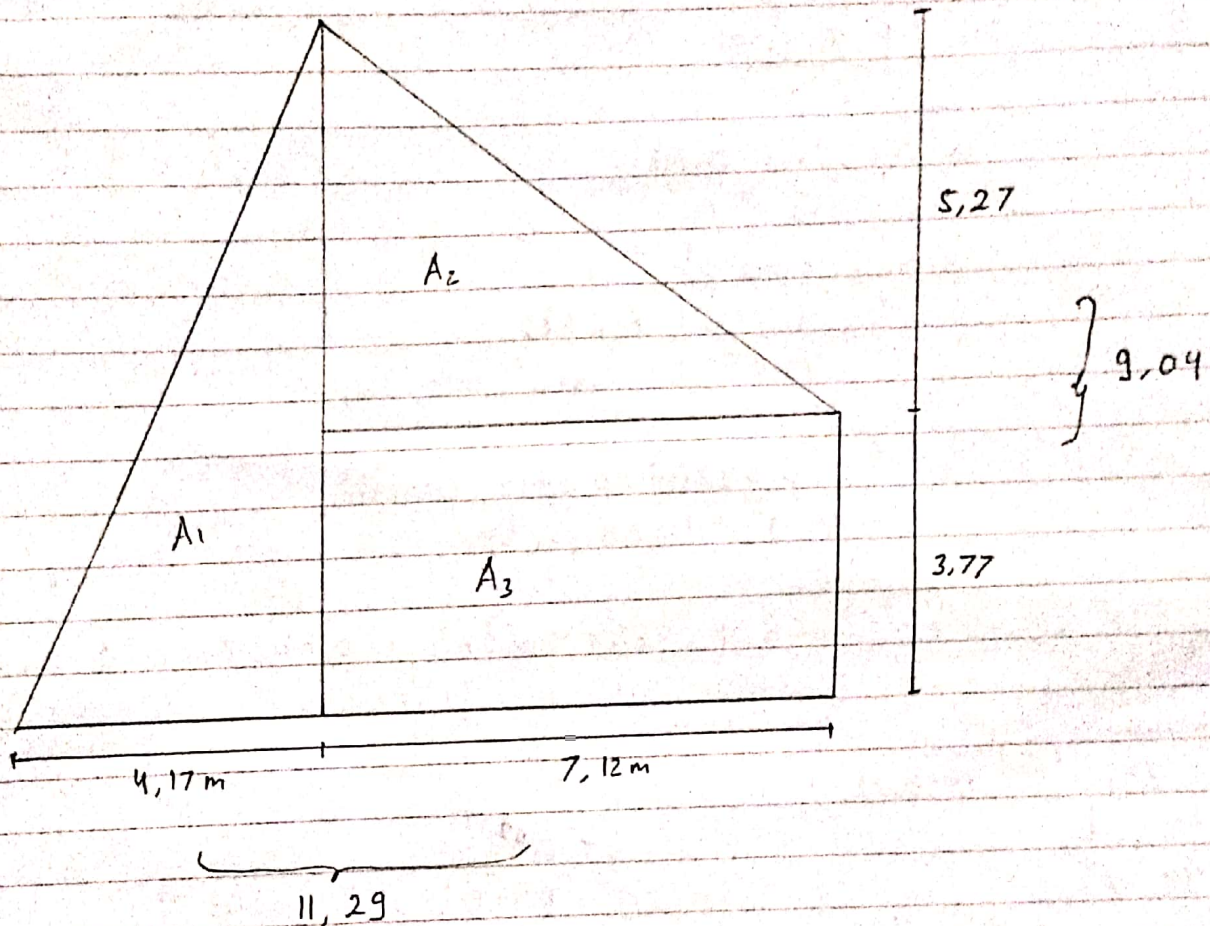
→ Viskositas Dinamik

$$\tau = \mu \frac{du}{dz}$$

$$\mu = \frac{\tau}{\frac{du}{dz}} = \frac{133,0959}{\frac{0,32}{2,17 \times 10^{-3}}}$$

$$\tau = 0,9026 \text{ kg/ms}$$

4.



Dari bawah

Bagian	Luas (A _i)	y _i	A _i · y _i	Y
A ₁	18,8484	3,013	56,79	
A ₂	18,7612	5,527	103,69	
A ₃	26,8424	1,885	50,60	

Luas Δ 1/2 a · t
Luas □ a · t

$$Y = 211,08 : 64,452 = 3,275$$

$$64,452 \quad 211,08 \Rightarrow 3,275$$

$$A_1 = \frac{1}{2} \cdot 4,17 \cdot 9,04 = 18,8484$$

$$y_1 = \frac{1}{3} \cdot 9,04 = 3,013$$

$$A_2 = \frac{1}{2} \cdot 7,12 \cdot 5,27 = 18,7612$$

$$y_2 = \frac{1}{3} \cdot 5,27 + 3,77 = 5,527$$

$$A_3 = 7,12 \cdot 3,77 = 26,8424$$

$$y_3 = \frac{1}{2} \cdot 3,77 = 1,885$$

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Dari atas

Bagian	Luas	Y_1	$A_i \cdot Y_i$	Y
A_1	18,8484	6,027	113,6	
A_2	18,7612	3,51	65,85	
A_3	26,8424	7,155	192,057	
	64,452		371,51	14,045

$$Y = 371,51 : 64,452 = 5,765$$

Memiliki luas yang sama

$$Y_1 = \frac{2}{3} \cdot 9,04 = 6,027$$

$$Y_2 = \frac{2}{3} \cdot 5,27 = 3,51$$

$$Y_3 = 5,27 + \frac{1}{2} \cdot 3,77 = 7,155$$

$$Y = 9,04$$

$$9,04 = 3,275 + 5,765$$

Dari kiri

Bagian	Luas	X_1	$A_i \cdot X_i$	X
A_1	18,8484	2,78	52,40	
A_2	18,7612	6,54	122,70	
A_3	26,8424	7,73	207,50	
	64,452		382,6	5,94

$$X = 382,6 : 64,452 = 5,94$$

Luas sama

$$X_1 = \frac{2}{3} \cdot 4,17 = 2,78$$

$$X_2 = \frac{1}{3} \cdot 7,12 + 4,17 = 6,54$$

$$X_3 = \frac{1}{2} \cdot 7,12 + 4,17 = 7,73$$

Dari Kanan

Bagian	Luas	X_1	$A_i \cdot X_i$	X
A_1	18,8484	8,51	160,40	
A_2	18,7612	4,75	89,1157	
A_3	26,8424	3,56	95,56	
	64,452		345,076	

Luasan yang sama

$$X = 345,076 : 64,452 = 5,35$$

$$X_1 = \frac{1}{3} \cdot 4,17 + 7,12 = 8,51$$

$$X_2 = \frac{2}{3} \cdot 7,12 = 4,75$$

$$X_3 = \frac{1}{2} \cdot 7,12 = 3,56$$

$$X = 5,94 + 5,35$$

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Sb. X

Benda	A	d	A · d ²	I _{x'}	I _x
A ₁	18,8484	0,262	1,2938	85,57	86,8638
A ₂	18,7612	2,252	95,1493	28,9474	124,0949
A ₃	26,8424	1,39	51,8622	31,7924	83,6546

→ I_{x'} + (A · d²)

→ Inersia x → 294,6133 m⁴

$$d_1 = 3,275 - 3,013 = 0,262$$

$$I_{x'} = \frac{1}{36} \cdot 4,17 \cdot 9,04^3 = 85,57$$

$$d_2 = 5,527 - 3,275 = 2,252$$

$$I_{x'} = \frac{1}{36} \cdot 7,12 \cdot 5,27^3 = 28,9474$$

$$d_3 = 3,275 - 1,885 = 1,39$$

$$I_{x'} = \frac{1}{12} \cdot 7,12 \cdot 3,77^3 = 31,7924$$

Sb Y → Kiri

Benda	A	d	A · d ²	I _{x'}	I _x
A ₁	18,8484	3,16	188,2126	18,2085	206,4211
A ₂	18,7612	0,6	6,7540	52,8382	59,5922
A ₃	26,8424	1,79	86,0057	113,3966	199,4023

→ I_{x'} + (A · d²)

→ Inersia y = 465,4156 m⁴

$$d_1 = 5,94 - 2,78 = 3,16$$

$$I_{x'} = \frac{1}{36} \cdot 4,17^3 \cdot 9,04 = 18,2085$$

$$d_2 = 6,54 - 5,94 = 0,60$$

$$I_{x'} = \frac{1}{36} \cdot 7,12^3 \cdot 5,27 = 52,8382$$

$$d_3 = 7,73 - 5,94 = 1,79$$

$$I_{x'} = \frac{1}{12} \cdot 7,12^3 \cdot 3,77 = 113,3966$$

3. Jet fluida

$$d = f(p, \mu, \rho, v, D)$$

$$\mu = M \cdot L^{-1} \cdot T^{-1}$$

$$v = L \cdot T^{-1}$$

$$D = L$$

$$d = L$$

Metode Buckingham

$$\pi_1 = M^{a_1} \cdot v^{b_1} \cdot D^{c_1} \cdot d$$

$$F^0 L^0 T^0 = (F \cdot L^{-1} \cdot T^{-1})^{a_1} \cdot (L \cdot T^{-1})^{b_1} \cdot (L)^{c_1} \cdot (L)$$

$$\text{Maka} \Rightarrow F \rightarrow 0 = a_1$$

$$L \rightarrow 0 = -a_1 + b_1 + c_1 + 1 \rightarrow C_1 = -1$$

$$T \rightarrow 0 = -a_1 - b_1$$

$$0 = 0 - b_1$$

$$b_1 = 0$$

$$\text{Jadi } \pi_1 = M^0 \cdot v^0 \cdot D^{-1} \cdot d$$

$$\pi_1 = \frac{d}{D}$$

$$\pi_2 = M^{a_2} v^{b_2} D^{c_2} \cdot \rho$$

$$F^0 L^0 T^0 = (F \cdot L^{-1} \cdot T^{-1})^{a_2} \cdot (L \cdot T^{-1})^{b_2} \cdot (L)^{c_2} \cdot (F \cdot L^{-3})$$

$$\text{Maka} = F \rightarrow 0 = a_2 + 1$$

$$a_2 = -1$$

$$T \rightarrow 0 = -a_2 - b_2$$

$$0 = 1 - b_2$$

$$b_2 = 1$$

$$L \rightarrow 0 = -a_2 + b_2 + c_2 - 3$$

$$0_2 = 1 + 1 + c_2 - 3$$

$$c_2 = 1$$

$$\text{Maka } \pi_2 = M^{-1} \cdot v^1 \cdot D^1 \cdot \rho$$

$$= \frac{\rho \cdot v \cdot D}{\mu}$$

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(5) (2)

Metode Rayleigh

$$\Pi_3 = M^{a_3} \cdot v^{b_3} \cdot D^{c_3} \cdot \sigma$$
$$F^0 \cdot L^0 \cdot T^0 = (F \cdot L^{-1} \cdot T^{-1})^{a_3} (L \cdot T^{-1})^{b_3} (L)^{c_3} \cdot (F \cdot T^{-2})$$

Maka $F \rightarrow 0 = a_3 + 1$

$$a_3 = -1$$

$T \rightarrow 0 = -a_3 - b_3 - 2$

$$0 = 1 - b_3 - 2$$

$$b_3 = -1$$

$L \rightarrow 0 = -a_3 + b_3 + c_3$

$$0 = 1 - 1 + c_3$$

$$c_3 = 0$$

Maka $\Pi_3 = M^{-1} \cdot v^{-1} \cdot D^0 \cdot \sigma$

$$\Pi_3 = \frac{\sigma}{M \cdot v}$$

Jadi $\Pi_1 = f(\Pi_2, \Pi_3)$

$$\frac{d}{D} = F \left(\frac{P \cdot v \cdot D}{M}, \frac{\sigma}{M \cdot v} \right)$$

Metode Rayleigh

$$d = F(P, M, \sigma, v, D)$$

$$d = K P^a M^b \sigma^c v^d D^e$$

$$L = K \left(\frac{M}{L^3} \right)^a \left(\frac{M}{LT} \right)^b \left(\frac{M}{T^2} \right)^c \left(\frac{L}{T} \right)^d (L)^e$$

$$L = K (M \cdot L^{-3})^a (M \cdot L^{-1} T^{-1})^b (M \cdot T^{-2})^c (L \cdot T^{-1})^d (L)^e$$

$$L = K M^a L^{-3a} M^b L^{-b} T^{-b} M^c T^{-2c} L^d T^{-d} L^e$$

$$M \Rightarrow 0 = a + b + c$$

$$L \rightarrow 1 = -3a - b + b + e$$

$$T \rightarrow 0 = -b - 2c - d$$

$$2a + 2b + 2c = 0$$

$$0 = -3a - b + (-b - 2c) + (a+1) - 1$$

$$-3a - b + d + e = 1$$

$$0 = -2a - 2b - c$$

$$-b - 2c - a = 0 \quad +$$

$$-a + e = 1$$

$$e = a + 1$$

$$-2a - 2b - c = 0$$

$$d = -b - 2b$$

$$2a + 2b + 2c = 0 \quad +$$

$$= -b - 2 \cdot (0)$$

$$c = 0$$

$$d = -b$$

$$a + b + 0 = 0$$

$$a = -b$$

$$a = d$$

$$a = 1$$

$$e = a + 1$$

$$b = -1$$

$$e = 1 + 1$$

$$d = 1$$

$$e = 2$$

$$e = 2$$

$$c = 0$$

$$\text{Maka } d = k \rho' \mu^{-1} \sigma^0 v' D^2$$

$$d = \frac{k \rho \cdot v \cdot b^2}{\mu}$$

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5. Keseimbangan Benda Terapung

Diketahui $\rho = 0,62$

$t = 1,12 \text{ m}$

sisi = $0,82 \text{ m}$

Ditanya = Tinggi metasetrum & stabilitas?

$\rightarrow \rho = \frac{\rho_{\text{benda}}}{\rho_{\text{air}}} \rightarrow \rho_{\text{benda}} = 0,62 \times 1000 = 620 \text{ kg/m}^3$

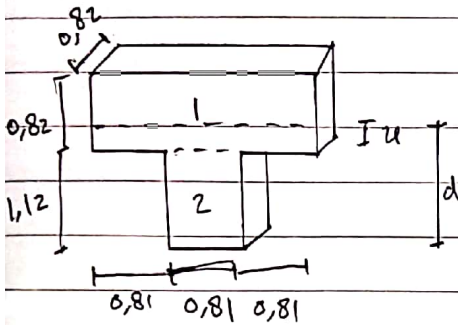
\rightarrow berat benda $F_g = W \cdot U$

$= \rho \cdot g \cdot (V_1 + V_2)$

$= 620 \cdot 9,81 ((0,82^2 \cdot 2,46) + (0,82^2 \cdot 1,12))$

$= 14641,02318 \text{ N}$

$= 14,64 \text{ kN}$



- Berat yang dipindahkan

$F_B = \rho_{\text{air}} \cdot g \cdot V$

$= 1000 \cdot 9,81 [(0,82^2 \cdot 1,12) + (0,82 \cdot 2,46 \cdot x)]$

$= (7387,79 + 19788,732x) \text{ N}$

$= (7,39 + 19,79x) \text{ kN}$

- Mengapung $F_B = F_G$

$7,39 + 19,79x = 14,64$

$x = \frac{14,64 - 7,39}{19,79}$

$x = 0,366 \text{ m}$

$d = 0,366 + 1,12 = 1,486 \text{ m}$

Jarak pusat akun apung

Benda	A_i	Y_i	$A_i \cdot Y_i$
1	$0,366 \times 2,46 = 0,90036$	$\frac{1}{2} \cdot 0,366 + 1,12 = 1,303$	1,1731
2	$0,82 \times 1,12 = 0,9184$	$\frac{1}{2} \cdot 1,12 = 0,56$	0,5143
	1,81876		1,6874

$$Y = \frac{1,6874}{1,81876} = 0,93 \text{ m}$$

- Jarak Pusat benda

Benda	A _i	Y _i	A _i Y _i	Y
1	2,0172	1,53	3,086	
2	0,9184	0,56	0,514	
	2,9356		3,600	

$$Y = \frac{3,6}{2,9356} = 1,23 \text{ m}$$

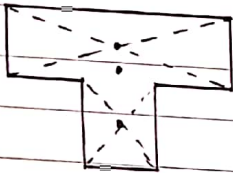
$$A_1 = 0,82 \times 2,46 = 2,0172$$

$$A_2 = 0,82 \times 1,12 = 0,9184$$

$$Y_1 = \frac{1}{2} \cdot 0,82 + 1,12 = 1,53$$

$$Y_2 = \frac{1}{2} \cdot 1,12 = 0,56$$

$$BE = OE - OB = 1,23 - 0,93 = 0,3 \text{ m}$$



$$d_1 = 1,53 - 1,23 = 0,30 \text{ m}$$

$$d_2 = 1,23 - 0,56 = 0,67 \text{ m}$$

Inersia

Sb. X

Benda	A	d	A · d ²	I _{x'}	I _x (I _{x'} + A d ²)	I _{x'}
1	2,0172	0,3	0,1815	$\frac{1}{12} \cdot 2,46 \cdot 0,82^3$	0,2945	0,1130
2	0,9184	0,67	0,6153	$\frac{1}{12} \cdot 0,82 \cdot 1,12^3$	0,7113	0,0960
					1,0058 m ⁴	

Sb. Y

↳ yang kecil

Benda	A	d	A · d ²	I _{x'}	I _x	I _{x'}
1	2,0172	0	0	$\frac{1}{12} \cdot 2,46^3 \cdot 0,82$	1,01727	
2	0,9184	0	0	$\frac{1}{12} \cdot 0,82^3 \cdot 1,12$	0,06455	
					1,08182 m ⁴	

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Dipindai dengan CamScanner

$$\begin{aligned} - \text{Volume basah} &= (0,82^2 \cdot 1,12) + (0,82 \cdot 2,46 \cdot 0,366) \\ &= \cancel{1,43685} \\ &= 1,4913832 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} - \text{BM} &= \frac{I_{ox}}{V_{\text{basah}}} = \frac{1,0058}{1,4913832} = 0,6744 \end{aligned}$$

$$\begin{aligned} - \text{Tinggi meta setrum} &= \text{GM} = \text{BM} - \text{BG} \\ &= 0,6744 - 0,3 \\ &= 0,3744 \rightarrow \text{positif (+) yang berarti stabil} \end{aligned}$$