	x	y	z
Diketahui	2	8	5

TUGAS 1
MEKANIKA FLUIDA 2020

1. kapilaritas

Diketahui

- Prisma tegak sisi 6 sama sisi dengan panjang = 4,85 cm ~ 0,0485 m.
- Masuk kedalam air secara tegak
- Tegangan permukaan (σ) = 0,0825 N/m.
- Berisi raksa ~ $\theta = 140^\circ$ (sudut)

Kenaikan pipa kapiler : ?

Jawab

$$P.\sigma.\cos\theta = A.h.\gamma$$

$$6.s.\sigma.\cos\theta = 3/2\sqrt{3}\, s^2.h.\gamma$$

$$h = \frac{6.s.\sigma.\cos\theta}{3/2\sqrt{3}\, s^2.\gamma}$$

$$h = \frac{6.s.\sigma.\cos\theta}{3/2\sqrt{3}.s^2.\rho.g}$$

$$= \frac{6.0{,}0485m.0{,}0825\ N/m.\cos 140^\circ}{3/2\sqrt{3}(0{,}0485)^2.1000\ kg/m^3.9{,}81\ m/s^2}$$

$$= -3{,}0675.10^{-4}\ m.$$

2. Viskositas Dinamis

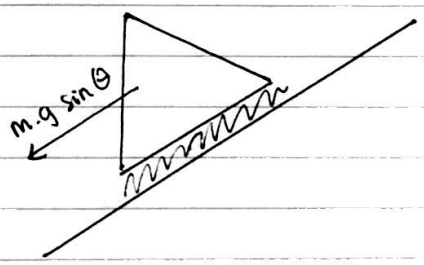
$V = 0{,}35\ m/s$

$r = 1{,}58\ m$

$m = 98{,}28\ kg$

$\theta = 44{,}28^\circ$

$z_0 = 2{,}28\ mm \rightsquigarrow 2{,}33.10^{-3}\ m.$



* Tegangan gerer ~ persamaan Stoker : gaya gesek ~ berat benda

$$F = w$$

$$= m.g.\sin\theta$$

$$= 98{,}28.9{,}81.\sin 44{,}28$$

$$= 673{,}12\ kg\ m/s$$

$$= 673{,}12\ N.$$

Nama : Mia Ayu Prasetyani
NIM : 17/410628/SV/12555

x	y	z
2	8	5.

* Tegangan geser : $\frac{F}{A}$

$$: \frac{673,12}{\pi . r^2}$$

$$: \frac{673,12}{3,14 . 1,58^2}$$

$$: 85,87 \ kg/m.s$$

Viskositas Dinamis.

$$\tau : \mu . \frac{dv}{dz}$$

$$\mu = \frac{\tau}{dv/dz}$$

$$: \frac{85,87}{0,35/2,33.10^{-3}}$$

$$= 0,572 \ kg/m.s.$$

3. Analisis Dimensi metode Buckingham dan Rayleigh.

$d = f(\rho . \mu . \sigma . V . D.$ Injeksi → jet fluida

$\mu : m . L^{-1} . T^{-1}$

$V : L . T^{-1}$

$D : L$

$d : L$

Metode Bukingham

$\pi_1 = \mu^{a_1} . V^{b_1} . D^{c_1} . d$

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

Maka $F \rightarrow 0 = a_1$

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

$T \rightarrow 0 = -a - b_1$

$0 = 0 - b_1$

$b_1 = 0$

Jadi $\pi_1 = \mu^0 . V^0 . D^{-1} . d.$

$$\pi = \frac{d}{D.}$$

Nama : Mia Ayu Prasetyani

NIM : 17/410628/SV/12551

x	y	z
2	8	5

$\pi_2 = \mu^{a_2} . V^{b_2} . D^{c_2} . \rho$

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

maka

$F \rightarrow 0 : a_2 + 1$

$a_2 : -1$

$T \rightarrow 0 : -a_2 - b_2$

$0 : 1 - b_2$

$b_2 : 1$

$L : 0 = -a_2 + b_2 + c_2 - 3$

$0 = 1 + 1 + c_2 - 3$

$c_2 : 1$

Maka $\pi_2 = \mu^{-1} . V^1 . D^1 . \rho$

$= \frac{\rho . V . D}{\mu}$

$\pi_3 = \mu^{a_3} . V^{b_3} . D^{c_3} \sigma$

$F^0 . L^0 T^0 = (F . L^{-1} . T^{-1})^{a_3} (L . T^{-1})^{b_3} (L)^{c_3} . (F . T^{-2})$

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

$\pi_3 = \mu^{-1} . V^{-1} . D^0 . \sigma$

$\pi_3 = \frac{\sigma}{\mu . V}$

Jadi $\pi_1 = f(\pi_2, \pi_3)$

$\frac{d}{D} = f\left(\frac{\rho . V . D}{\mu}, \frac{\sigma}{\mu . V}\right)$

Metode Rayleigh

$d = f(\rho . \mu . \sigma . V . D)$

$d = k \rho^a \mu^b \sigma^c V^d D^e$

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

$L = k (m . L^{-3})^a (m . L^{-1} T^{-1})^b (m . T^{-2})^c (L . T^{-1})^d (L)^e$

$L = k\, m^a L^{-3a} m^b L^{-b} T^{-b} m^c T^{-2c} L^d T^{-d} L^e$

$m \rightarrow 0 = a + b + c$

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

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

Nama : Mia Ayu Prasetyani

NIM : 17/410628/SV/12555

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

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

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

$-a + e = 1$

$e = a + 1.$

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

$0 = -2a - 2b - 2c \quad \ldots (2)$

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

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

$c = 0$

$d = -b - 2c$

$= -b - 2.(0)$

$d = -b.$

$a + b + 0 = 0$

$a = -b$

Maka $a = d.$

$e = a + 1$

$e = 1 + 1$

$= 2$

Maka

$a = 1$

$b = -1$

$d = 1$

$e = 2$

Jadi $d = k\, \rho^1\, \mu^{-1}\, T^0\, v^1\, D^2$

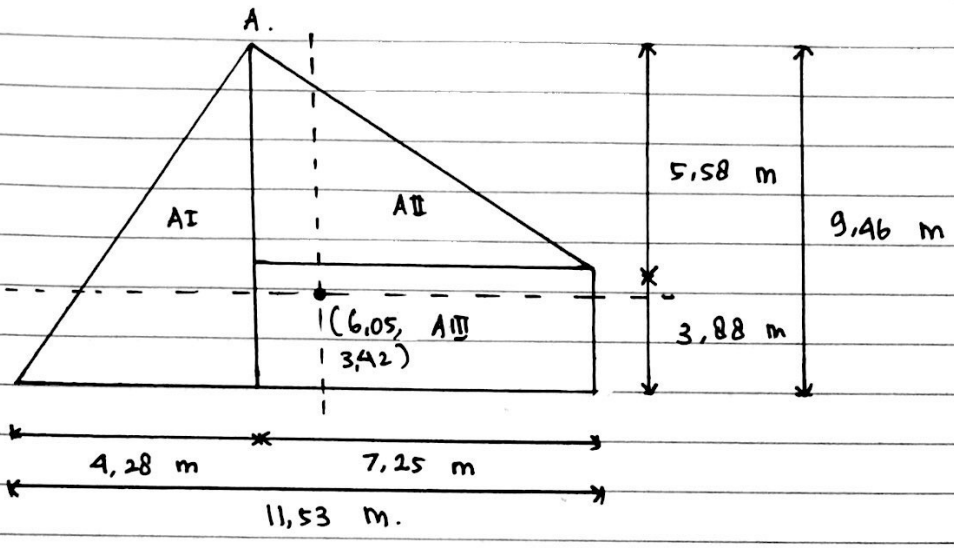
$d = \frac{k \rho . v . D^2}{\mu}.$

Nama : Mia Ayu Prasetyani

NIM : 17/410628/SV/12551

x	y	z
2	8	5

9. Momen Inersia



* Menentukan titik berat dari kiri dan bawah.

Bangun	Luas (A)	x	A . x	y	A . y	d_x	A . d_x^2	d_y	A . dy^2
AI	20,29	2,85	57,68	3,15	63,76	3,2	207,26	0,27	1,475
AII	20,22	6,69	135,27	5,74	116,06	0,64	8,28	2,32	168,83
AIII	28,13	7,9	222,23	1,94	54,57	1,85	96,27	1,48	61,61
Total	68,59		415,18		234,39				

Titik berat Sb x : $\frac{415,18}{68,59}$ = 6,05 m

titik berat Sb y : $\frac{234,39}{68,59}$: 3,42 m.

* Menentukan titik berat dari kanan dan atas.

Bangun	luas (A)	x	A . x	y	A . y	d_x	A . d^2	d_y	A . dy^2
AI	20,24	8,68	175,68	6,31	127,71	3,2	207,26	0,27	1,475
AII	20,22	4,83	97,66	3,72	75,22	0,64	8,28	2,32	108,83
AIII	28,13	3,625	101,97	7,52	211,54	1,85	96,27	1,48	61,61
Total	68,59		375,31		414,47				

Titik berat Sb x : $\frac{375,31}{68,59}$: 5,47 m.

titik berat Sb y : $\frac{414,47}{68,59}$: 6,04 m.

Nama : Mia Ayu P.
NIM : 17/410628/SV/12555

X	y	z
2	8	5.

Tabel keterangan 2

Keterangan Tabel

* Luas (A) → luar dari bangun

$A_1 = \frac{1}{2} . a . t$

$= \frac{1}{2} . 4,28 . 9,46$

$= 20,24 \ m^2$

* X → titik dari dilihat dari kiri

$A_1 \rightsquigarrow x = \frac{2}{3} . 4,28$

$= 2,85 \ m$

* A . x → merupakan perkalian luas dan x

$A_1 \rightsquigarrow A . x$

$= 20,24 . 2,85$

$= 57,68 \ m^2$

* y → dilihat dari bawah

$A_1 \rightsquigarrow y \rightsquigarrow \frac{1}{3} . 9,46$

$= 3,15 \ m$

* A.y → perkalian luas dan y

$A_1 \rightsquigarrow A.y$

$20,24 . 3,15$

$= 63,76$

* dx merupakan jarak titik berat bangun A_1 dan titik berat bangun gabungan dilihat dr Sb x

$A_1 \rightsquigarrow dx = 3,2$

* $A.dx^2$ → luas dikali dx^2

$A_1 \rightsquigarrow A . dx^2$

$= 20,24 . 3,2^2$

$= 207,26$

* dy merupakan titik berat bangun A_1 & titik berat bangun gabungan dilihat dari Sb y

$A_1 \rightsquigarrow dy = 0,27$

* $A.dy^2$ → luas dikali dy^2

$A_1 \rightsquigarrow A . dy^2$

$= 20,24 . 0,27^2$

$= 1,475$

Nama : Mia Ayu Prasetyani
NIM : 17/410628/SV/12555

* Menentukan Momen Inersia

Bangun A I

$I_{x_1} = 1/36 \cdot b \cdot h^3 + A \cdot d_x^2$

$= 1/36 \cdot 4,28 \cdot 9,46^3 + 207,26$

$= 307,91 \ m^4$

$I_{y_1} = 1/36 \cdot b^3 \cdot h + A \cdot dy^2$

$= 1/36 \cdot 4,28^3 \cdot 9,46 + 1,475$

$= 22,08 \ m^4$

Bangun A II

$I_{x_2} = 1/36 \cdot b \cdot h^3 + A \cdot d_x^2$

$= 1/36 \cdot 7,25 \cdot 5,58^3 + 8,28$

$= 93,27 \ m^4$

$I_{y_{II}} = 1/36 \cdot b^3 \cdot h + A \cdot dy^2$

$= 1/36 \cdot 7,25^3 \cdot 5,58 + 108,83$

$= 167,89 \ m^4$

Bangun A III

$I_{x_{III}} = 1/12 \cdot b \cdot h^3 + A \cdot d_x^2$

$= 1/12 \cdot 7,25 \cdot 3,88^3 + 96,27$

$= 131,56 \ m^4$

$I_{y_{III}} = 1/12 \cdot b^3 \cdot h + A \cdot dy^2$

$= 1/12 \cdot 7,25^3 \cdot 3,88 + 61,61$

$= 184,82 \ m^4$

I_x total $= I_{x_1} + I_{x_{II}} + I_{x_{III}}$

$= 307,91 + 93,27 + 131,56$

$= 482,74 \ m^4$

I_y total $= I_{y_I} + I_{y_{II}} + I_{y_{III}}$

$= 22,08 + 167,89 + 184,82$

$= 374,79 \ m^4$

Nama : Mia Ayu P.
NIM : 17/410628/SV/12555

x	y	z
2	8	5

5. Keseimbangan benda terapung

rapat relatif : 0,65

tinggi : 1,25 m.

sisi : 0,85 m.

Diapungkan dalam air dengan sumbu panjang Vertikal.

Ditanya : Tinggi metasentrum ?

Stabilitas benda ?

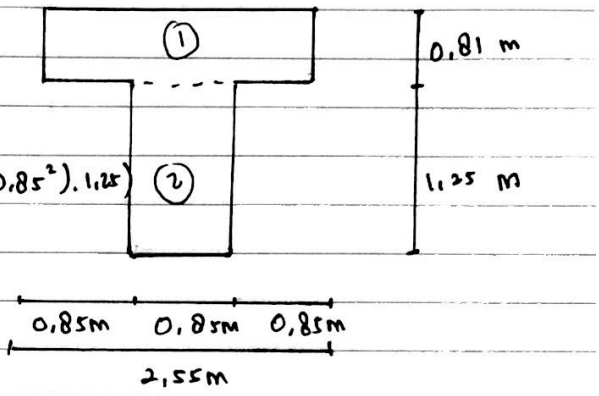
Jawab.

$S = \frac{\rho \text{ benda}}{\rho \text{ air}}$

ρ benda : 0,65 . 1000

: 650 kg/m³.

Berat benda



$F_G = W \cdot V$

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

$= 650 \cdot 9,81 \left((0,85^2 \cdot 2,55) + (0,85^2) \cdot 1,25\right)$

$= 17506,68$ N

$= 17,51$ kN.

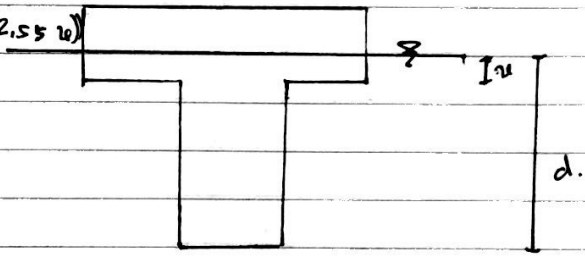
Berat air yang dipindahkan

$F_B = \rho air \cdot g \cdot V$

$= 1000 \cdot 9,81 \left((0,85^2 \cdot 1,25) + (0,85 \cdot 2,55\, u)\right)$

$= (8859,66 + 21263,18\, u)$ N

$= (8,86 + 21,26u)$ kN.



Benda mengapung

$F_B = F_G$

$8,86 + 21,26\, u = 17,51$

$u = 0,41$ m.

$d = u + 1,25$

$= 0,41 + 1,25$

$= 1,66$ m.

Nama : Mia Ayu Praretyani

NIM : 17/410628/SV/12555

* Jarak pusat Apung.

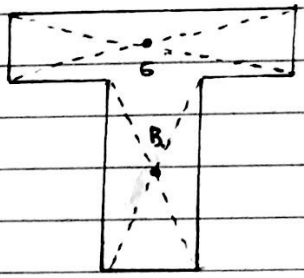
Bagian	A	y_i	A . y.
1.	0,91 x 2,55 : 1,05	1/2.0,91 + 1,25 : 1,455	1,53
2.	0,85 x 1,25 : 1,06	1/2 . 1,25 : 0,625	0,66
Jumlah	2,11		2,19

$OB = y = \frac{2,19}{2,11} = 1,04$ m.

Jarak pusat benda

Bagian	A	y_i	A.y.
1	0,85 . 2,55 : 2,16	1/2 . 0,85 + 1,25 : 1,675	3,62
2	0,85 . 1,25 : 1,06	1/2 . 1,25 : 0,625	0,662
Jumlah	3,22		4,28

$OG = y = \frac{4,28}{3,22} = 1,33$ m.



$BG = OG - OB$
$= 1,33 - 1,04$
$= 0,29$ m.

$d_1 = y_{i①} - OG = 1,455 - 1,33 = 0,125$ m
$d_2 = OG - y_{i②} = 1,33 - 0,625 = 0,705$ m.

Mencari momen inersia (Sb x)

bagian	A	d	Ad^2	I_x'	$I_x (I_x' + Ad^2)$
1	2,16	0,125	0,034	$1/12 . 2,55 . 0,85^3 = 0,122$	0,156
2	1,06	0,705	0,53	$1/12 . 0,85 . 1,25^3 = 0,138$	0,668 +

$I_{total} = 0,824$ m^4 (dipakai)

Inersia Sb y.

bagian	A	d	Ad^2	I_y'	$I_y = (I_y' + Ad^2)$
1	2,16	0	0	$1/12 . 2,55^3 . 0,85 = 1,174$	1,174
2	1,06	0	0	$1/12 . 0,85^3 . 1,25 = 0,063$	0,063 +

$I_{y\ total} = 1,237$ m^4

Volume bagian $= (0,85^2 . 1,25) + (0,85 . 2,55 . 0,41)$
$= 1,7918$ m^3

$BM = \frac{I_{ox}}{V_{bagian}} = \frac{0,824}{1,7918} = 0,46$ m.

Tinggi metasentum $GM = BM - BG$
$: 0,46 - 0,29$
$: 0,17$

Stabil karena Tinggi metasentrum (+)

Mia Ayu Prasetyani