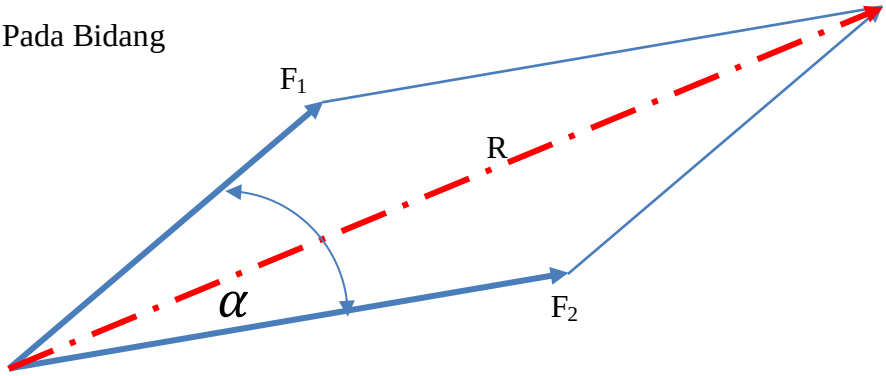
GAYA

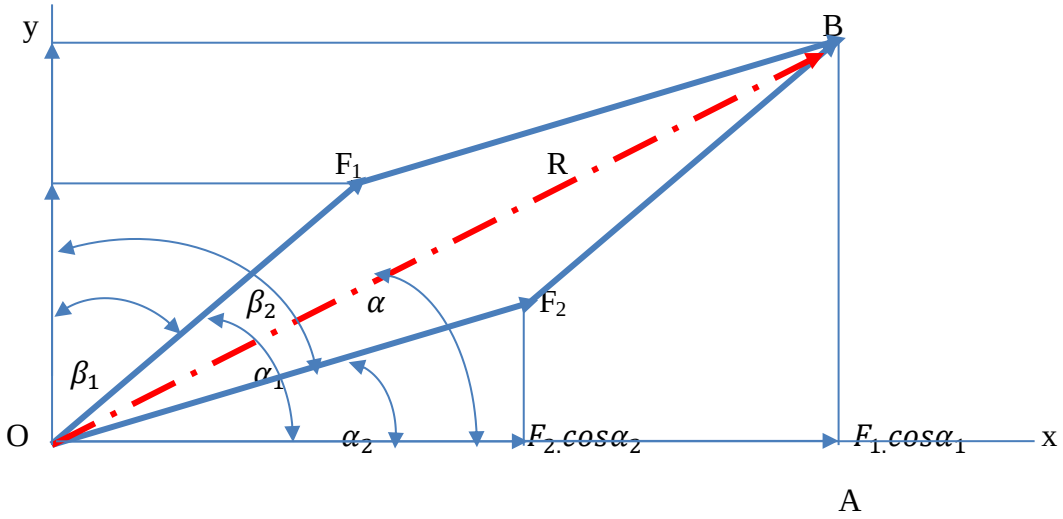
A. Gaya Pada Bidang



Resultante (R):

$$\mathbf{R} = \sqrt{\mathbf{F_1^2 + F_2^2 + 2F_1F_2.cos\alpha}}$$

Jika diketahui lebih dari dua gaya, maka yang digunakan adalah rumus sebagai berikut:



$\sum F_x = R \cos \alpha = F_1 \cos \alpha_1 + F_2 \cos \alpha_2$

$\sum F_y = R \cos \beta = F_1 \cos \beta_1 + F_2 \cos \beta_2$

Dalam Δ OAB:

$R^2 = OA^2 + AB^2$

$R^2 = \sum F_x^2 + \sum F_y^2$

$$\mathbf{R} = \sqrt{\sum \mathbf{F_x^2} + \sum \mathbf{F_y^2}}$$

$$\mathbf{tg\ \alpha} = \frac{\sum \mathbf{F_y}}{\sum \mathbf{F_x}}$$

Contoh:

Diketahui:

$\alpha_1 = 45^0$ $\beta_1 = 45^0$

$\alpha_2 = 15^0$ $\beta_2 = 75^0$

F_1 = 10 0 N F_2 = 200 N

Ditanyakan:

Besarnya resultante dan sudut yang dibentuknya terhadap sumbu x

Jawab:

$\sum F_x = F_1 \cos \alpha_1 + F_2 \cos \alpha_2$

= 100. Cos. 45^0 + 200. Cos 15^0

= 100. 0,7071 + 200. 0,9659

= 70,71 + 193,3

= 264, 01 N

$\sum F_y = F_1 \cos \beta_1 + F_2 \cos \beta_2$

= 100. Cos. 45^0 + 200. Cos 75^0

= 100. 0,7071 + 200. 0,2588

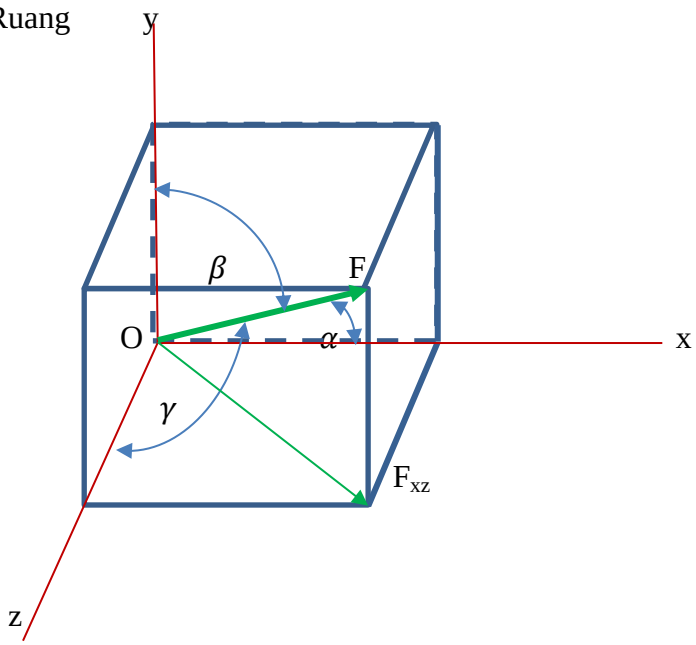
= 70,71 + 51,76

= 122,47 N

$$\mathbf{R} = \sqrt{\sum \mathbf{F_x^2} + \sum \mathbf{F_y^2}} = \sqrt{\mathbf{264,01^2 + 122,47^2}} = \sqrt{}$$

$$\mathbf{tg\ \alpha = \frac{F_y}{F_x} = \frac{122,47}{264,01} = 0,4626} \qquad \boldsymbol{Jadi\ \alpha = 24^0\ 50^1}$$

B. Gaya Pada Ruang



α : sudut F terhadap sumbu x

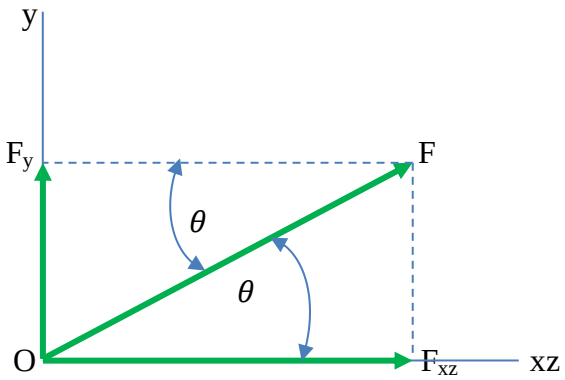
β : sudut F terhadap sumbu y

γ : sudut F terhadap sumbu z

Maka : $F_x = F \cos \alpha$

$F_y = F \cos \beta$

$F_z = F \cos \gamma$

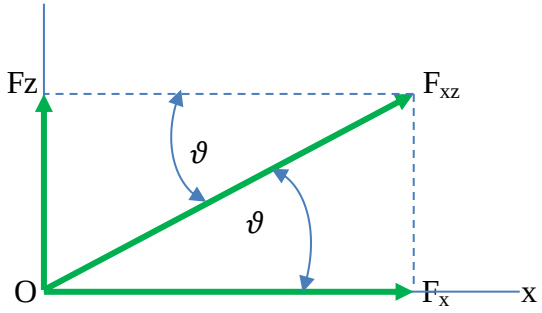


θ : sudut F terhadap sumbu xz

F_{xz} : F cos θ

F_y : F sin θ

$F^2 = F_{xz}^2 + F_y^2$ …… (1)



ϑ : sudut F_{xz} terhadap sumbu z

F_x : $F_{xz} \cos \vartheta$

F_z : $F_{xz} \sin \vartheta$

$F_{xz}^2 = F_z^2 + F_x^2$ ……(2)

Dari 1 da 2 didapat:

$F^2 = F_x^2 + F_y^2 + F_z^2$

$$F = \sqrt{F_x^2 + F_y^2 + F_z^2}$$

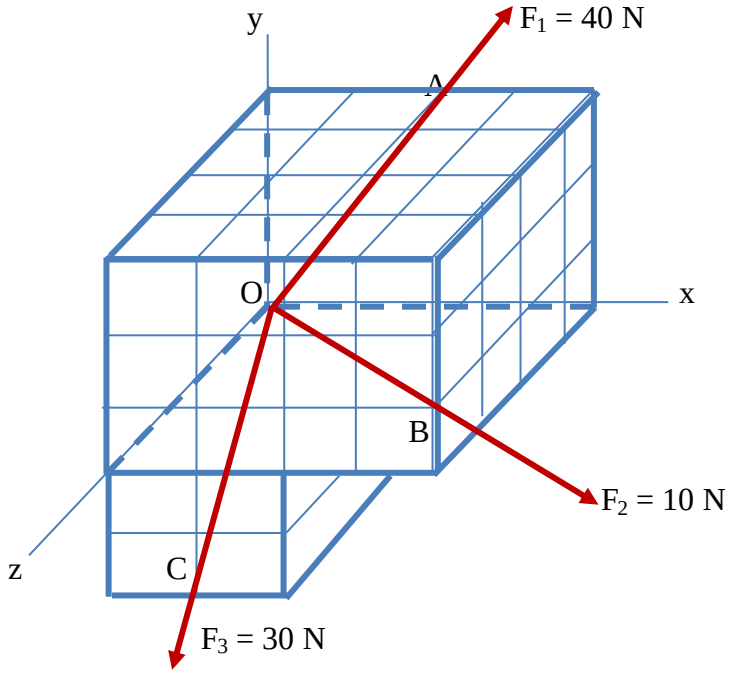
Jadi besarnya Resultante (R):

$$\boldsymbol{R = \sqrt{\sum F_x^2 + \sum F_y^2 + \sum F_z^2}}$$

$$\boldsymbol{Cos\ \alpha = \frac{\sum F_x}{R}} \qquad \boldsymbol{Cos\ \beta = \frac{\sum F_y}{R}} \qquad \boldsymbol{Cos\ \gamma = \frac{\sum F_z}{R}}$$

$$\boldsymbol{Cos^2\alpha + Cos^2\beta + Cos^2\gamma = 1}$$

Contoh:



$OA = \sqrt{x^2 + y^2 + z^2}$ $OB = \sqrt{x^2 + y^2 + z^2}$ $OC = \sqrt{x^2 + y^2 + z^2}$

$= \sqrt{2^2 + 3^2 + 0^2}$ $= \sqrt{4^2 + 1^2 + 4^2}$ $= \sqrt{1^2 + (-2)^2 + 4^2}$

= 3,6 = 5,7 = 4,6

$\sum F_x = F_1 \cos\alpha_1 + F_2 cos\alpha_2 + F_3 cos\alpha_3$ $\sum F_y = F_1 \cos\beta_1 + F_2 cos\beta_2 - F_3 cos\beta_3$

$= 40 * \frac{2}{3,6} + 10 * \frac{4}{5,7} + 30 * \frac{1}{4,6}$ $= 40 * \frac{3}{3,6} + 10 * \frac{1}{5,7} + 30 * \frac{-2}{4,6}$

$= 22 + 7 + 6,54 = \mathbf{35,54\ N}$ $= 33,2 + 1,75 - 13,1 = \mathbf{21,85\ N}$

$\sum F_z = F_1 \cos\gamma_1 + F_2 cos\gamma_2 + F_3 cos\gamma_3$

$= 40 * \frac{0}{3,6} + 10 * \frac{4}{5,7} + 30 * \frac{4}{4,6}$

= 0 + 7 + 26,1 = **33,1 *N***

$\boldsymbol{R = \sqrt{\sum F_x^2 + \sum F_y^2 + \sum F_z^2}}$

$= \sqrt{35,54^2 + 21,85^2 + 33,1^2}$

= 53,3 N

Sudut yang dibentuk oleh R:

$Cos\ \alpha = \frac{\sum F_x}{R} = \frac{35,54}{53,3} = 0,6668, \quad maka\ \alpha = 48^0 11^1$

$Cos\ \beta = \frac{\sum F_y}{R} = \frac{21,85}{53,3} = 0,4099, \quad maka\ \beta = 65^0 48^1$

$Cos\ \gamma = \frac{\sum F_z}{R} = \frac{33,1}{53,3} = 0,6210, \quad maka\ \gamma = 51^0 36^1$

Chek:

$\boldsymbol{Cos^2\alpha + Cos^2\beta + Cos^2\gamma = 1}$

$0,6668^2 + 0,4099^2 + 0,6210^2 = 1$

$0,9982 = 1$

KESETIMBANGAN & DIAGRAM BENDA BEBAS

Dalam memecahkan persoalan kesetimbangan benda tegar, sangatlah penting untuk meninjau semua gaya yang beraksi pada benda tersebut, juga sama pentingnya untuk tidak memasukan setiap gaya yang tidak langsung diterapkan pada benda itu. Jadi langkah pertama dalam memecahkan persoalan adalah ***penggambaran diagram benda bebas*** dari benda tegar yang sedang ditinjau.

Reaksi dapat dikelompokan menjadi tiga menurut jenis dukungan atau sambungan.

1. Reaksi yang ekuivalen dengan sebuah gaya yang diketahui garis aksinya
2. Reaksi yang ekuivalen dengan gaya yang arahnya tidak diketahui
3. Reaksi yang ekuivalen dengan suatu gaya dan suatu kopel.

Syarat Setimbang:

$$\sum F_x = 0$$

$$\sum F_y = 0$$

Jika dalam ruang ditambah:

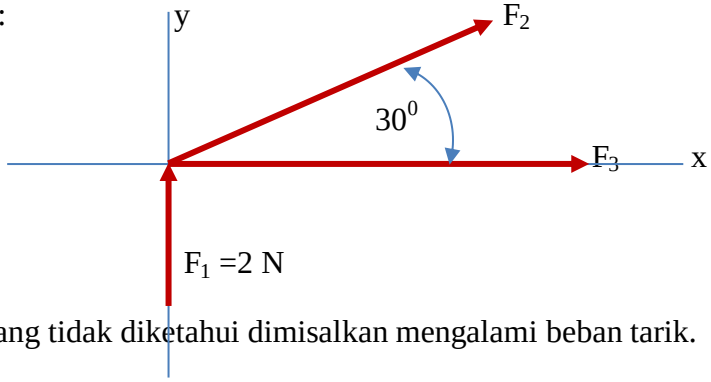
$$\sum F_z = 0$$

Jika ada unsur momen, maka:

$$\sum M = 0$$

Contoh:

(1)



Gaya yang tidak diketahui dimisalkan mengalami beban tarik.

$$\sum F_y = 0$$

$F_1 + F_2 \sin 30^0 = 0$

$2 + F_2.0{,}5 = 0$

$2 = -\ 0{,}5.F_2$

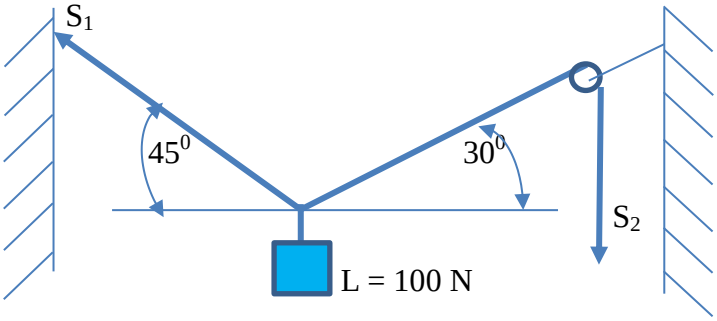
F_2 = - 4 N (beban tekan)

$$\sum F_x = 0$$

- $F_2 \text{ Cos } 30^0 + F_3 = 0$
- $4 .0{,}5\sqrt{3} + F_3 = 0$

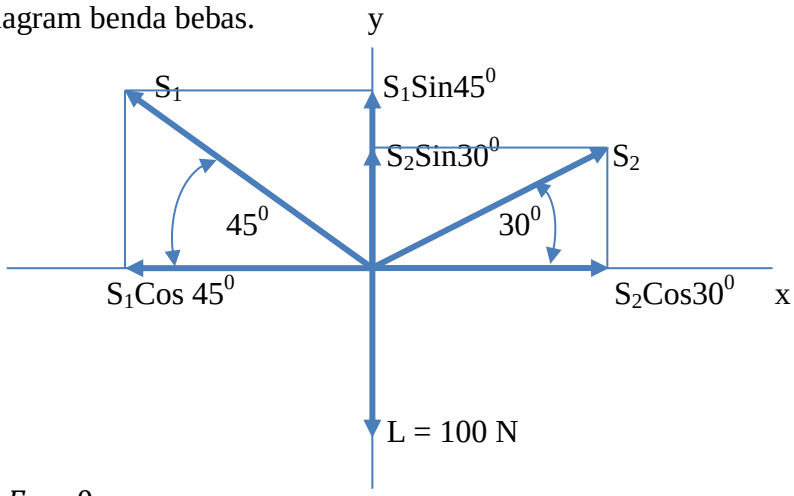
  $F_3 = 2\sqrt{3}$ (beban tarik)

(2)



Jawab.

Diagram benda bebas.



$\sum F_x = 0$

$-S_1\text{Cos}45^0 + S_2\text{Cos}30^0 = 0$ ……(1)

$\sum F_y = 0$

$S_1\text{Sin}45^0 + S_2\text{Sin}30^0 - 100 = 0$ ……(2)

Dari (1) dan (2) :

$-S_1 * 0{,}7071 + S_2 * 0{,}8660 = 0$

$\underline{S_1 * 0{,}7071 + S_2 * 0{,}5 - 100 = 0}$

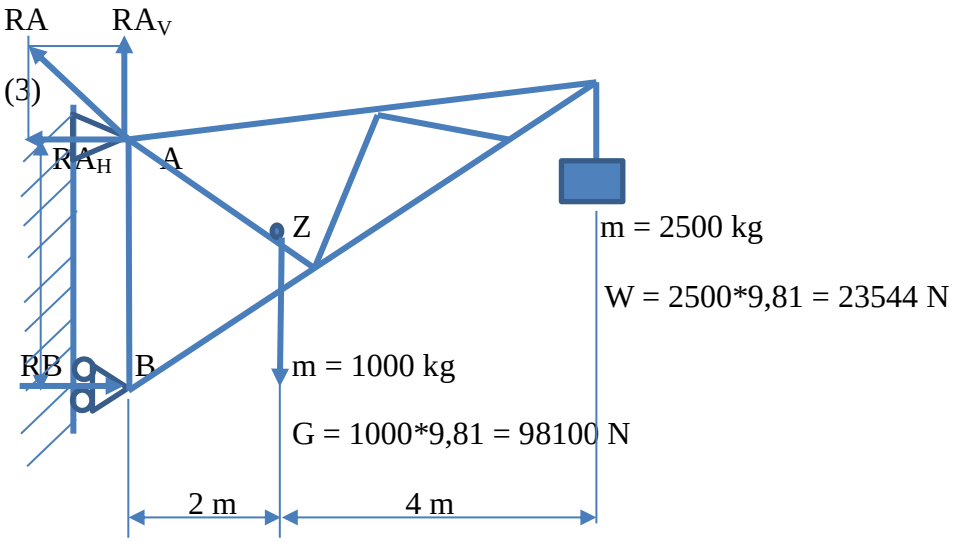
$S_2 * 1{,}3660 = 100$

$S_2 = 73{,}2$ N

$S_1 * 0{,}7071 + 73{,}2 * 0{,}5 - 100 = 0$

$S_1 = 89{,}66$ N

(3)



$$\sum M_A = 0$$

-RB*1,5 + G*2 + W*6 = 0

RB*1,5 - 9810*2 – 23544*6 = 0

RB*1,5 – 19620 – 141264 = 0

$$\mathbf{RB} = \frac{\mathbf{160884}}{\mathbf{1,5}} = \mathbf{1077256\ N}$$

$$\sum M_B = 0$$

- RA$_x$*1,5 + G*2 + W*6 = 0
- RA$_x$*1,5 +98100*2 + 23544*6 = 0

$$\mathbf{RAx} = -\frac{\mathbf{160884}}{\mathbf{1,5}} = \mathbf{1077256\ N}$$

$$\sum F_y = 0$$

RA$_y$ + G + W = 0

RA$_y$ + 9810 + 23544 = 0

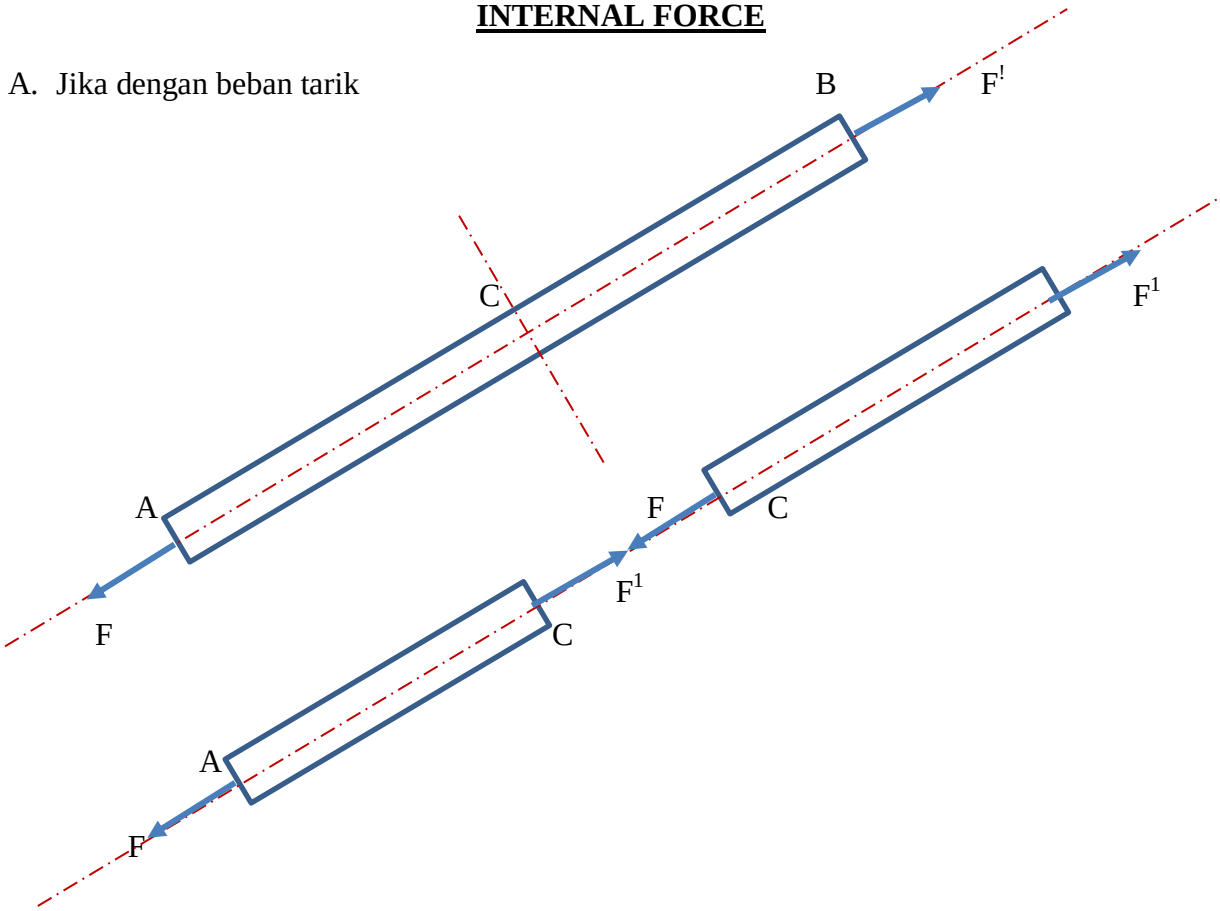
$$\mathbf{RA_y = 33354\ N}$$

$$\mathbf{tg}\ \boldsymbol{\alpha} = \frac{RA_y}{RA_x} = \frac{33354}{107256} = \mathbf{0,3110}$$

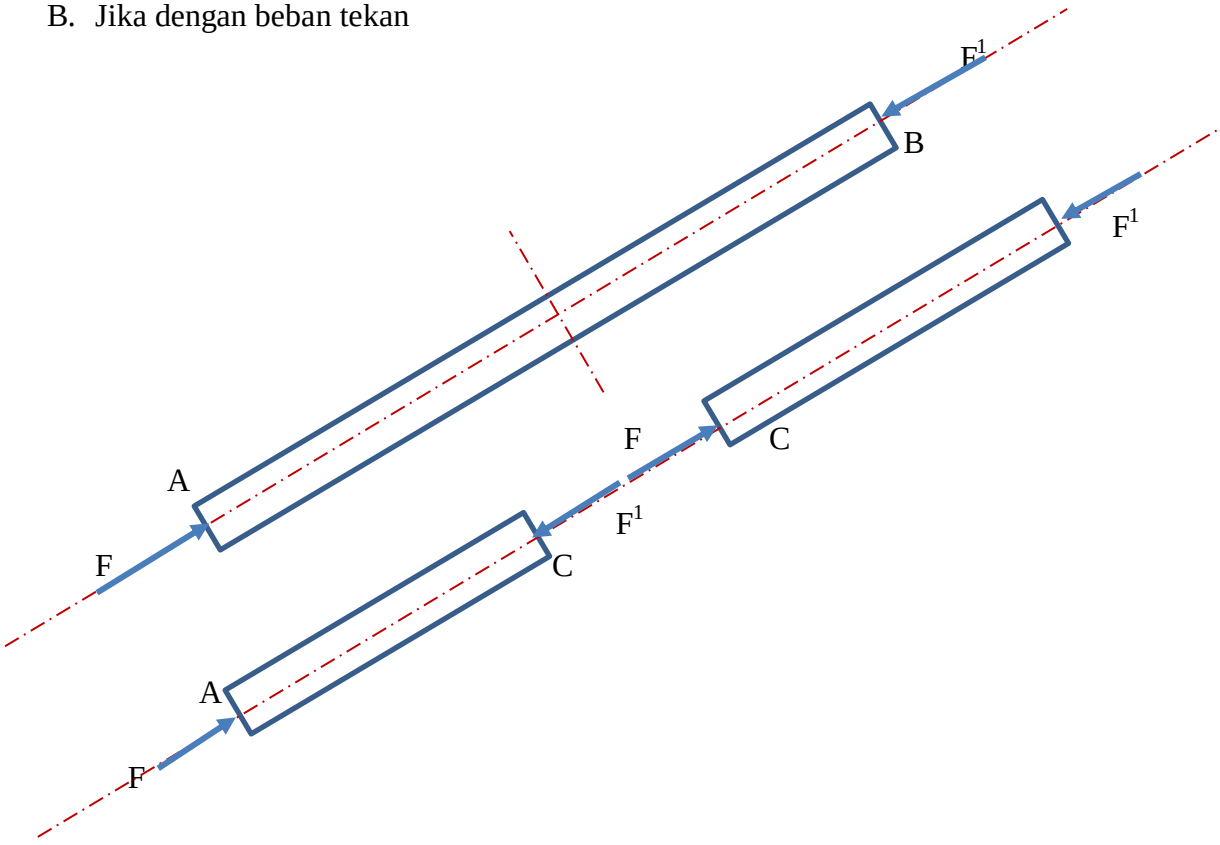
$$\boldsymbol{\alpha} = \mathbf{17^0 17^1}$$

INTERNAL FORCE

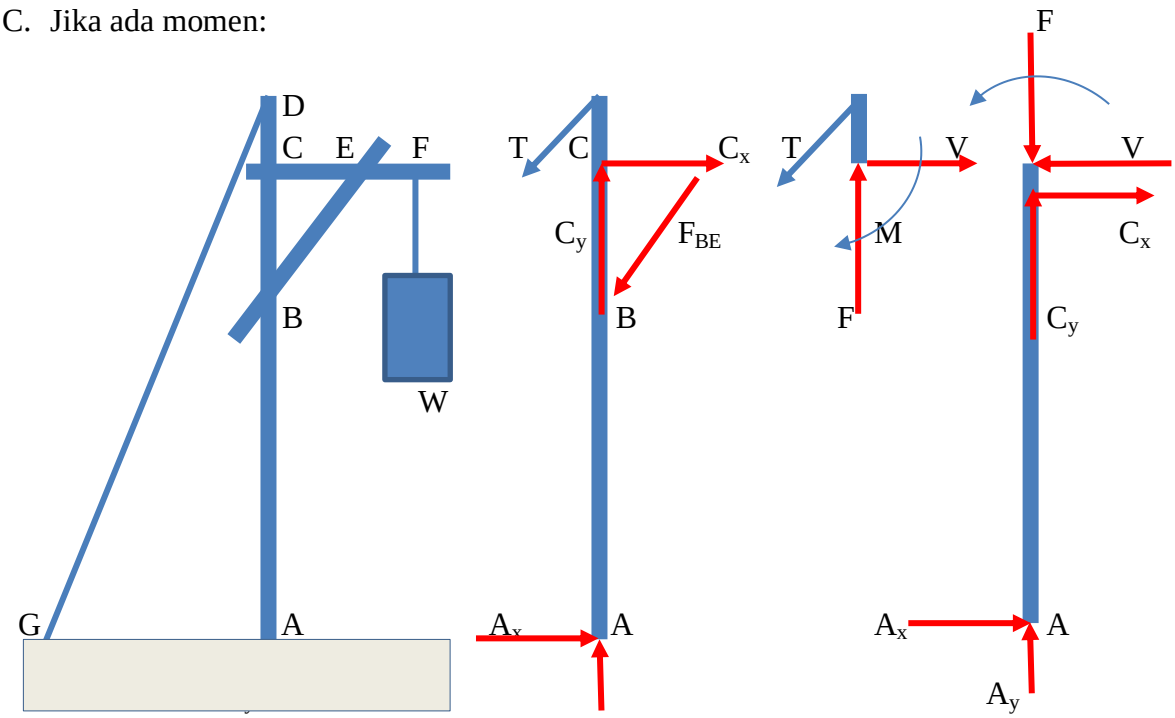
A. Jika dengan beban tarik



B. Jika dengan beban tekan



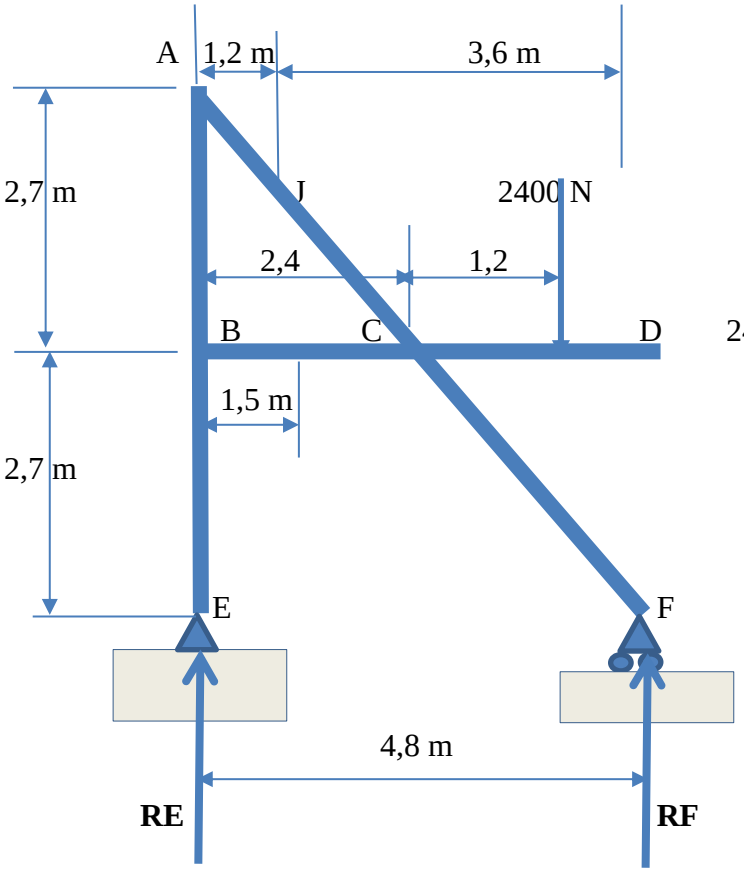
C. Jika ada momen:



F: Gaya aksial

C: Gaya geser

Contoh



$\sum M_E = 0$

2400*3,6 – F*4,8 = 0

F = 1800 N ↑

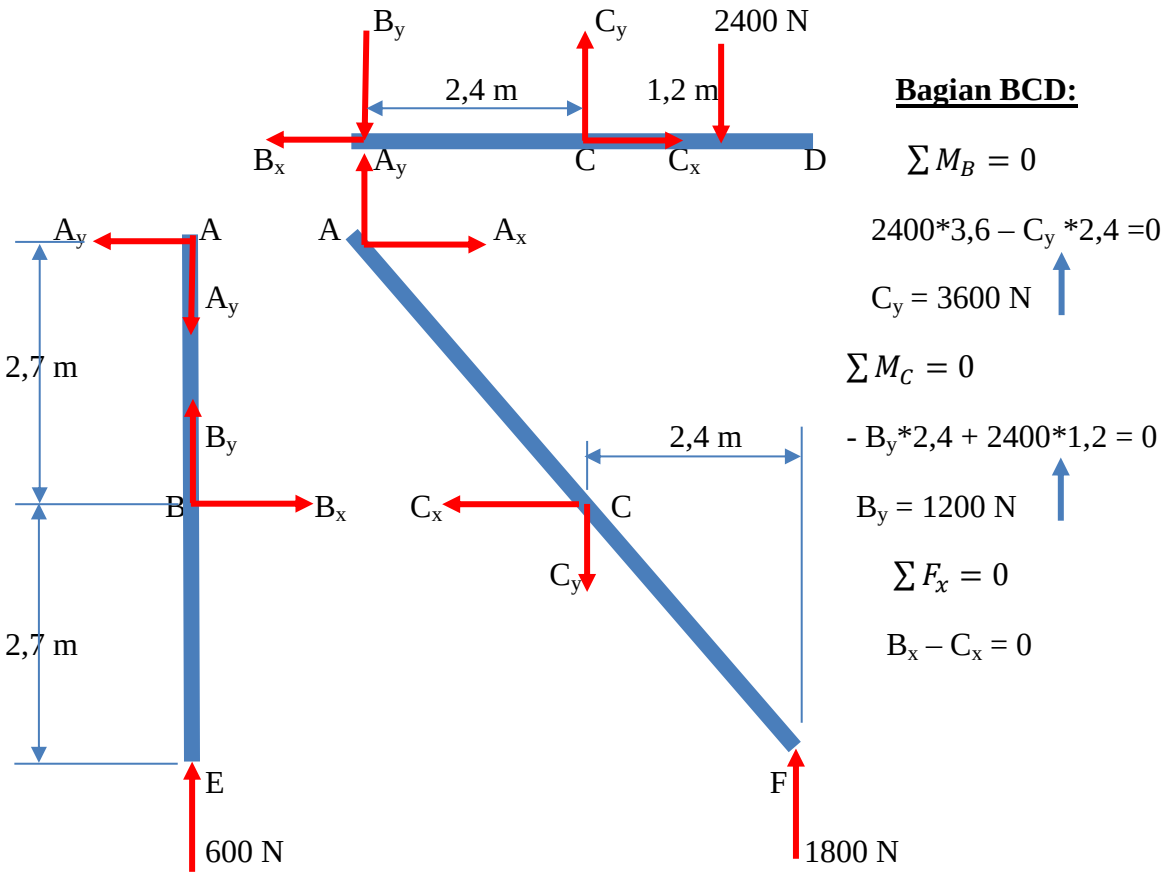
$\sum M_F = 0$

2400 * 1,2 – E*4,8 = 0

E = 600 N ↑

$\sum E_x = 0$

E = 0 →



Bagian BCD:

$\sum M_B = 0$

$2400*3,6 - C_y*2,4 = 0$

$C_y = 3600$ N

$\sum M_C = 0$

$-B_y*2,4 + 2400*1,2 = 0$

$B_y = 1200$ N

$\sum F_x = 0$

$B_x - C_x = 0$

Bagian ABE:

$\sum M_A = 0$

$B_x*2,7 = 0 \longrightarrow B_x = 0$

$\sum F_x = 0$

$A_x + B_x = 0 \longrightarrow A_x = 0$

$\sum F_y = 0$

$-A_y + 600 + B_y = 0$

$A_y = 600 + 1200 = 1800$ N

Bagian BCD:

$\sum F_x = 0$

$B_x - C_x = 0$

$0 - C_x = 0 \longrightarrow C_x = 0$

CHEK:

$\sum M_C = 0$

$-1800*2,4 + A_y*2,4 + A_x*2,7 = 0$

$-4320 + 1800*2,4 + 0*2,7 = 0$

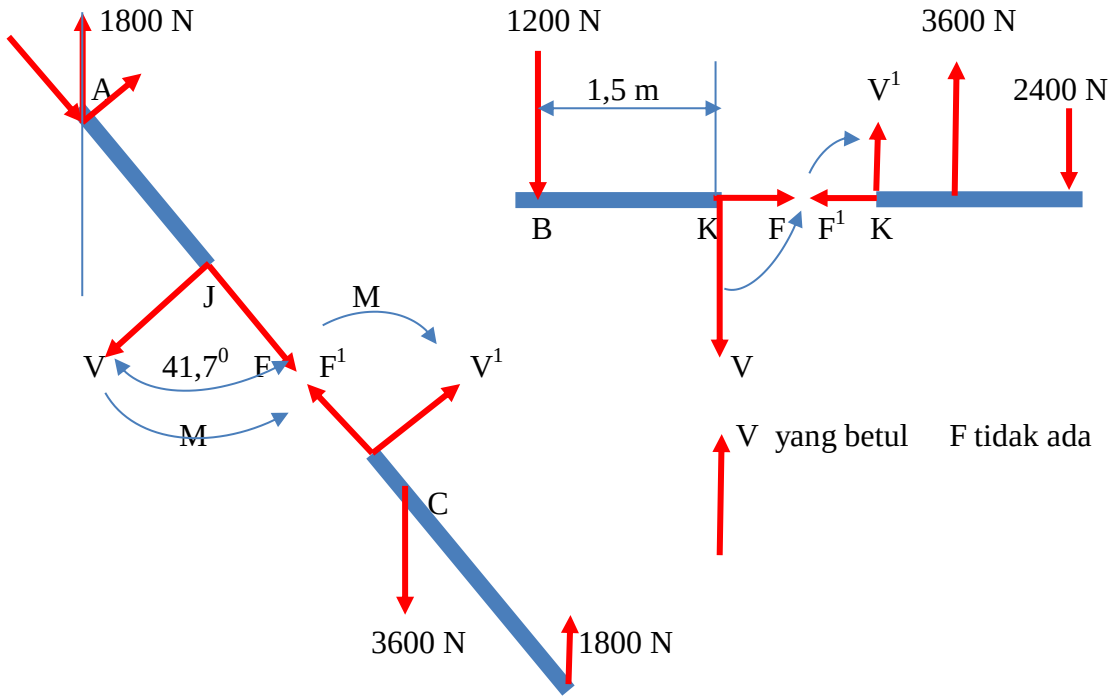
$-4320 + 4320 = 0$ (cocok)

atau $\sum M_F = 0$

$A_y*4,8 + A_x*5,4 - C_x*2,7 - C_y*2,4 = 0$

$1800*4,8 + 0*5,4 - 0*2,7 - 3600*2,4 = 0$---

$8640 - 0 - 0 - 8640 = 0$ (cocok)



Perhatikan AJ:

$\sum M_J = 0$

-M + 1800*cos.41,7^0 = 0

M = 2160 Nm

$\sum F_x = 0$ $\qquad$ $\sum F_y = 0$

F – 1800*cos.41,7^0 = 0 $\qquad$ -V + 1800*sin.41,7^0 = 0

F = 1344 N $\qquad$ V = 1197 N

Perhatikan BK:

$\sum M_K = 0$

-M – 1200 *1,5 = 0

M = - 1800 N m

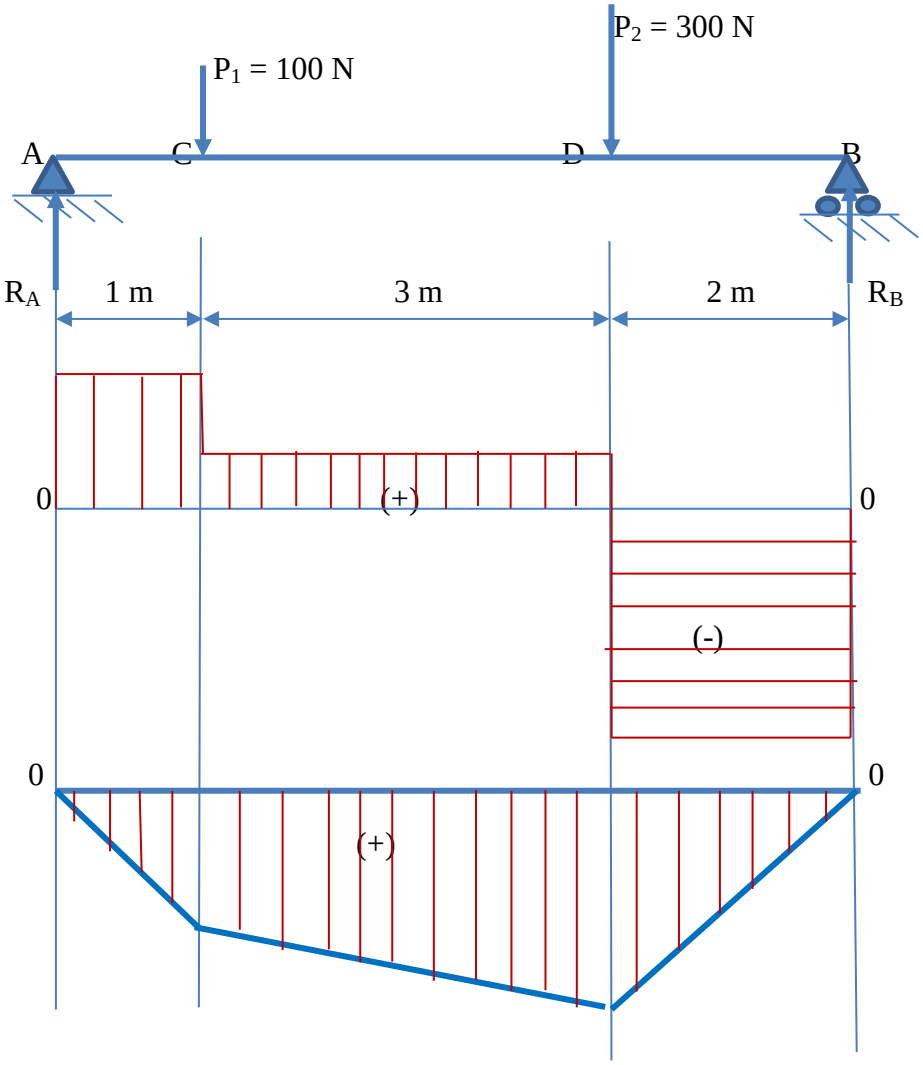
$\sum F_x = 0$ $\qquad$ $\sum F_y = 0$

F + 0 = 0 $\qquad$ V + 1200 = 0

F = 0 $\qquad$ V = - 1200 N

GAYA LINTANG & BIDANG MOMEN

A. BEBAN TITIK



$$\sum M_A = 0$$

- R_B*6 + P_2*4 + P_1*1 = 0
- R_B*6 + 300*4 + 100*1 = 0

$$R_B = \frac{1300}{6} = 216{,}66\ N$$

$$\sum M_B = 0$$

R_A*6 + P_1*5 + P_2*2 = 0
- R_A*6 + 100*5 + 300*2 = 0

$$R_A = \frac{1100}{6} = 183{,}34\ N$$

Gaya Lintang (*Shear Force Diagram*/Bidang D):

$0 \leq x \leq 1$

$D_0 = R_A$ = 183,34 N

$D_1 = R_A - P_1$ = 183,34 – 100 = 83,34 N

$1 \leq x \leq 4$

$D_1 = R_A - P_1 = 183{,}34 - 100 = 83{,}34$ N

$D_4 = R_A - P_1 - P_2 = 183{,}34 - 100 - 300 = -216{,}6$ 6N

$4 \leq x \leq 6$

$D_4 = R_A - P_1 - P_2 = 183{,}34 - 100 - 300 = -216{,}66$ N

$D_6 = R_A - P_1 - P_2 + R_B = 183{,}34 - 100 - 300 + 216{,}66 = 0$ N

Bidang Momen (*Bending Moment Diagram*/Bidang M):

$0 \leq x \leq 1$

$M_x = R_A * x$

$M_0 = R_A * 0 = 0$

$M_1 = R_A * 1 = 183{,}34 * 1 = 183{,}34$ N

$1 \leq x \leq 4$

$M_x = R_A * x - P_1(x-1)$

$M_1 = 183{,}34*1 - 100\ (1-1) = 183{,}34$ N

$M_4 = 183{,}34*4 - 100\ (4-1) = 433{,}36$ N

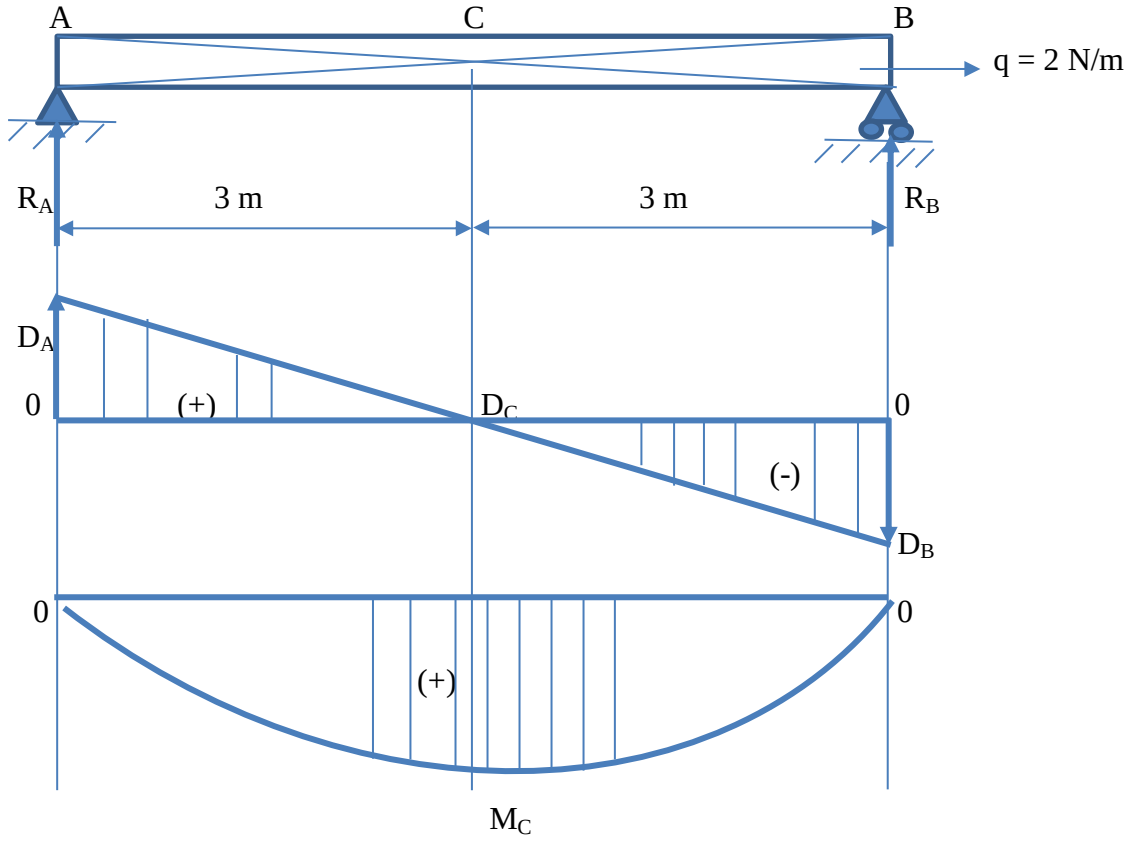
$4 \leq x \leq 6$

$M_x = R_A * x - P_1(x-1) - P_2(x-4)$

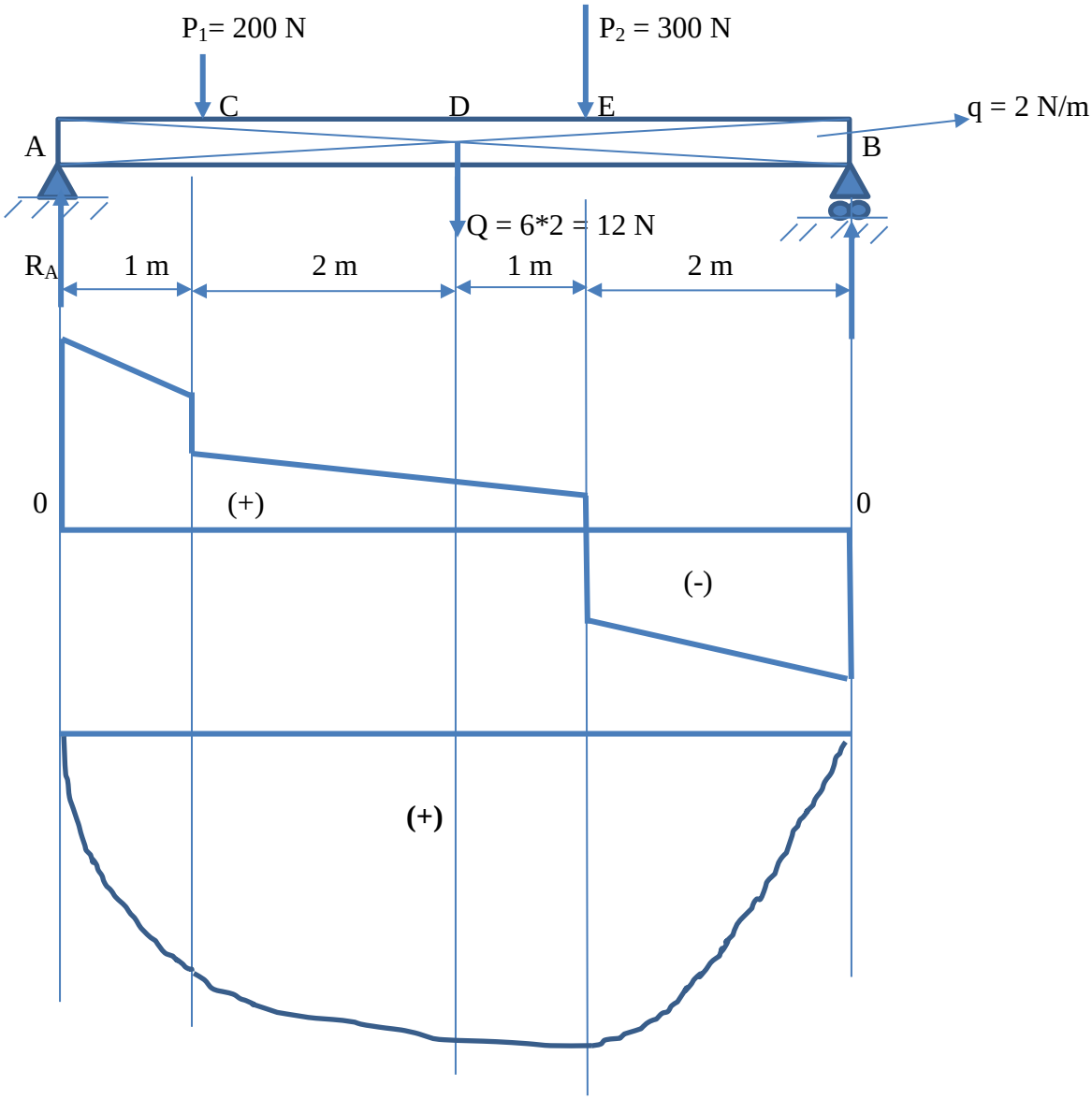
$M_4 = 183{,}34*4 - 100\ (4-1) = 433{,}36$ N

$M_6 = 183{,}34*6 - 100\ (6-1) - 300\ (6-4) = 1100{,}4 - 500 - 600 = 0$ N

B. BEBAN MERATA



C. BEBAN CAMPURAN



$\sum M_B = 0$

$R_A*6 – P_1*5 – Q*3 – P_2*2 = 0$

$R_A*6 – 200*5 – 12*3 – 300*2 = 0$

$R_A*6 – 1000 – 36 – 600 = 0$

$$\mathbf{R_A = \frac{1636}{6} = 272,67\ N}$$

$\sum M_A = 0$

$- R_B*6 + P_2*4 + Q*3 + P_1*1 = 0$

$- R_B*6 + 300*4 + 12*3 + 200*1 = 0$

$- R_B*6 + 1200 + 36 + 200 = 0$

$$\mathbf{R_B = \frac{1436}{6} = 239,33\ N}$$

Gaya Lintang.

$0 \leq x \leq 1$

$D_x = R_A – qx$

$D_x = 272,67 – 2x$

x=0 : $D_A = 272,67 – 2*0 = 272,67$ N

x=1: $D_C = 272,67 - 2*1 = 270,67$ N

$1 \leq x \leq 4$

$D_x = R_A – qx – P_1$

$D_x = 272,67 – 2x – 200$

$D_x = 72,67 – 2x$

x=1: $D_C = 72,67 – 2*1 = 70,67$ N

x=4: $D_E = 72,67 – 2*4 = 64,67$ N

$4 \leq x \leq 6$

$D_x = R_A – qx – P_1 – P_2$

$D_x = 272,67 – 2x – 200 - 300$

$D_x = -227,33 – 2x$

x=4: $D_E = - 227,33 – 2*4 = - 235,33$ N

x=6: $D_B = - 227,33 – 2*6 = - 239,33$ N

Bidang Momen

$0 \leq x \leq 1$

$$M_x = R_A*x – \frac{1}{2}qx^2$$

$$M_x = 272,67*x – \frac{1}{2}2x^2$$

x=0 : $M_A = 272,67*0 – \frac{1}{2} * 2*0^2 = 0$ Nm

x=1: $M_C = 272,67*1 - \frac{1}{2} * 2*1^2 = 271,67$ Nm

$1 \leq x \leq 4$

$$M_x = R_A*x – \frac{1}{2}qx^2 – P_1(x-1)$$

$$M_x = 272,67*x – \frac{1}{2}2x^2 – 200\ (x-1)$$

$M_x = 272,67*x – x^2 – 200\ x + 200$

$M_x = - x^2 + 72,67x + 200$

x=1: $M_C = - 1 + 72,67 + 200 = 271,67$ Nm

x=4: $M_E = - 4^2 + 72,67*4 + 200 = - 16 + 290,68 + 200 = 474,68$ Nm

$4 \leq x \leq 6$

$$M_x = R_A*x - \frac{1}{2}qx^2 - P_1(x-1) - P_2(x-4)$$

$$M_x = 272,67*x - \frac{1}{2}2x^2 - 200\ (x-1) - 300\ (x-4)$$

$M_x = 272,67*x - x^2 - 200\ x + 200 - 300x + 1200$

$M_x = - x^2 - 227,33x + 1400$

x=4: $M_E = - 4^2 - 227,33*4 + 1400 = 474,68$ Nm

x=6: $M_B = - 6^2 - 227,33*6 + 1400 = 0$ Nm

TITIK BERAT

Macam-macam titik berat:

A. **Titik berat garis**
B. **Titik berat luas**
C. **Titik berat volume**

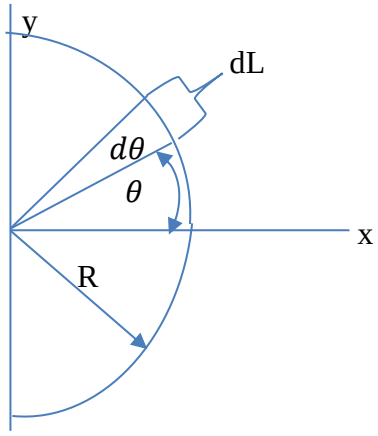
Untuk menetukan letak titik berat dilakukan dengan 2 cara:

1. **Secara analitis**

$$x = \frac{x * \sum A}{\sum A}$$

$$y = \frac{y * \sum A}{\sum y}$$

Contoh.
(1)
A. Titik berat garis



dL = R*dθ

$x = R.cos\theta$

$$x = \frac{\int_{-\pi/2}^{\pi/2} x*dL}{\int_{-\pi/2}^{\pi/2} dL}$$

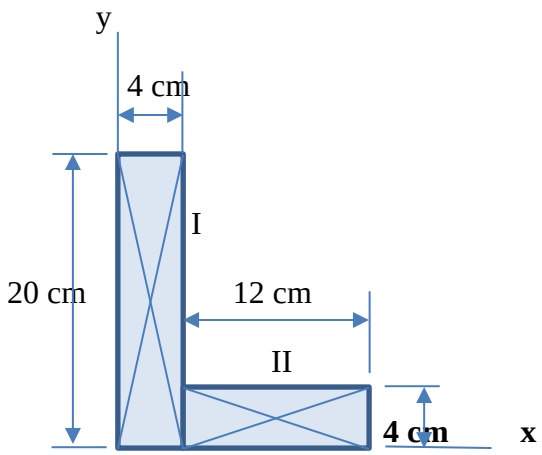
$$x = \frac{\int_{-\pi/2}^{\pi/2} Rcos\theta*R*d\theta}{\int_{-\pi/2}^{\pi/2} R*d\theta}$$

$$x = \frac{R^2 sin\theta\big|_{-\pi/2}^{\pi/2}}{R\theta\big|_{-\pi/2}^{\pi/2}}$$

$$x = \frac{R^2(sin^{\pi}/_2 + sin^{\pi}/_2)}{R(^{\pi}/_2 + ^{\pi}/_2)}$$

$$\boldsymbol{x = \frac{R^2 * 2}{R * \pi} = \frac{2R}{\pi}} \quad \textbf{(dari titik pusat)}$$

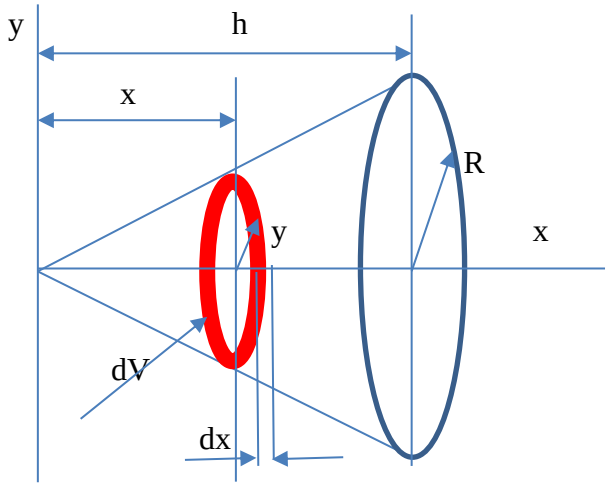
(2) Titik berat luas



$$\boldsymbol{x = \frac{x * \sum A}{\sum A} = \frac{(x_1 * 20 * 4) + (x_2 * 12 * 4)}{(20 * 4) + (12 * 4)} = \frac{(10 * 80) + (2 * 48)}{128} = \frac{896}{128} = 7\ cm}$$

$$\boldsymbol{y = \frac{y * \sum A}{\sum y} = \frac{(y_1 * 20 * 4) + (y_2 * 12 * 4)}{(20 * 4) + (12 * 4)} = \frac{(2 * 80) + (10 * 48)}{128} = \frac{640}{128} = 5\ cm}$$

B. Titik berat Volume



y : R = x : h

$$y = \frac{R * x}{h}$$

$$dV = \pi * y^2 * dx$$

$$x = \frac{\int_0^h x*dV}{\int_0^h dV}$$

$$x = \frac{\int_0^h x*\pi y^2 dx}{\int_0^h \pi y^2 dx}$$

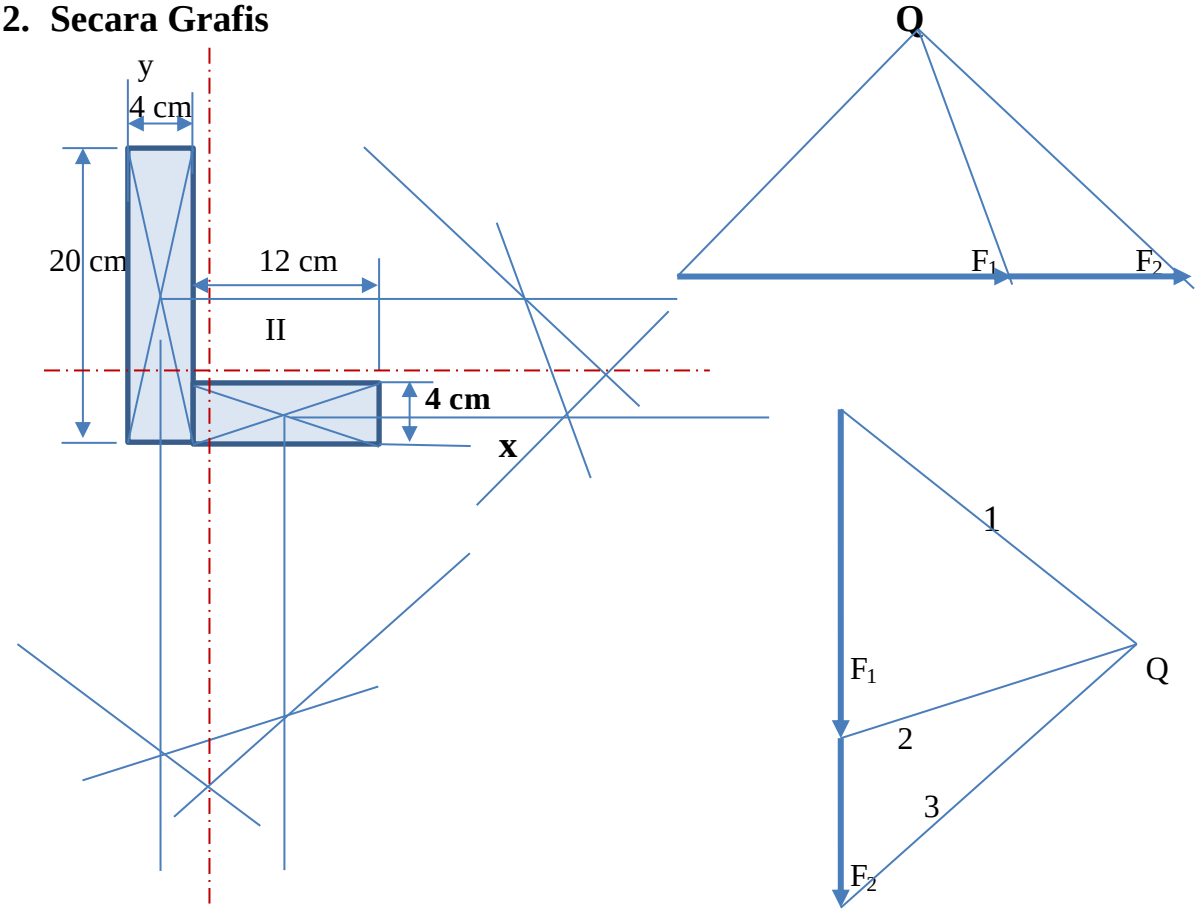
$$x = \frac{\int_0^h \pi*x*\frac{R^2*x^2}{h^2}dx}{\int_0^h \pi\frac{R^2*x^2}{h^2}dx}$$

$$x = \frac{\int_0^h \pi\frac{R^2x^3}{h^2}dx}{\int_0^h \pi\frac{R^2x^2}{h^2}dx}$$

$$x = \frac{\frac{\pi R^2}{h^2}\frac{1}{4}x^4\Big|_0^h}{\frac{\pi R^2}{h^2}\frac{1}{3}x^3\Big|_0^h}$$

$$\boldsymbol{x = \frac{\frac{1}{4}h^4}{\frac{1}{3}h^3} = \frac{3}{4}h \quad (dari\ puncak)}$$

2. Secara Grafis



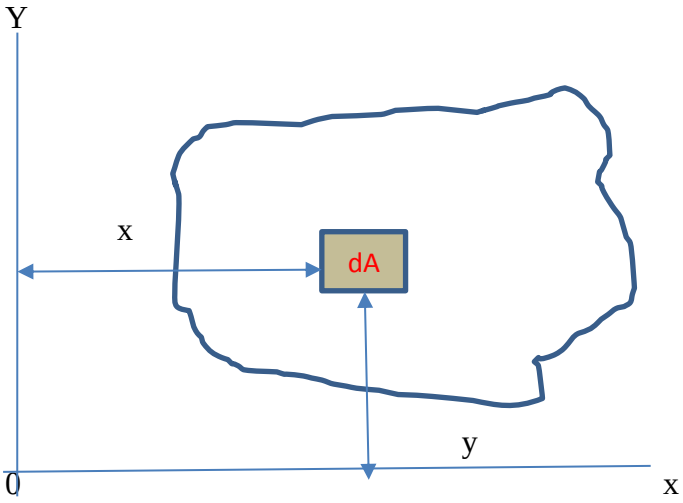
MOMEN INERSIA (MOMEN LEMBAM)

Momen lembam adalah luas dikalikan dengan kwadrat jaraknya.

Momen lembam dibagi 2 yaitu:

a. Momen lembam linier
b. Momen lembam polair

a. Momen Lembam linier.
   Adalah luas penampang dikalikan dengan kwadrat jaraknya darinsuatu garis yang kita pandang.
   Perhatikan gambar berikut ini:



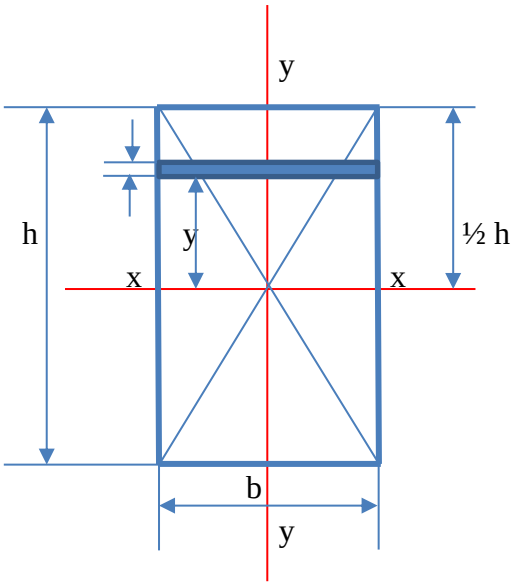
Momen lembam terhadap sumbu x (I_x):

$I_x = \int y^2 \, dA$

$I_y = \int x^2 \, dA$

Contoh:

1.



$I_x = \int_{-\frac{1}{2}h}^{\frac{1}{2}h} y^2 dA$ dimana dA = b. dy

$= \int_{-\frac{1}{2}h}^{\frac{1}{2}h} y^2 \, b.dy$

$= b\int_{-\frac{1}{2}h}^{\frac{1}{2}h} y^2 dy$

$= b\frac{1}{3}y^3\Big]_{-\frac{1}{2}h}^{\frac{1}{2}h}$

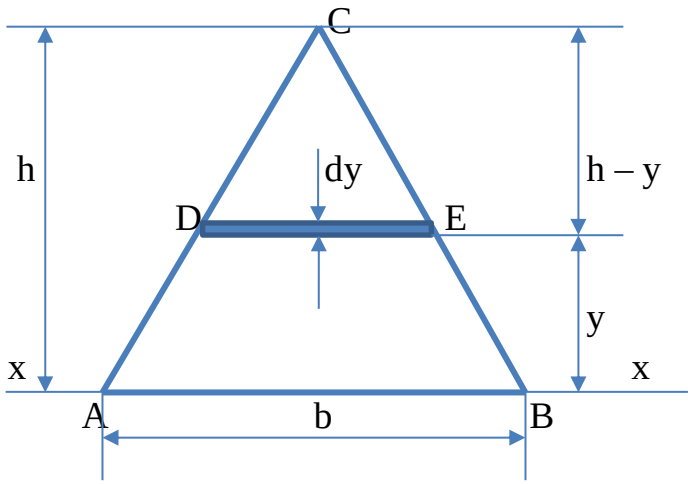
$= b\left[\frac{1}{3}\left(\frac{1}{2}h\right)^3 - \left(-\frac{1}{2}h\right)^3\right]$

$= \frac{1}{3}b\left(\frac{1}{8}h^3 + \frac{1}{8}h^3\right)$

$= \frac{1}{3}b\left(\frac{1}{4}h^3\right)$

$= \mathbf{\frac{1}{12}bh^3}$ **analog akan didapat** $\mathbf{I_y = \frac{1}{12}hb^3}$

2.



DE : AB = (h – y) : h

DE : b = (h – y) : h

DE $= \frac{(h-y)}{h}b$

dA = dE . dy

$I_x = \int_0^h y^2 dA = \int_0^h y^2 \frac{(h-y)b}{h} dy = \int_0^h \frac{(bhy^2 - by^3)}{h} dy = \int_0^h \frac{bhy^2}{h} dy - \int_0^h \frac{y^3 b}{h} dy$

$= \int_0^h by^2 dy - \int_0^h \frac{b}{y} y^3 dy = \frac{1}{3}by^3\Big|_0^h - \frac{1}{4}\frac{b}{h}y^4\Big|_0^h$

$= \frac{1}{3}bh^3 - \frac{b}{h}\frac{1}{4}h^4$

$= \frac{1}{3}bh^3 - \frac{1}{4}bh^3$

$= \mathbf{\frac{1}{12}bh^3}$

Jari-jari Girasi:

$$I = \int R^2 dA$$

$$I = R^2 A$$

$$R = \sqrt{\frac{I}{A}}$$

R : jari-jari girasi (kx)

$$I_x = \int kx^2 dA$$

$$I_x = kx^2 dA$$

Atau:

$$I_y = \int ky^2 dA$$

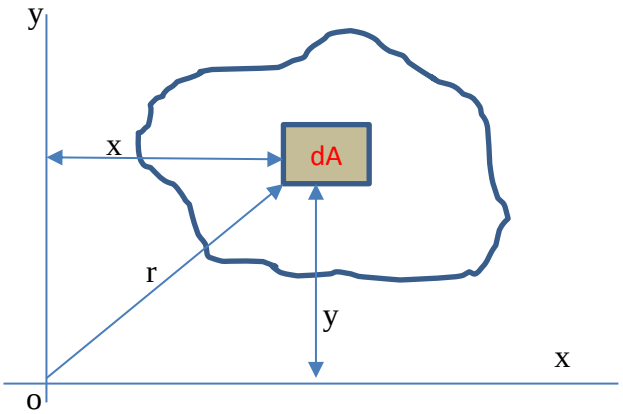
$$I_y = ky^2 dA$$

b. Momen Lembam Polair

Adalah momen lembam yang ditinjau dari titik perpotongan sumbu x dan sumbu y

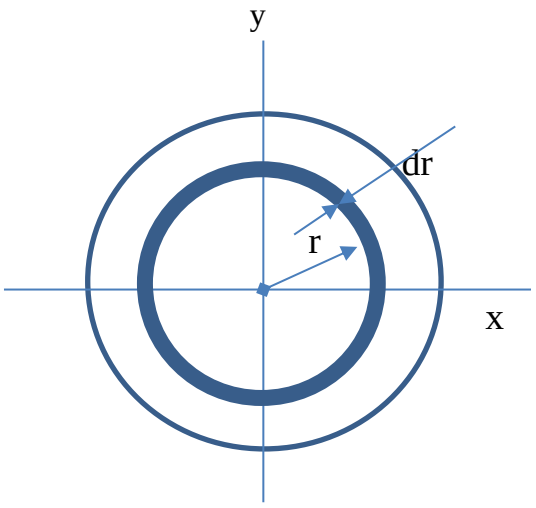
Jadi $I_p = I_x + I_y$

Perhatikan gambar dibawah ini.



$$I_p = \int r^2 dA$$

Contoh:



$$dA = 2\pi r.dr$$

$$I_p = \int_0^{\frac{1}{2}d} r^2 dA$$

$$I_p = \int_0^{\frac{1}{2}d} r^2 . 2\pi r. dr$$

$$I_p = \int_0^{\frac{1}{2}d} r^3 . 2\pi . dr$$

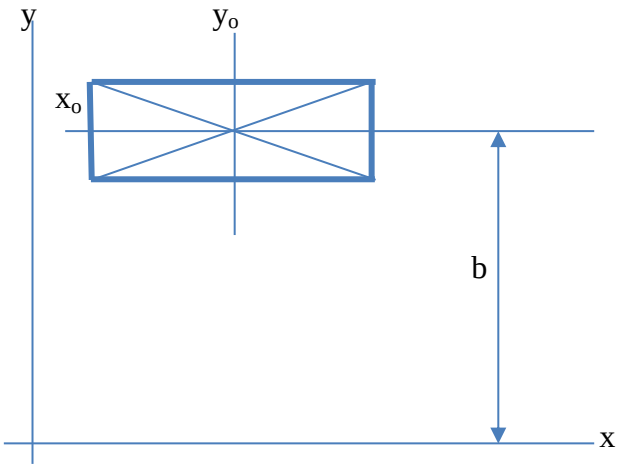
$$I_p = 2\pi . \frac{1}{4} r^4 \Big|_0^{\frac{1}{2}d}$$

$$I_p = \frac{2}{4}\pi \left(\frac{1}{2}d\right)^4$$

$$I_p = \frac{2}{4}\pi \frac{1}{16} d^4$$

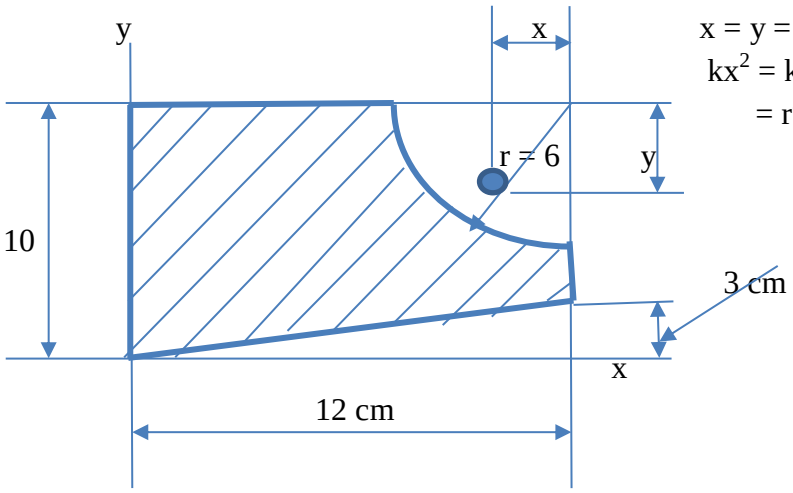
$$\boldsymbol{I_p = \frac{\pi}{32} d^4}$$

Teori Sumbu Sejajar:



$$I_x = I_{xo} + b^2.A$$

Contoh:

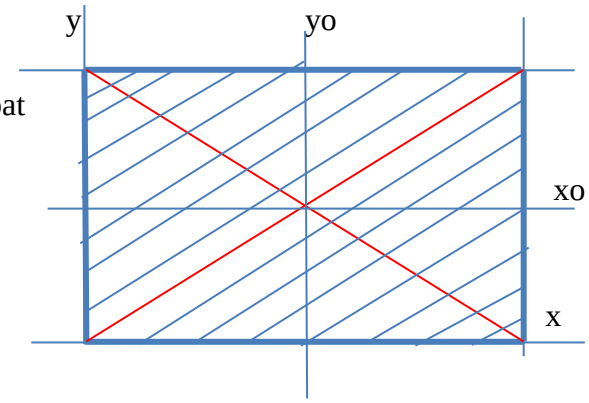


$x = y = 4r/3\pi$

$kx^2 = ky^2$

$= r^2 ((9\pi^2 - 64)/(36\pi^2))$

A. Segi empat



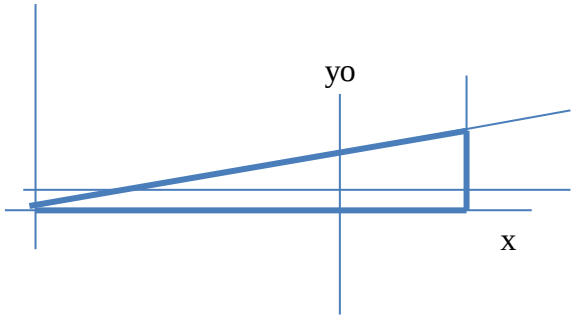
$I_y = I_{yo} + b^2A$

$= 1/12\ bh^3 + 6^2.10.12$

$= 1/12.\ 10.12^3 + 36.10.12$

$= 5760\ cm^4$

B. Segitiga



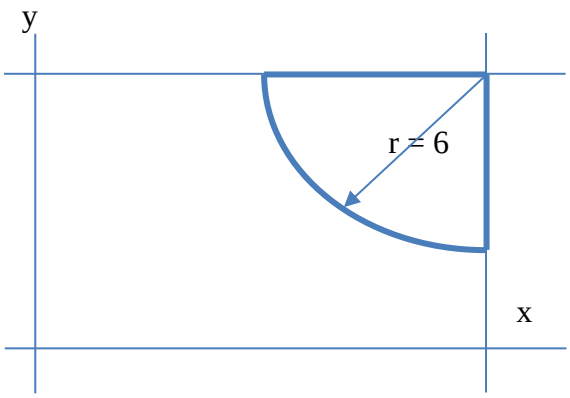
$I_y = I_{yo} + b^2A$

$= 1/36.\ bh^3 + b^2\ A$

$= 1/36.\ 3.12^3 + 8^2.((3.12)/2)$

xo **$= 1296\ cm^4$**

C. Seperempat Lingkaran



$I_y = I_{yo} + b^2A$

$= ky^2 .A + b^2.A$

$= \left(r^2 \frac{9\pi^2-64}{36.\pi^2}\right)\left(\frac{\pi}{4}r^2\right) + \left(12 - \frac{4r}{3\pi}\right)^2\left(\frac{\pi}{4}r^2\right)$

$= \left(6^2 \frac{9\pi^2-64}{36.\pi^2}\right)\left(\frac{\pi}{4}6^2\right) + \left(12 - \frac{4.6}{3\pi}\right)^2\left(\frac{\pi}{4}6^2\right)$

$= 70{,}65 + 2529$

$= 2599{,}65\ cm^4$

Jadi I_y = A – B - C

$= 5760\ cm^4 – 1296\ cm^4 – 2599{,}6\ cm^4$

$= 1864{,}4\ cm^4$