

Upload Tugas Pertemuan ke 12

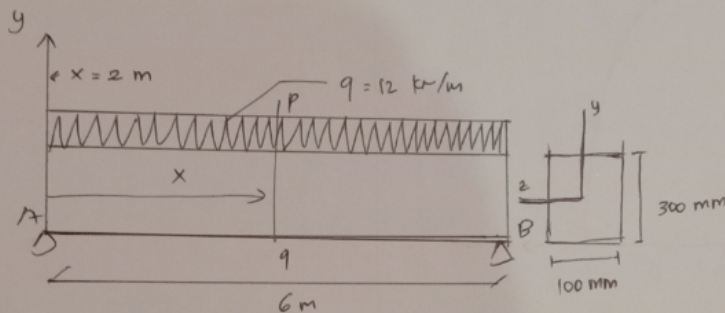
Soal 12

Nama : Muhammad Reza Niscaya

Nim : 182 710037

Soal

Sebuah balok sederhana dengan beban terbagi merata seperti di gambar. balok ini terbuat dari kayu dengan penampang berbentuk persegi panjang, selidikilah tegangan utama dan tegangan geser maksimum di potongan melintang PQ yang terletak pada jarak $x = 2$ m dari titik A.



Syarat :

$$\sum M = 0$$

$$\sum V = 0$$

$$\sum H = 0$$

$$Q = qL$$

$$= 12 \cdot 6$$

$$= 72 \text{ kN}$$

$$Q_x = q \cdot x$$

$$= 12 \cdot x$$

Reaksi perletakan

$$\sum M_A = 0$$

$$Q \cdot 3 - V_B \cdot 6 = 0$$

$$72(3) - V_B \cdot 6 =$$

$$V_B = 36 \text{ kN}$$

$$\sum M_B = 0$$

$$V_A \cdot 6 - Q \cdot 3 = 0$$

$$V_A \cdot 6 - 72 \cdot 3 = 0$$

$$V_A = 36 \text{ kN}$$

$$\text{kontrol} : \sum V = 0$$

$$V_A + V_B - P = 0$$

$$36 \text{ kN} + 36 \text{ kN} - 72 \text{ kN} = 0 \quad \dots \text{Oke!}$$

$$\sum H = 0$$

$$H_A = 0$$

Perhitungan Bidang momen (M_x) dan lintang (Q_x).

Batang AB : $0 \leq x \leq 6$ m diukur dari titik A

$$M_x = V_A \cdot x - Q_x \cdot \frac{1}{2} x$$

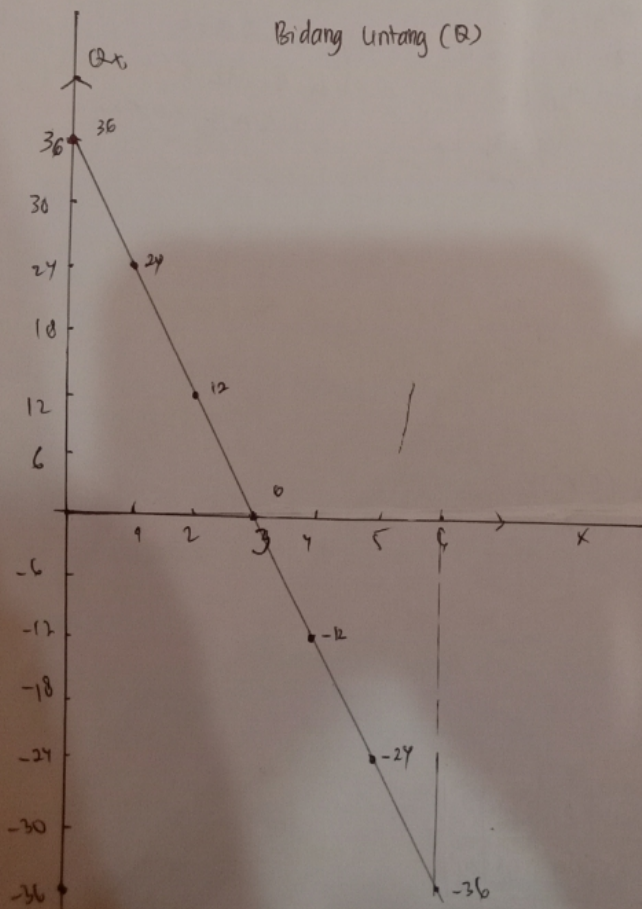
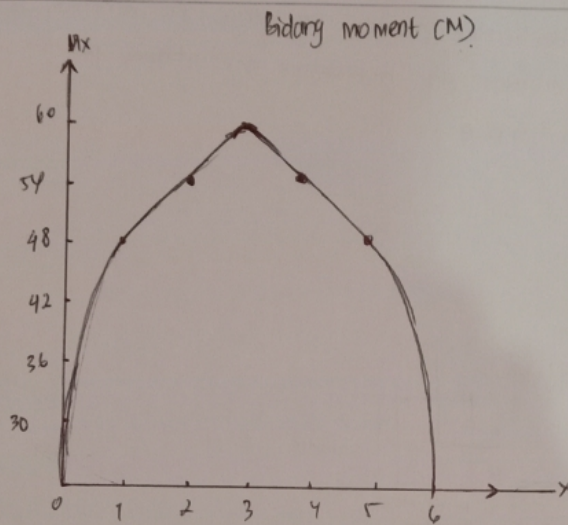
$$= 36 \cdot x - 12 \cdot x \cdot \frac{1}{2} x$$

$$M_x = 36 \cdot x - 6x^2$$

x (m)	0	1	2	3	4	5	6	7	8
M_x (kN-m)	0	30	48	54	48	30	0	-30	-60

$$Q_x = \frac{dM}{dx} = 36 - 12x$$

X (m)	0	1	2	3	4	5	6
Q _x (kN)	36	24	12	0	-12	-24	-36



Tegangan normal di potongan melintang pq

$$\sigma_x = - \frac{My}{I} = - \frac{My}{\frac{1}{2}bh^3}$$

$$\sigma_x = \frac{-(48) \cdot y \cdot 10^6}{\frac{1}{2} \cdot (100) (300^3)} = -0,213 y$$

Tegangan geser di potongan melintang pq

$$Q = b \left(\frac{h}{2} - y \right) \left(y + \frac{h/2 - y}{2} \right)$$

$$Q = \frac{b}{2} \left(\frac{h^2}{4} - y^2 \right)$$

$$\tau = \frac{VQ}{Ib}$$

$$\tau = - \frac{6V}{bh^3} \left(\frac{h^2}{4} - y^2 \right)$$

$$\tau = \frac{6(12 \times 10^3)}{100(300)^3} \left(\frac{300^2}{4} - y^2 \right)$$

$$\tau = -2,67 \times 10^{-5} (22500 - y^2)$$

Tegangan utama & Tegangan geser maksimum.

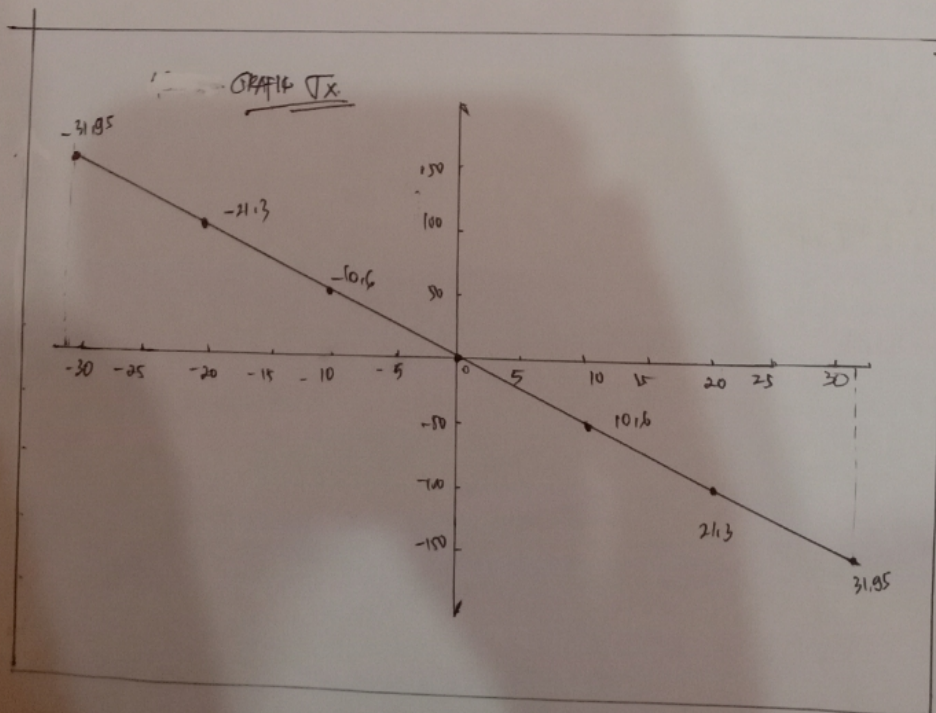
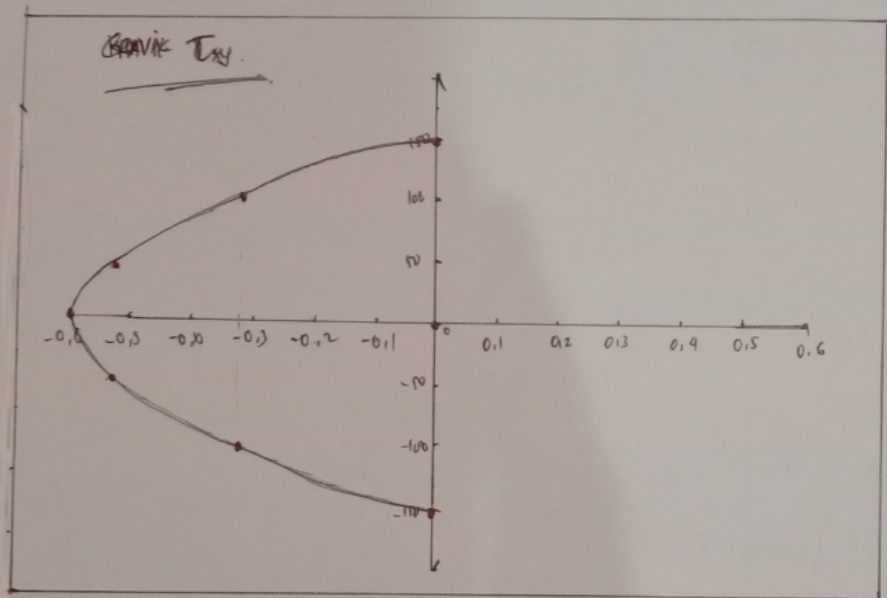
$$\sigma_{1,2} = \frac{\sigma_x}{2} \pm \sqrt{\left(\frac{\sigma_x}{2} \right)^2 + \tau_{xy}^2}$$

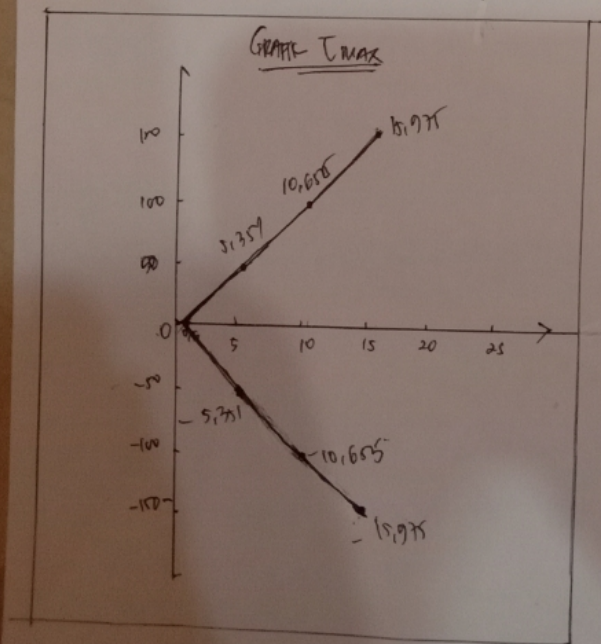
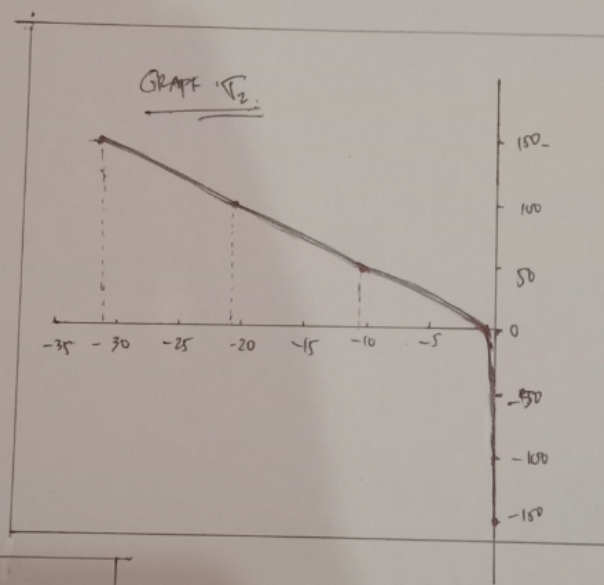
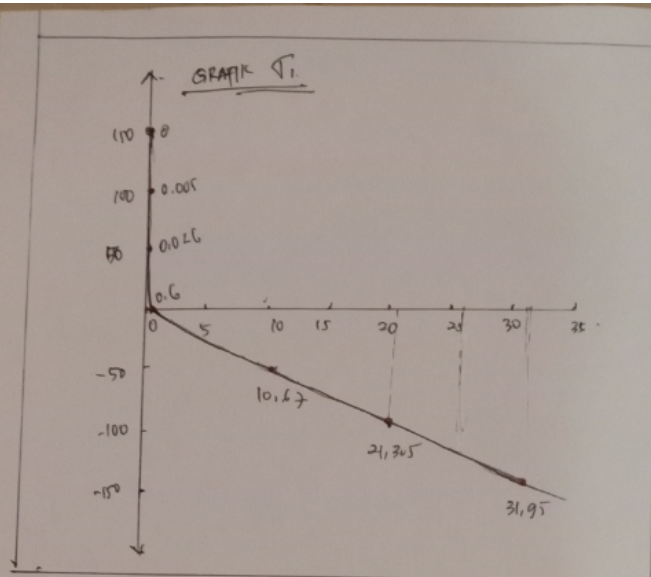
$$\tau_{max} = \sqrt{\left(\frac{\sigma_x}{2} \right)^2 + \tau_{xy}^2}$$

mana didapat tabel

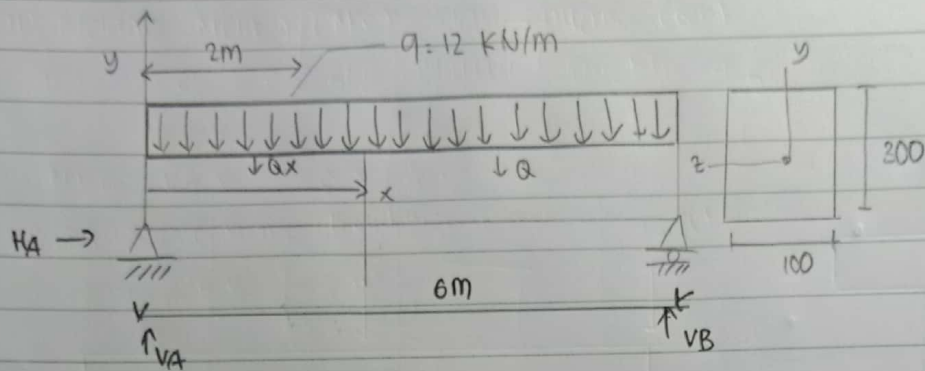
bentuk ini :

Tipe	y (mm)	τ_{xy}	τ_{yx}	σ_1	σ_2	τ_{maks}
A	150	0	-31,95	0	-31,95	15,975
B	100	-0,33	-21,3	0,005	-21,3	10,65
C	50	-0,53	-10,65	0,026	-10,67	5,351
D	0	-0,6	0	0,6	-0,6	0,6
E	-50	-0,53	10,65	10,67	-0,02	5,351
F	-100	-0,33	21,3	21,305	0,005	10,655
G	-150	0	31,95	31,95	0	15,975





soal 12 :



syarat : $\sum M = 0$

$\sum V = 0$

$\sum H = 0$

$$Q = q \cdot l$$

$$= 12 (6)$$

$$= 72 \text{ kN}$$

$$Qx = q \cdot x$$

$$= 12x$$

Reaksi perletakan:

$\sum MA = 0$

$Q(3) - VB(6) = 0$

$72(3) - 6(VB) = 0$

$216 - 6VB = 0$

$VB = 36 \text{ kN}$

$\sum MB = 0$

$VA(6) - Q(3) = 0$

$6VA - 72(3) = 0$

$6VA = 72(3)$

$VA = 36$

Kontrol $= \sum V = 0$

$VA + VB - P = 0$

$36 + 36 - 72 = 0$

$0 = 0 \quad (\text{OK!})$

$$\sum H = 0, \quad H_A = 0$$

Perhitungan Bidang Momen (M_x) dan Litang (Q_x)

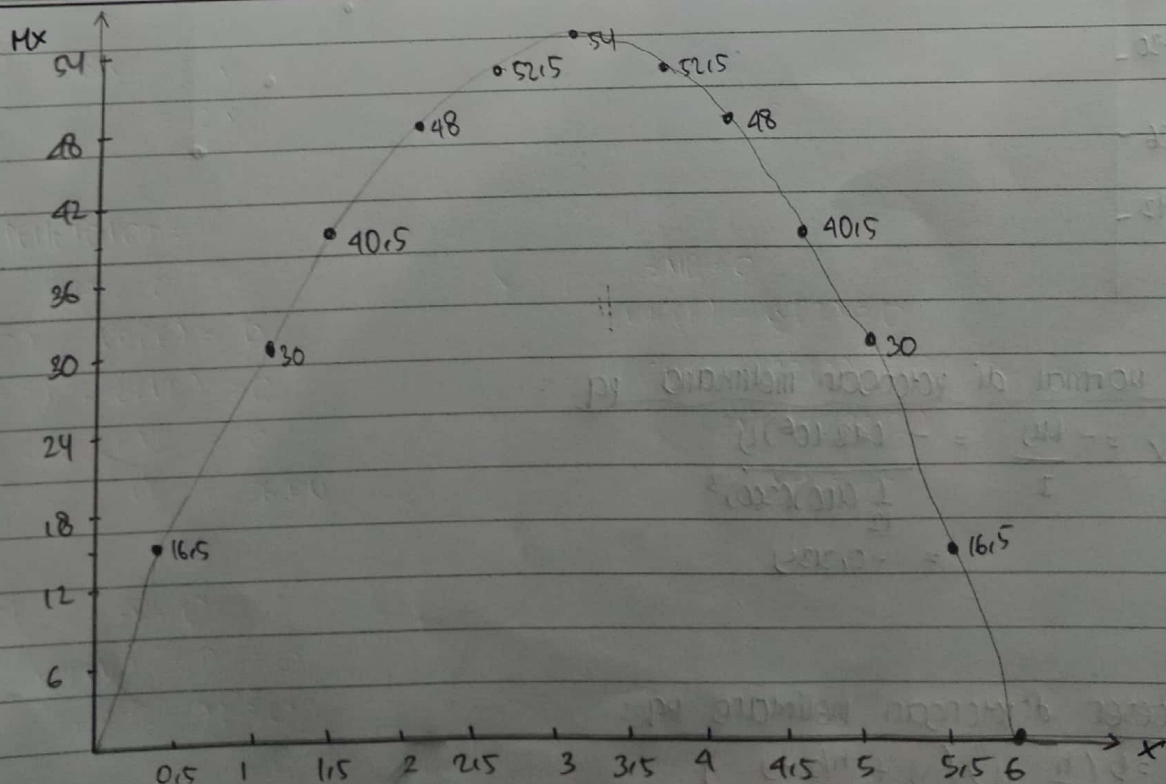
Batang AB $= 0 \leq x \leq 6m$ diukur dari titik A

$$\begin{aligned} M_x &= V_A x - Q_x \cdot \frac{1}{2} x \\ &= 36x - 12x \cdot \frac{1}{2} x \\ &= 36x - 6x^2 \end{aligned}$$

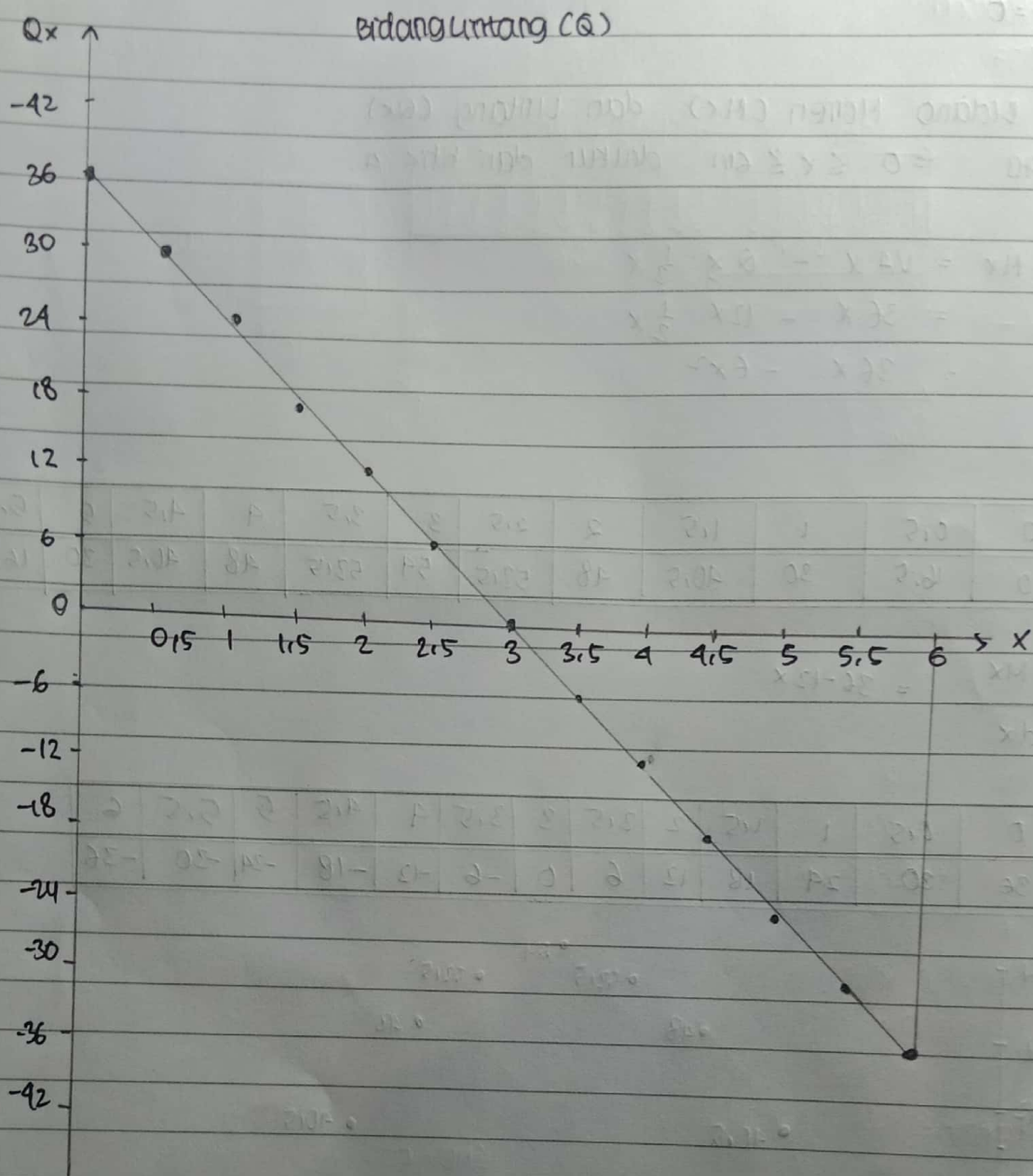
x (m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
M_x (kN-m)	0	16,5	30	40,5	48	52,5	54	52,5	48	40,5	30	16,5	0

$$Q_x = \frac{dM_x}{dx} = 36 - 12x$$

x (m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
M_x (kN-m)	36	30	24	18	12	6	0	-6	-12	-18	-24	-30	-36



- Bidang Momen -



• tegangan normal di potongan melintang pq :

$$\sigma_x = -\frac{My}{I} = -\frac{(48 \cdot 10^6)y}{\frac{1}{12}(100)(300)^3}$$

$$= -0.213y$$

• tegangan geser di potongan melintang pq :

$$Q = b\left(\frac{h}{2} - y\right)\left(y + \frac{h/2 - y}{2}\right)$$

$$= \frac{b}{2}\left(\frac{h^2}{4} - y^2\right)$$

$$\tau = \frac{VQ}{Ib}$$

$$\tau = \frac{V \left(\frac{b}{2} \left(\frac{h^2}{4} - y^2 \right) \right)}{\left(\frac{1}{12} b h^3 \right) b} = \frac{-6V}{bh^3} \left(\frac{h^2}{4} - y^2 \right)$$

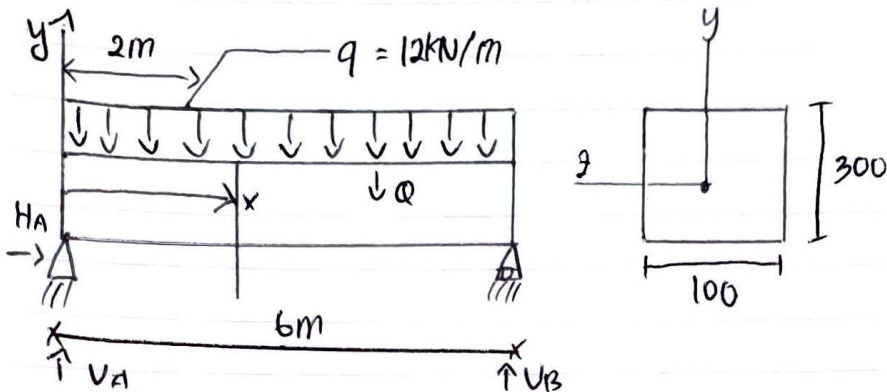
$$\tau = \frac{6(10^4)}{100 \cdot 300^3} \left(\frac{300^2}{4} - y^2 \right)$$

$$= -2.22 \cdot 10^{-5} (22500 - y^2)$$

tegangan utama & geser max.

Nama : Shafta Adynata
NIM : 182710038

Soal 12 :



Syarat :

$$\sum m = 0$$
$$\sum V = 0$$
$$\sum H = 0$$

$$Q = q \cdot l$$
$$= 12 \cdot 6$$
$$= 72 \text{ kN}$$

$$Q_x = q \cdot x$$
$$= 12 \cdot x$$

Reaksi Perletakan

$$\sum M_A = 0$$
$$Q(3) - V_B(6) = 0$$
$$72(3) - 6V_B = 0$$
$$216 - 6V_B = 0$$
$$V_B = 36 \text{ kN}$$

$$\sum M_B = 0$$
$$V_A(6) - Q(3) = 0$$
$$6V_A - 72(3) = 0$$
$$6V_A = 72(3)$$
$$V_A = 36 \text{ kN}$$

Kontrol = $\sum V = 0$

$$V_A + V_B - P = 0$$
$$36 + 36 - 72 = 0$$
$$0 = 0 \text{ (ok)!!}$$

$$\sum H = 0, \sum M_A = 0$$

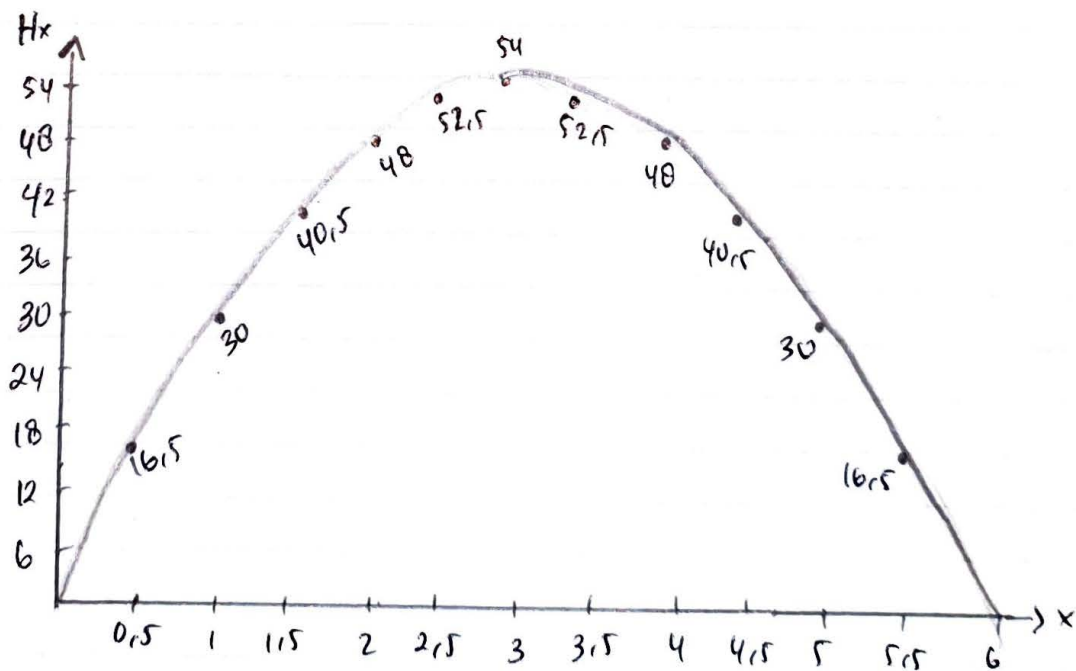
"Perhitungan Bidang Momen (M_x) dan Lintang (Q_x)"
Batang AB = $0 \leq x \leq 6m$ diukur dari titik A

$$\begin{aligned} M_x &= V_A x - Q_x \frac{1}{2} x \\ &= 36x - 12x \cdot \frac{1}{2} x \\ &= 36x - 6x^2 \end{aligned}$$

x(m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
M_x (kN-m)	0	16,5	30	40,5	48	52,5	54	52,5	48	40,5	30	16,5	0

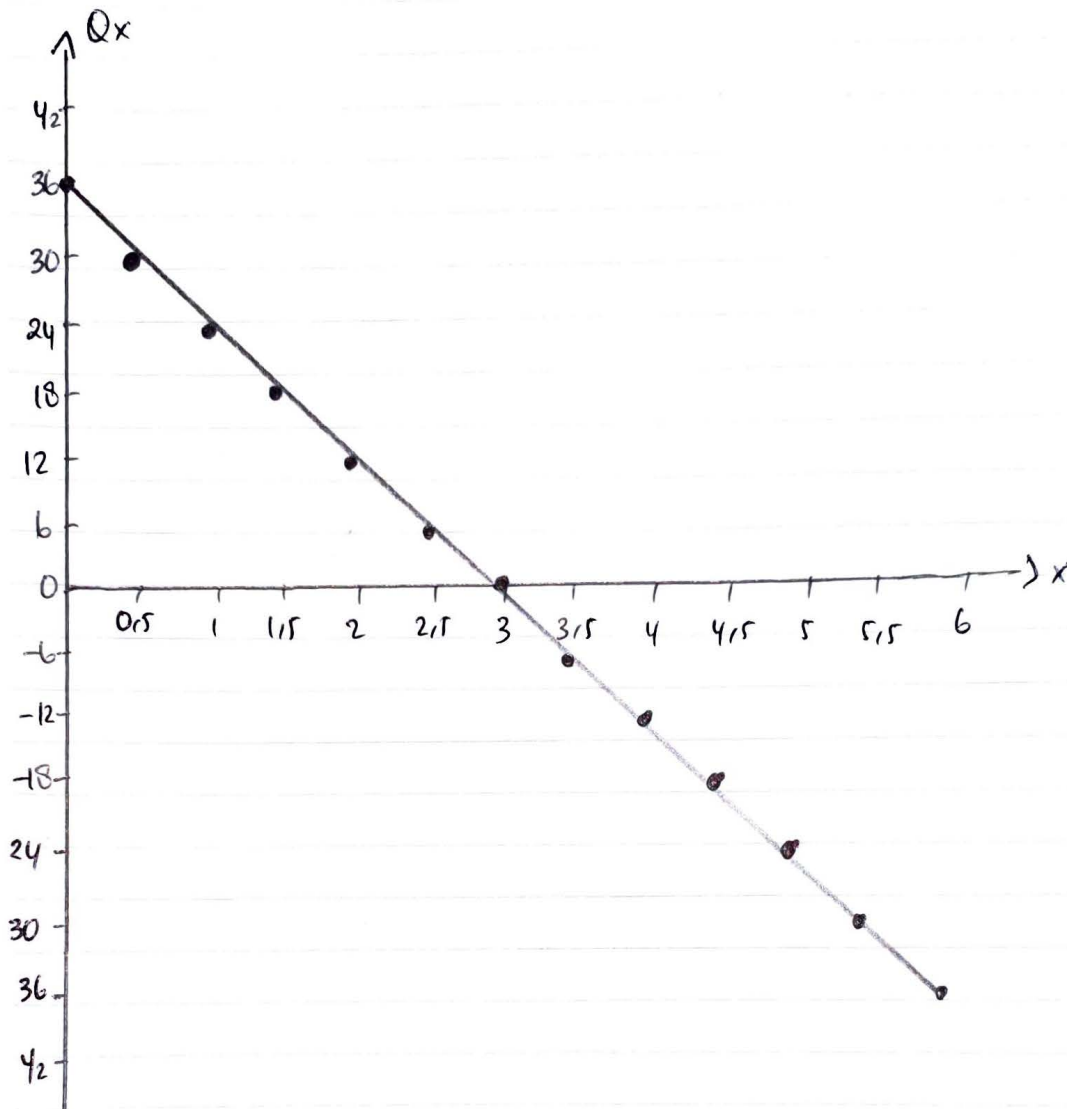
$$Q_x = \frac{dM_x}{dx} = 36 - 12x$$

x(m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
M_x (kN-m)	36	30	24	18	12	6	0	-6	-12	-18	-24	-30	-36



- Bidang Momen -

- Bidang lintang -



- Tegangan normal di potongan melintang M :

$$\sigma_x = \frac{-My}{I} = - \frac{(48 \cdot 10^6) y}{\frac{1}{12} (100)(300)^3} = -0,213 y$$

- Tegangan geser di potongan melintang pq :

$$Q = b \left(\frac{h}{2} - y \right) \left(y + \frac{h/2 - y}{2} \right)$$

$$= \frac{b}{2} \left(\frac{h^2}{4} - y^2 \right)$$

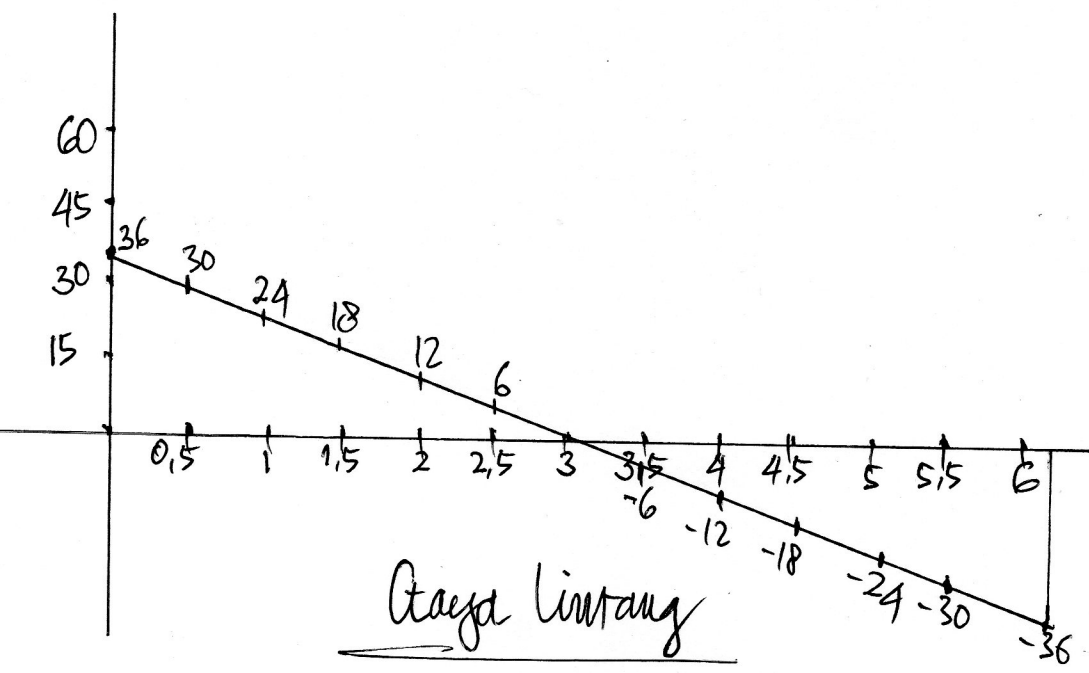
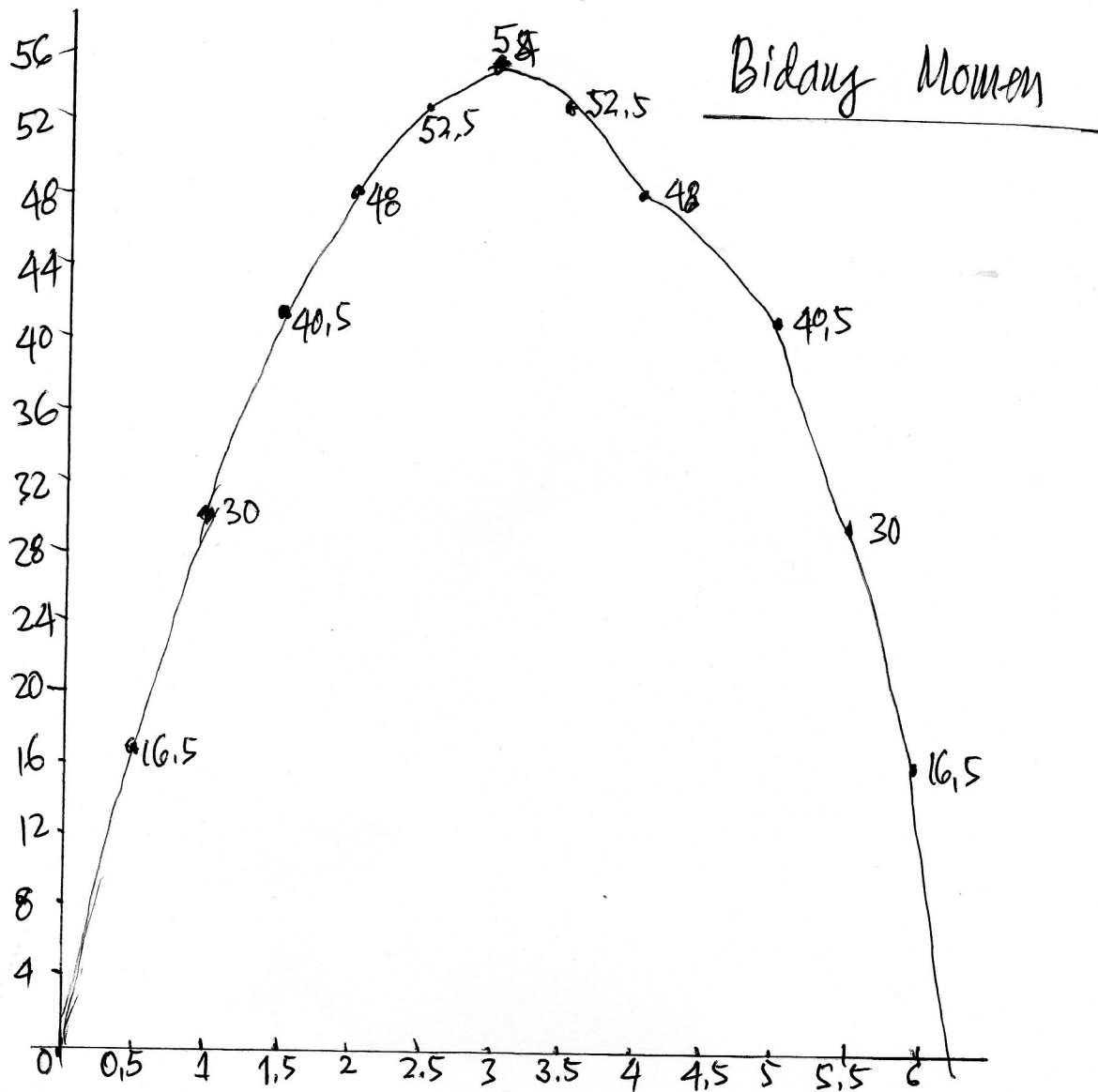
$$\tau = \frac{VQ}{Ib}$$

$$\tau = \frac{V \left(\frac{b}{2} \left(\frac{h^2}{4} - y^2 \right) \right)}{\left(\frac{1}{12} b h^3 \right) b} = \frac{-bV}{bh^3} \left(\frac{h^2}{4} - y^2 \right)$$

$$\tau = \frac{6(10^4)}{100 \cdot 300^3} \left(\frac{300^2}{4} - y^2 \right)$$

$$\tau = -2,22 \cdot 10^{-5} (22.500 - y^2)$$

Tegangan utama dan geser max



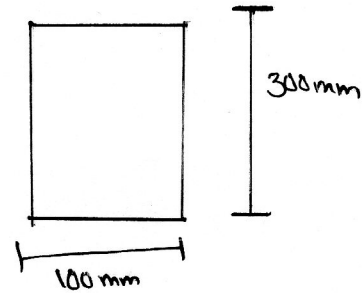
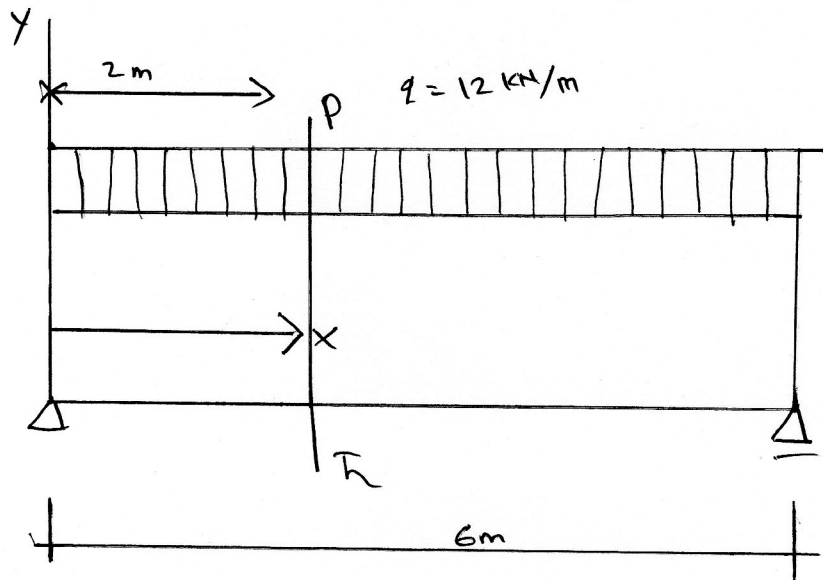
Nama : Wahid Sapta

Mata Kuliah : Mekanika Terapan

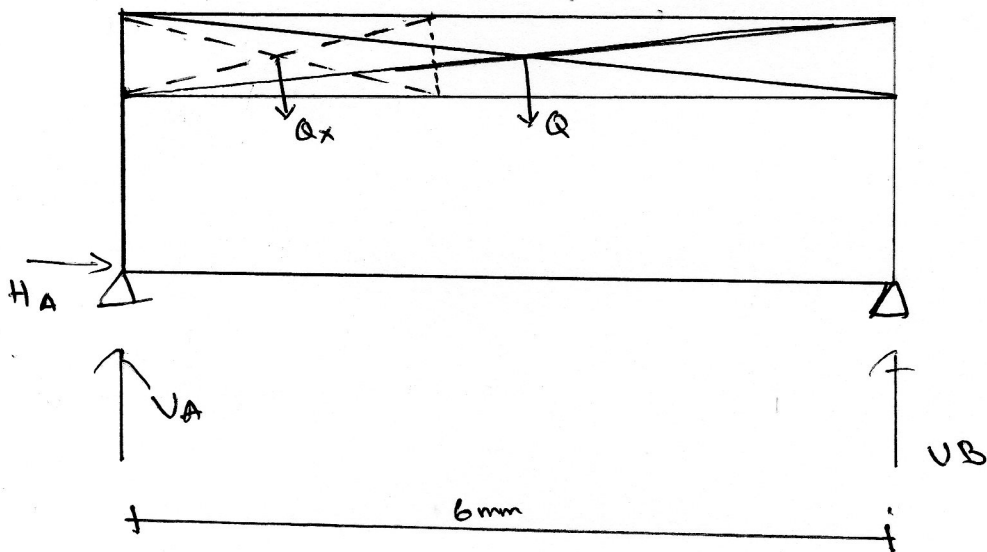
NIM : 182710033

Dosen : Dr.Firdaus,MT

Tugas no.12



Penyelesaian:



Syarat: $\sum M = 0$ $\sum V = 0$ $\sum H = 0$

$$Q = qL = 12 \cdot 6 = 72 \text{ kN}$$

$$Q_x = q \cdot x = 12x$$

Reaksi perletakan:

$$\sum M_B = 0 \quad V_A \cdot 6 - Q \cdot 3 = 0$$

$$V_A \cdot 6 - 72 \cdot 3 = 0 \rightarrow V_A = \frac{216}{6} = 36 \text{ kN}$$

$$\sum M_A = 0 \quad -V_B \cdot 6 + Q \cdot 3 = 0 \rightarrow V_B = \frac{216}{6} = 36 \text{ kN}$$

$$\sum V = 0 \quad V_A + V_B - Q = 0$$

2.

$$\sum H = 0 \quad 36 + 36 - 72 = 0 \quad (OK)$$

$$\sum M_A = 0.$$

Pernitung bidang Momen (M_x) dan lintang (Q_x)

Batang AB $0 \leq x \leq 6 \text{ m}$ diukur dari titik A

$$\begin{aligned} M_x &= V_A \cdot x - Q \cdot \frac{1}{2} x \\ &= 36 \cdot x - 12 \cdot \frac{1}{2} x = 36x - 6x^2 \\ &= 36x - 6x^2 \end{aligned}$$

x (m)	0	0.5	1	1.5	2	2.5	3.0	3.5	4.5	5.0	5.5	6.0
Mx (kN-m)	0	16.5	30	40.5	48	52.5	54	52.5	40.5	30	16.5	0

$$M_x = 36x - 6x^2$$

$$Q_x = \frac{dM_x}{dx} = 36 - 12x$$

x (m)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Qx (kN)	36	30	24	18	12	6	0	-6	-12	-18	-24	-30	-36

Tegangan normal di potongan melintang PQ

$$\sigma_x = \frac{-My}{I} = \frac{-48 \cdot y \times 106}{\frac{1}{12} (100) (300^3)} = \frac{-48 \times 12 \cdot 10^6}{217 \times 10^9} y$$
$$= \frac{576 y}{217 \times 10^3} = -0.121 y$$

(4.)

Tegangan geser di potongan melintang PQ

$$Q = b \left(\frac{h}{2} - y \right) \left(y + \frac{h/2 - y}{2} \right)$$
$$= b \left(\frac{h^2}{4} - y^2 \right)$$

$$\tau = \frac{VQ}{Ib} = \frac{V \left(\frac{b}{2} \left(\frac{h^2}{4} - y^2 \right) \right)}{\left(\frac{1}{12} bh^3 \right) b}$$

$$\tau = -\frac{6V}{bh^3} \left(\frac{h^2}{4} - y^2 \right) = \frac{6 \cdot (12 \cdot 10^3)}{100 \times 300^3} \left(\frac{300^2}{4} - y^2 \right)$$

$$\tau = \frac{72 \cdot 10^3}{2.700.000.000} (90.000 - y^2)$$

$$\tau = 2.67 \times 10^{-5} (22.500 - y^2)$$

$$= 2.67 \times 10^{-5} (22500 - y^2)$$

Tegangan utama dan tegangan geser maksimum

$$\text{Tegangan utama : } \sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

karena tidak ada tegangan normal arah y, maka!

$$\sigma_{1,2} = \frac{\sigma_x}{2} \pm \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau_{xy}^2}$$

$$\text{Tegangan geser maksimum! } \tau_{\max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\tau_{\max} = \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau_{xy}^2}$$

Y (mm)	σ_x	τ_{xy}	σ_y	σ_z	$\tau_{\max}$
150	-31.5	0	0	-31.5	15.75

jadi, tegangan utama

$$a) \sigma_{1,2} = \frac{-31.5}{2} \pm \sqrt{\left(\frac{31.5}{2}\right)^2}$$

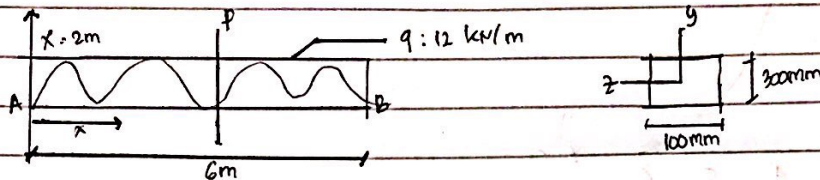
$$= -31.5 + 15.75 = -15.75 \text{ Mpa}$$

$$b) \text{Tegangan geser max } \tau_{\max} = 15.75 \text{ mpa.}$$

Nama: Zul Aslam

Nim: 182710039.

Tugas 12.



Syarat :

$$\begin{aligned} \sum M &= 0 & Q &= q \cdot L \\ & & &= 12 \cdot 6 \\ \sum V &= 0 & &= 72 \text{ kN} \\ \sum H &= 0 & Q_x &= q \cdot x \\ & & &= 12 \cdot x \end{aligned}$$

Reaksi penopangan

$$\begin{aligned} \sum M_A &= 0 & \sum M_B &= 0 \\ Q \cdot 3 - V_B \cdot 6 &= 0 & V_A \cdot 6 - Q \cdot 3 &= 0 \\ 72(3) - V_B \cdot 6 &= 0 & V_A \cdot 6 - 72(3) &= 0 \\ V_B &= 36 \text{ kN} & V_A &= 36 \text{ kN} \end{aligned}$$

Kontrol $\sum V = 0$

$$V_A + V_B - P = 0$$

$$36 \text{ kN} + 36 \text{ kN} - 72 \text{ kN} = 0$$

$$0 = 0 \dots \text{ok!}$$

Kontrol $\sum H = 0$

$$H_A = 0$$

Perhitungan bidang momen (M_x) dan lintang (Q_x)

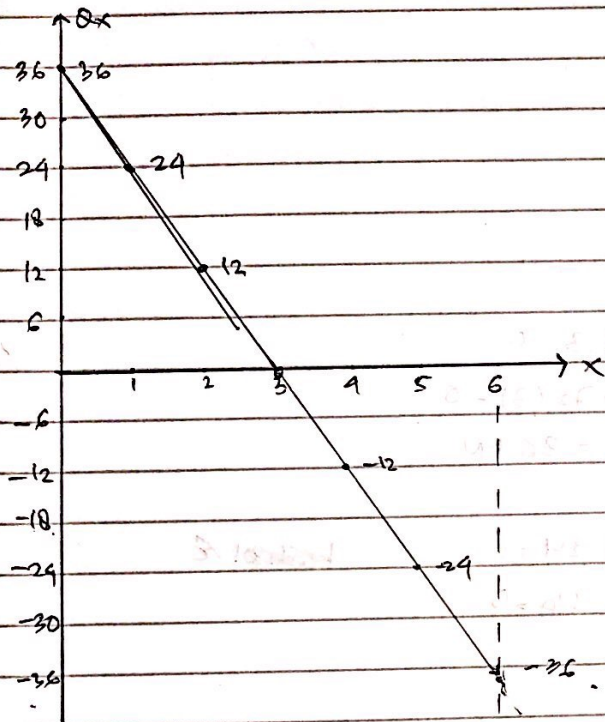
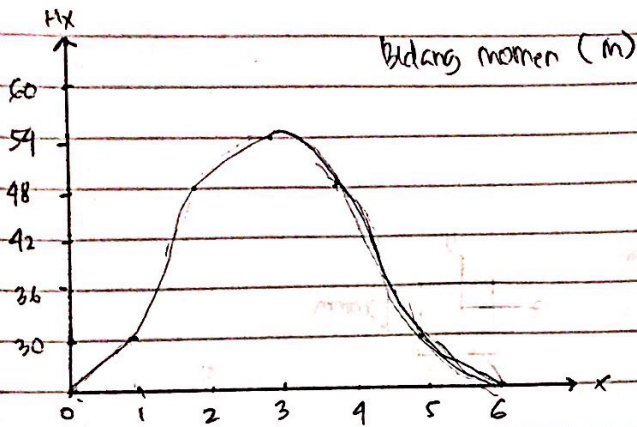
Batang AB : $0 \leq x \leq 6 \text{ m}$ dihitung dari titik A

$$\begin{aligned} M_x &= V_A \cdot x - Q_x \cdot \frac{1}{2} x \\ &= 36x - 12x \cdot \frac{1}{2} x \\ &= 36x - 6x^2 \end{aligned}$$

x (m)	0	1	2	3	4	5	6
M_x (kN.m)	0	30	48	54	48	30	0

$$Q_x = \frac{dM_x}{dx} = 36 - 12x$$

x (m)	0	1	2	3	4	5	6
Q_x (kN)	36	24	12	0	-12	-24	36



Tegangan Normal dipotong melintang Pq

$$\sigma_x = -\frac{My}{I} = -\frac{My}{\frac{1}{12}bh^3}$$

$$\sigma_x = -\frac{(48) \cdot y \cdot 10^6}{\frac{1}{12} \cdot (100) (300)^3} = -0,243 y$$

Tegangan Geser dipotong melintang Pq

$$Q = b \left(\frac{h}{2} - y \right) \left(y + \frac{h}{2} - y \right)$$

$$Q = \frac{b}{2} \left(\frac{h^2}{4} - y^2 \right)$$

$$\tau = \frac{VQ}{I_b} = \frac{bv}{bh^3} \left(\frac{h^2}{4} - y^2 \right) = \frac{6 (12 \times 10^3)}{100 (300)^3} \cdot \left(\frac{300^2}{4} - y^2 \right) = -2,67 \cdot 10^{-5} (22500 - y^2)$$

Tegangan Utama dan Tegangan geser maksimum.

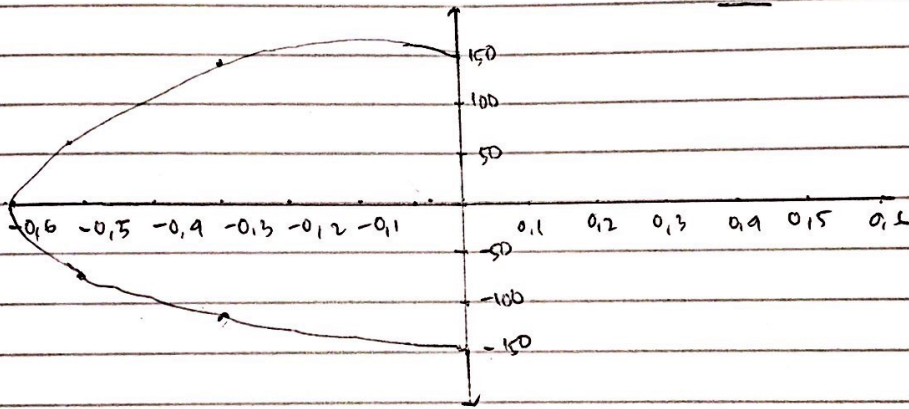
$$\sigma_{1,2} = \frac{\sigma_x}{2} \pm \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau_{xy}^2}$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau_{xy}^2}$$

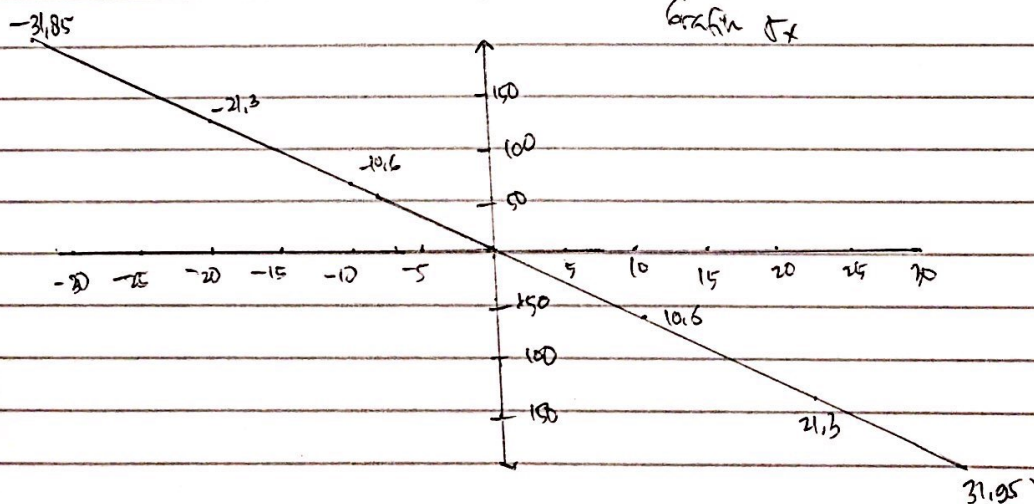
Maka didapat tabel berikut.

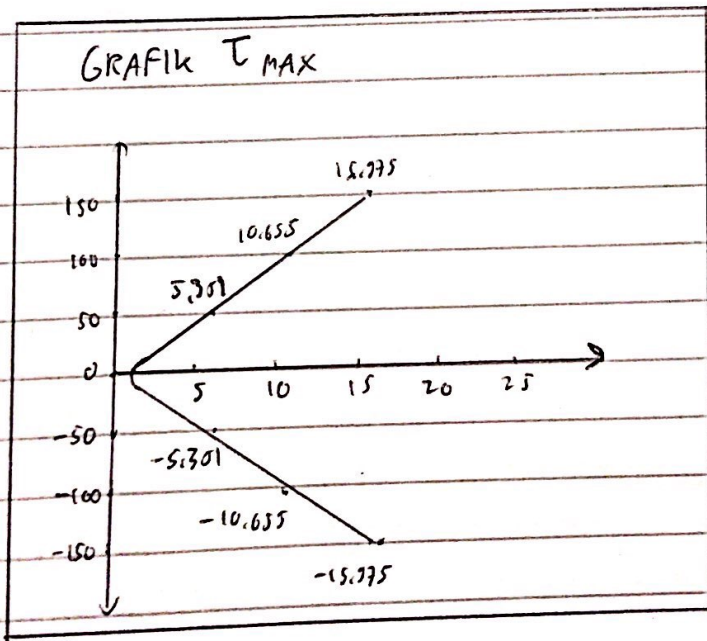
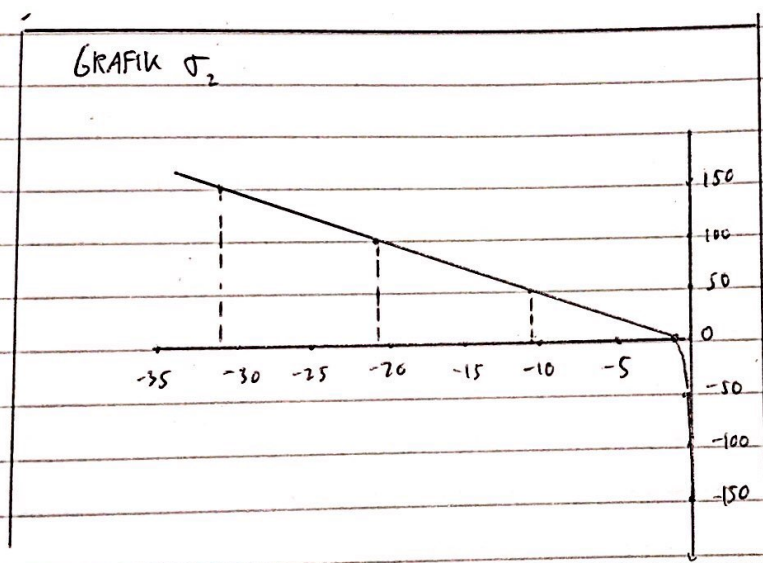
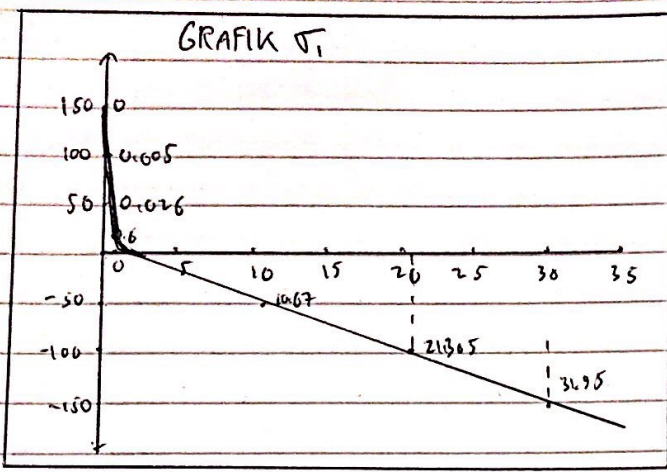
Titik	y (mm)	τ_{xy}	σ_x	σ_1	σ_2	τ_{maks}
A	150	0	-31,95	0	-31,95	15,975
B	100	-0,33	-21,3	0,005	-21,3	10,655
C	50	-0,53	-10,65	0,026	-10,67	5,351
D	0	-0,6	0	0,6	-0,6	0,6
E	-50	-0,53	10,65	10,67	-0,62	5,351
F	-100	-0,33	21,3	21,305	0,005	10,655
G	-150	0	31,95	31,95	0	15,975

Grafik τ_{xy}



Grafik σ_x

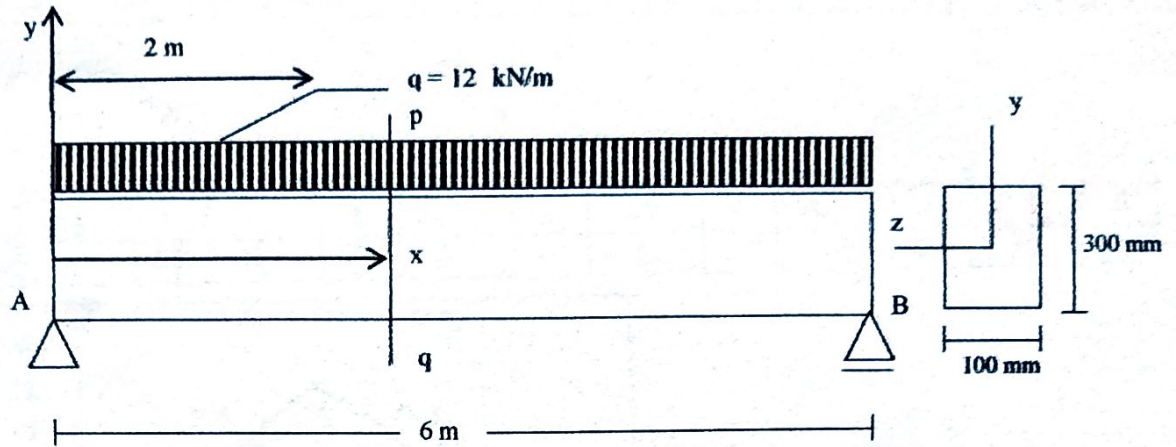




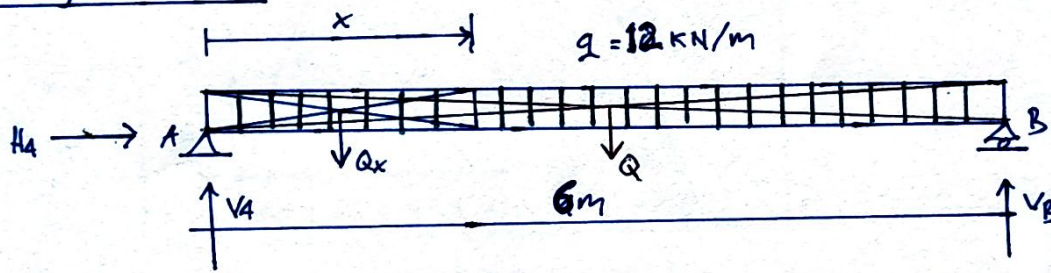
NAMA : ALDAFI
 NIM : 182710040
 MK : MEKANIKA TERAPAN
 DOSEN : Dr. FIRDAUS, MT

Soal

1. Suatu balok sederhana dengan beban terbagi merata seperti tergambar. Balok ini terbuat dari baja dengan penampang berbentuk persegi panjang. Selidikilah tegangan utama dan tegangan geser maksimum di potongan melintang pq, yang terletak pada jarak $x = 2$ m dari titik A.



PENYELESAIAN :



SYARAT :

$$\begin{aligned}\sum M &= 0 \\ \sum Y &= 0 \\ \sum H &= 0\end{aligned}$$

$$Q = q \cdot L$$

$$Q = 12 \text{ kN/m} \times 6 \text{ m} = 72 \text{ kN}$$

$$Q_x = q \cdot x = 12x$$

REAKSI PERLETAKAN :

$$\sum M_A = 0$$

$$Q \cdot 3 - V_B \cdot 6 = 0$$

$$72 \cdot 3 - 6 V_B = 0$$

$$V_B = 36 \text{ kN}$$

$$\sum M_B = 0$$

$$V_A \cdot 6 - Q \cdot 3 = 0$$

$$V_A \cdot 6 - 72 \cdot 3 = 0$$

$$V_A = 36 \text{ kN}$$

KONTROL : $\sum V = 0$

$$V_A + V_B - P = 0$$

$$36 \text{ kN} + 36 \text{ kN} - 72 \text{ kN} = 0$$

$$0 = 0 \rightarrow \text{OK!!}$$

$$\sum H = 0$$

$$H_A = 0$$

PERHITUNGAN BIDANG MOMEN (M_x) DAN LINTANG (Q_x)

BATANG AB : $0 \leq x \leq 4 \text{ m}$ DIUKUR DARI TITIK A

$$M_x = V_A \cdot x - Q_x \cdot \frac{1}{2} x$$

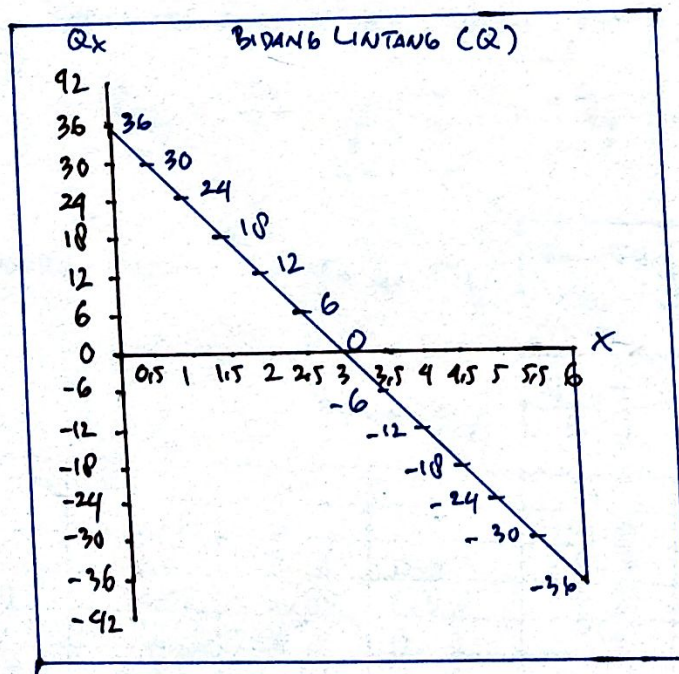
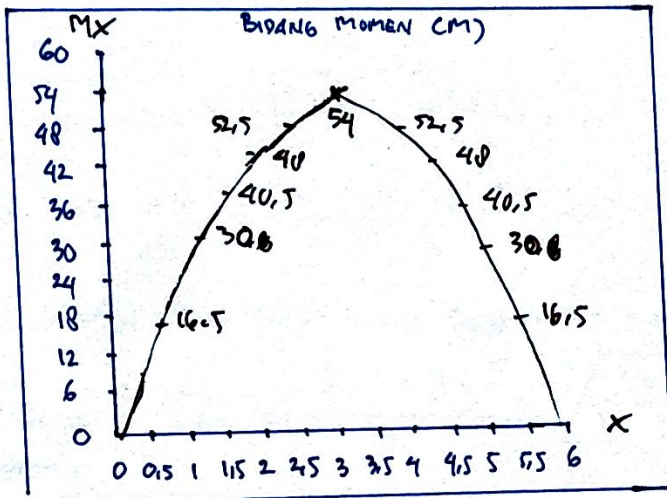
$$M_x = 36 \cdot x - 12x \cdot \frac{1}{2} x$$

$$M_x = 36 \cdot x - 6x^2$$

x (m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
M_x (kN-m)	0	16,5	30	40,5	48	52,5	54	52,5	48	40,5	30	16,5	0

$$Q_x = \frac{dM_x}{dx} = 36 - 12x$$

x (m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
Q_x (kN)	36	30	24	18	12	6	0	-6	-12	-18	-24	-30	-36



TEGANGAN NORMAL DIPOTONGKAN MELINTANG PQ

$$\sigma_x = \frac{M_y}{I} = - \frac{M_y}{\frac{1}{12} b h^3}$$

$$\sigma_x = - \frac{(48 \cdot 126) y}{\frac{1}{2} (100) (300^3)} = -0,637 y$$

TEGANGAN GESER DI POTONGAN MELINTANG PQ

$$Q = b \left[\frac{h}{3} - y \right] \left[y + \frac{h/3 - y}{2} \right]$$

$$Q = \frac{b}{2} \left[\frac{h^2}{4} - y^2 \right]$$

$$\tau = \frac{VQ}{Ib}$$

$$\tau = \frac{V \left[\frac{b}{2} \left(\frac{h^2}{4} - y^2 \right) \right]}{\left(\frac{1}{12} bh^3 \right) b} = - \frac{6V}{bh^3} \left[\frac{h^2}{4} - y^2 \right]$$

$$\tau = - \frac{6 (10^4)}{100 \times 300^3} \left[\frac{300^2}{4} - y^2 \right]$$

$$\tau = - 2,22 \times 10^{-5} (225.000 - y^2)$$

TEGANGAN UTAMA DAN TEGANGAN GESER MAKSIMUM

$$\text{TEGANGAN UTAMA : } \sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left[\frac{\sigma_x - \sigma_y}{2} \right]^2 + \tau_{xy}^2}$$

KARENA TIDAK ADA TEGANGAN NORMAL DALAM ARAH Y, MAKA :

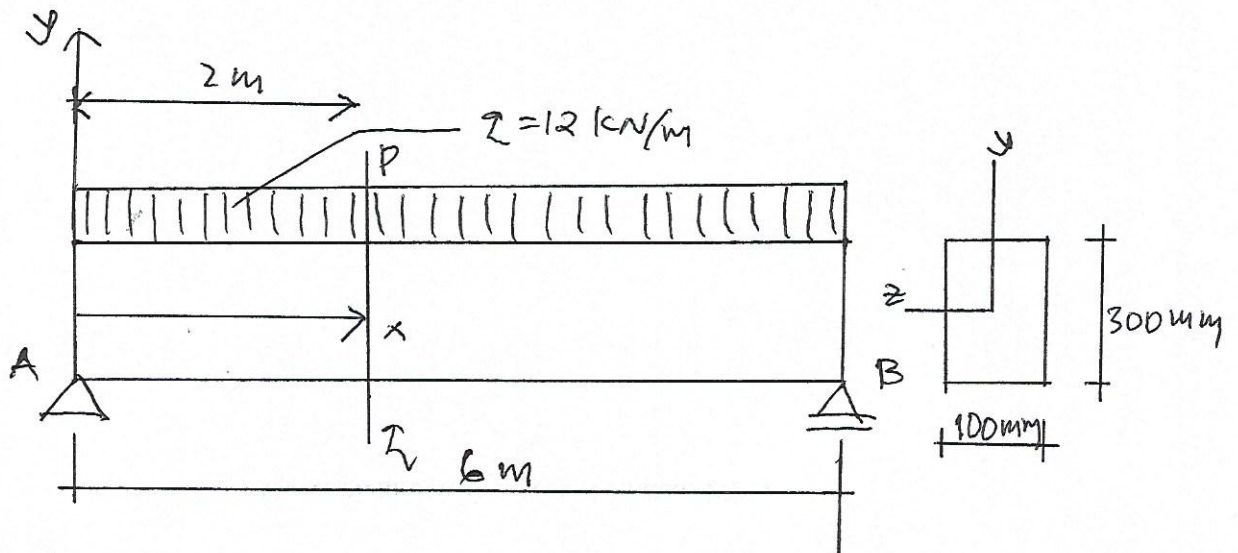
$$\sigma_{1,2} = \frac{\sigma_x}{2} \pm \sqrt{\left[\frac{\sigma_x}{2} \right]^2 + \tau_{xy}^2}$$

$$\text{TEGANGAN GESER MAKSIMUM : } \tau_{maks} = \sqrt{\left[\frac{\sigma_x - \sigma_y}{2} \right]^2 + \tau_{xy}^2}$$

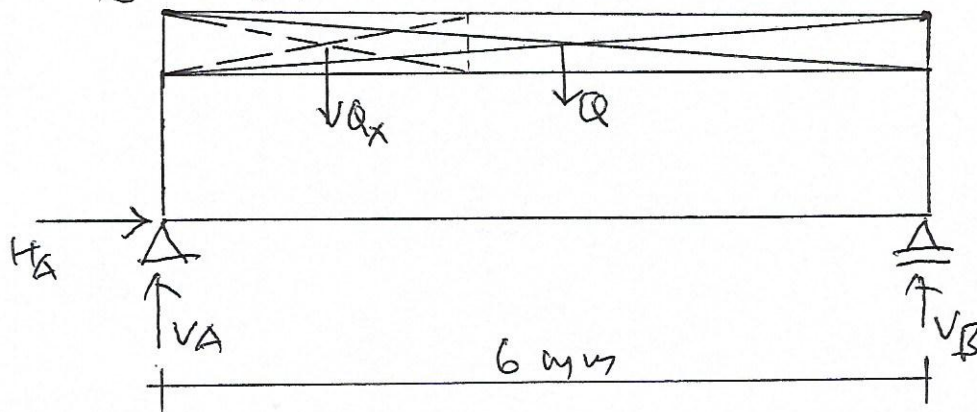
$$\tau_{maks} = \sqrt{\left[\frac{\sigma_x}{2} \right]^2 + \tau_{xy}^2}$$

TITIK	y (mm)	σ_x	τ_{xy}	σ_1	σ_2	τ_{maks}
A	150	-95,55	0	0	-95,55	5,03
B	100	-63,7	-0,28	0,01	-63,8	3,36
C	50	-31,85	-0,44	0,06	-31,84	1,73
D	0	0	-0,50	0,50	0,5	0,50
E	-50	31,85	-0,44	31,41	-0,06	1,73
F	-100	63,7	-0,28	6,71	-0,01	3,36
G	-150	95,55	0	10,05	0,00	5,03

ARTHA
182710032



Pengelasan:



Syarat: $\sum M = 0$ $\sum V = 0$ $\sum H = 0$

$$Q = qL = 12 \cdot 6 = 72 \text{ kN}$$

$$Q_x = q \cdot x = 12x$$

Pada: perletakan:

$$\sum M_B = 0 \quad V_A \cdot 6 - Q \cdot 3 = 0$$

$$V_A \cdot 6 - 72 \cdot 3 = 0 \rightarrow V_A = \frac{216}{6} = 36 \text{ kN}$$

$$\sum M_A = 0 \quad -V_B \cdot 6 + Q \cdot 3 = 0 \rightarrow V_B = \frac{216}{6} = 36 \text{ kN}$$

$$\sum V = 0 \quad V_A + V_B - Q = 0$$

$$36 + 36 - 72 = 0 \quad (\text{OK})$$

$$\sum H = 0$$

$$H_A = 0$$

Perhitungan besaran Momen (M_x) dan Lintasan (Q_x)
Batang AB $0 \leq x \leq 6$ m diukur dari titik A

$$\begin{aligned} M_x &= V_A \cdot x - Q_x \cdot \frac{1}{2} x \\ &= 36 \cdot x - 12x \cdot \frac{1}{2} x = 36x - 6x^2 \\ &= 36x - 6x^2 \end{aligned}$$

x (m)	0	0,5	1	1,5	2	2,5	3,0	3,5	4,5	5,0	5,5	6
M_x (kNm)	0	16,5	30	40,5	48	52,5	54	52,5	40,5	30	16,5	0

$$\begin{aligned} M_x &= 36x - 6x^2 \\ Q_x &= \frac{dM_x}{dx} = 36 - 12x \end{aligned}$$

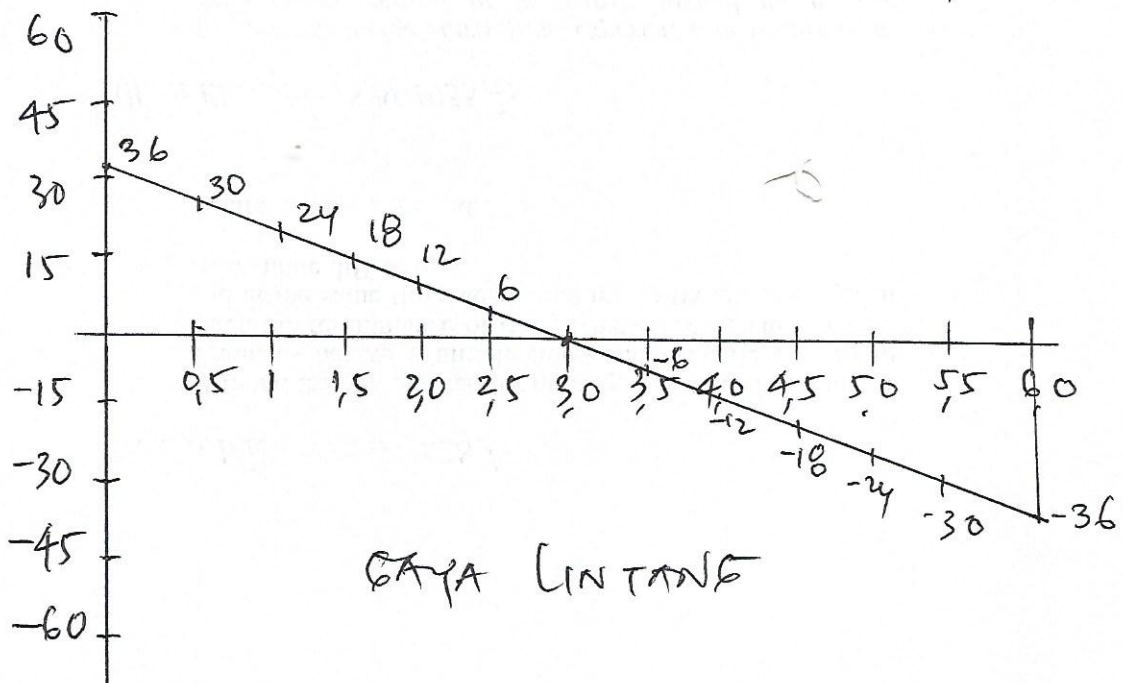
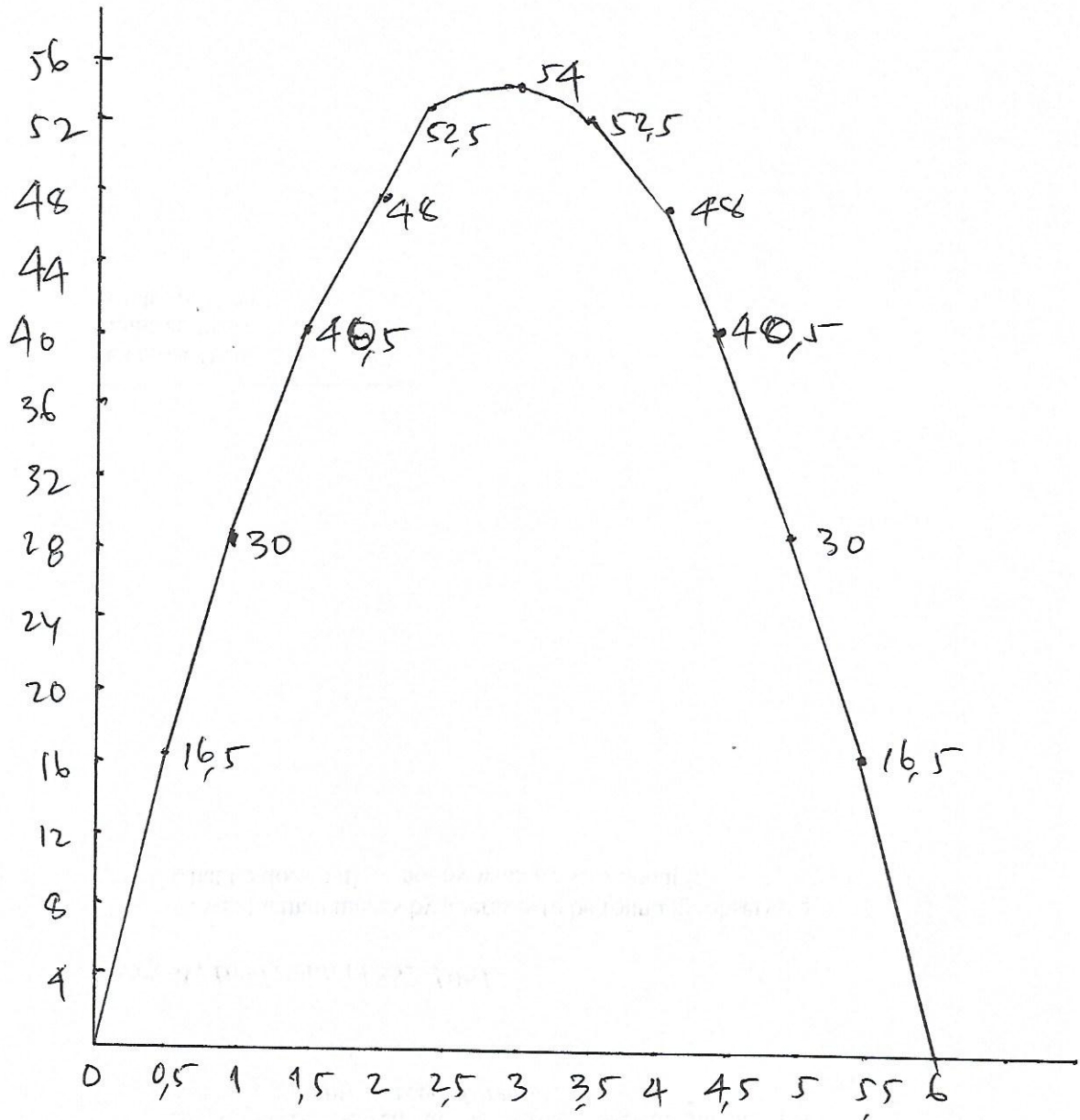
4,0
48

x (m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
Q_x (kN)	36	30	24	18	12	6	0	-6	-12	-18	-24	-30	-36

BIDANG MOMEN

ARTHA B
182710032

③



Arhaty
182710032

Tegangan utama dan tegangan geser maksimum

Tegangan utama : $\sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$

Karena tidak ada tegangan normal arah y, maka:

$$\sigma_{1,2} = \frac{\sigma_x}{2} \pm \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau_{xy}^2}$$

Tegangan geser maksimum : $\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau_{xy}^2}$$

y(mm)	σ_x	τ_{xy}	σ_1	σ_2	τ_{max}	
150	-31,5	0	0	-31,5	15,75	

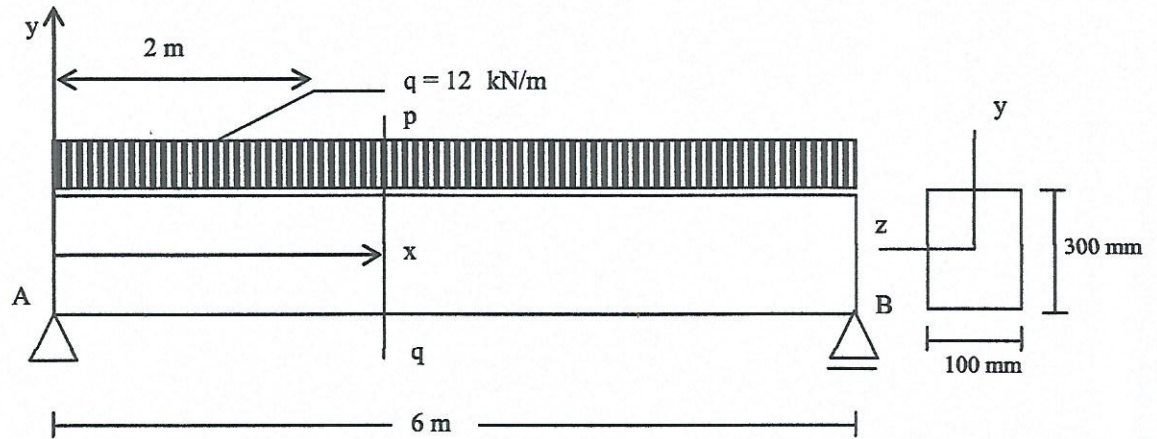
Jadi Tegangan utama

a) $\sigma_{1,2} = \frac{-31,5}{2} \pm \sqrt{\left(\frac{31,5}{2}\right)^2}$
 $= -31,5 + 15,75 = -15,75 \text{ MPa}$

b) Tegangan geser max $\tau_{max} = 15,75 \text{ MPa}$

Soal

1. Suatu balok sederhana dengan beban terbagi merata seperti tergambar. Balok ini terbuat dari baja dengan penampang berbentuk persegi panjang. Selidikilah tegangan utama dan tegangan geser maksimum di potongan melintang pq, yang terletak pada jarak $x = 2$ m dari titik A.

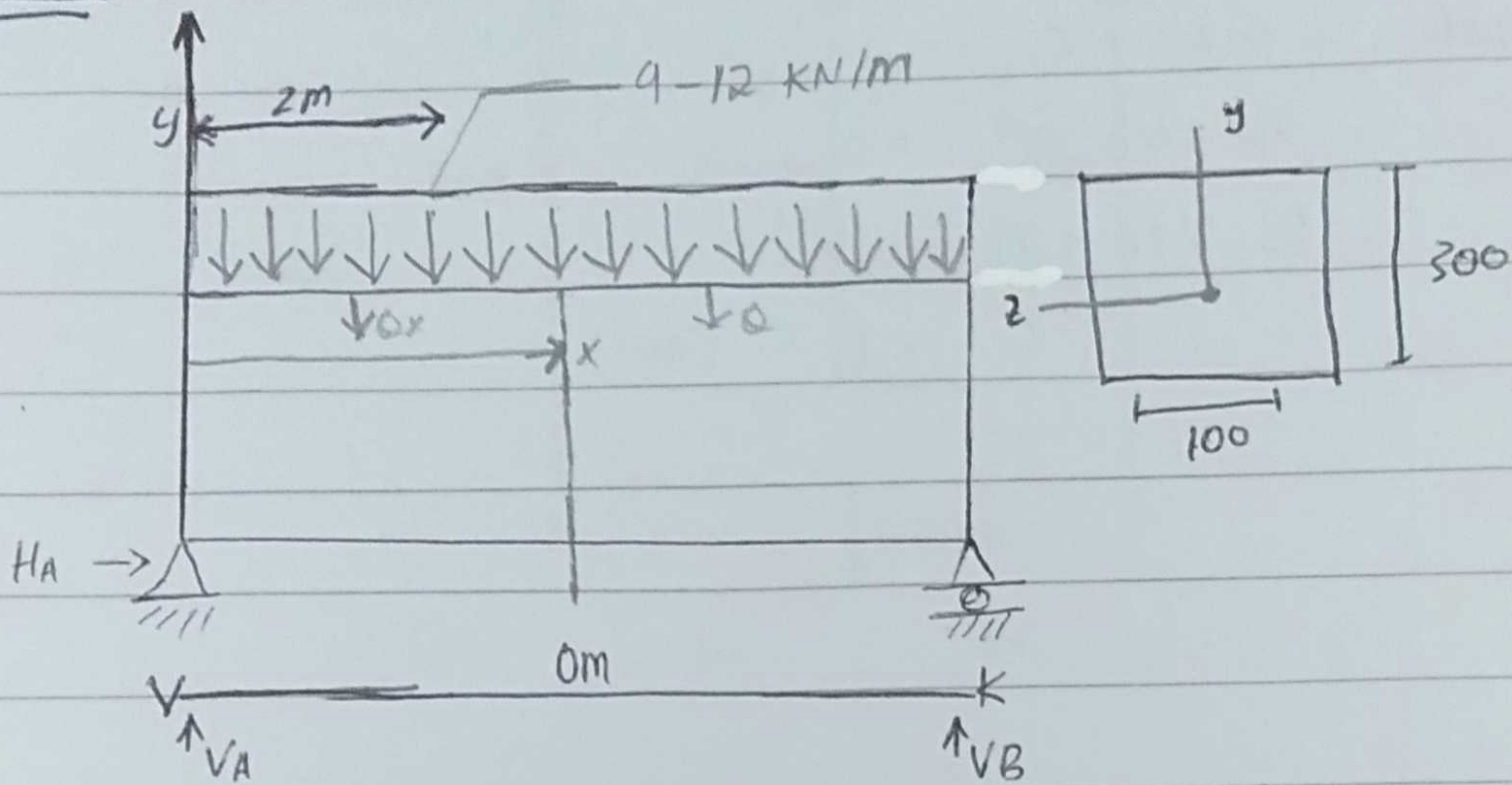


Nama : Ari Oka Putra
Nim : 182710035

Date.

No.

Soal 12



$$\text{Syarat} = \sum m = 0$$

$$\sum V = 0$$

$$\sum H = 0$$

$$Q = q \cdot L$$

$$= 12 (6)$$

$$= 72 \text{ kN}$$

$$Q_x = q \cdot x$$

$$= 12 \cdot x$$

Reaksi perletakan

$$\sum m_A = 0$$

$$Q(3) - V_B(6) = 0$$

$$72(3) - 6(V_B) = 0$$

$$216 - 6V_B = 0$$

$$V_B = 36 \text{ kN}$$

$$\sum m_B = 0$$

$$V_A(6) - Q(3) = 0$$

$$6V_A - 72(3) = 0$$

$$6V_A = 72(3)$$

$$V_A = 36$$

$$V_{\text{node}} = 4V - 0$$

$$V_A + V_B - P = 0$$

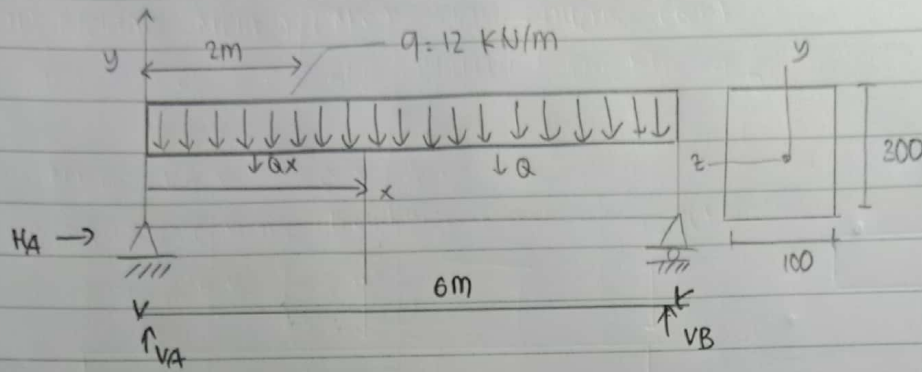
$$36 + 36 - 72 = 0$$

$$0 = 0 \quad (\text{OK}).$$

Nama : Deni Hattson

WPM : 182710027

soal 12 :



syarat : $\sum M = 0$

$$\sum V = 0$$

$$\sum H = 0$$

$$Q = q \cdot l$$

$$= 12 (6)$$

$$= 72 \text{ kN}$$

$$Q_x = q \cdot x$$

$$= 12x$$

Reaksi Perletakan:

$$\sum M_A = 0$$

$$Q(3) - V_B(6) = 0$$

$$72(3) - 6(V_B) = 0$$

$$216 - 6V_B = 0$$

$$V_B = 36 \text{ kN}$$

$$\sum M_B = 0$$

$$V_A(6) - Q(3) = 0$$

$$6V_A - 72(3) = 0$$

$$6V_A = 72(3)$$

$$V_A = 36$$

Kontrol $= \sum V = 0$

$$V_A + V_B - P = 0$$

$$36 + 36 - 72 = 0$$

$$0 = 0 \quad (\text{OK!})$$

$$\sum H = 0, \quad H_A = 0$$

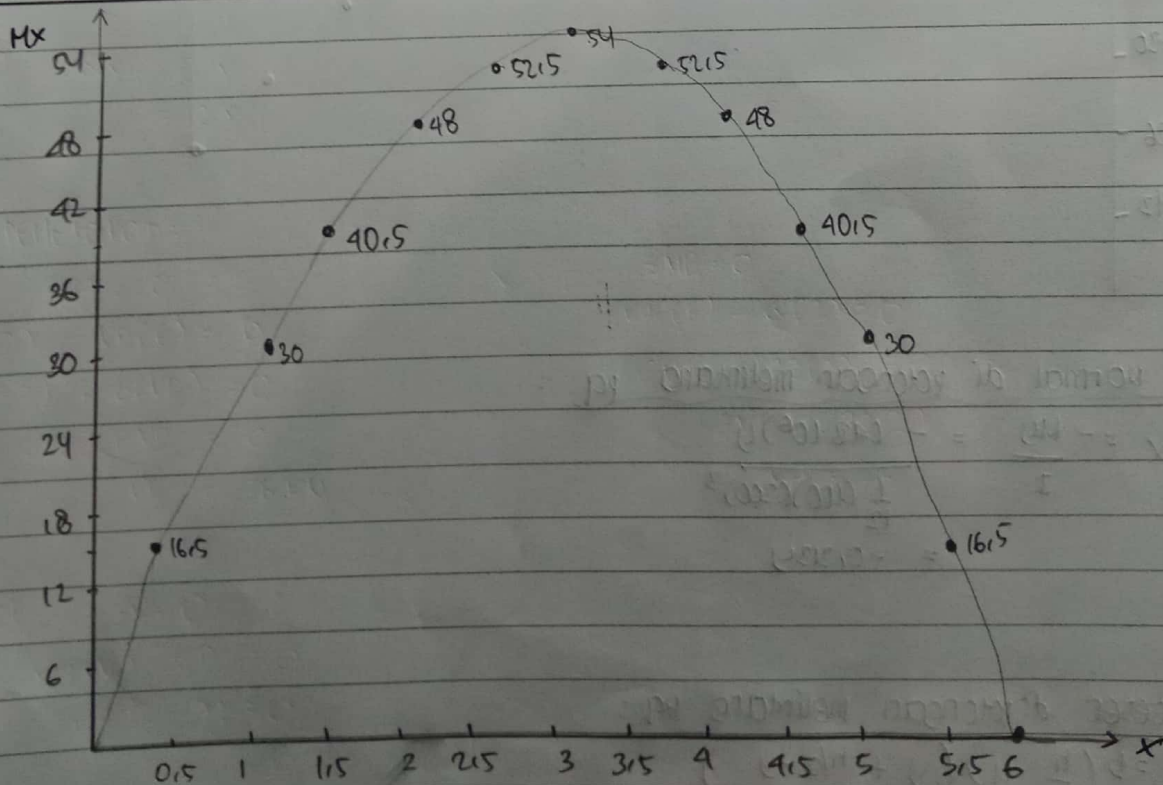
Perhitungan Bidang Momen (M_x) dan Lintang (Q_x)
Batang AB $= 0 \leq x \leq 6m$ diukur dari titik A

$$\begin{aligned} M_x &= V_A x - Q_x \cdot \frac{1}{2} x \\ &= 36x - 12x \cdot \frac{1}{2} x \\ &= 36x - 6x^2 \end{aligned}$$

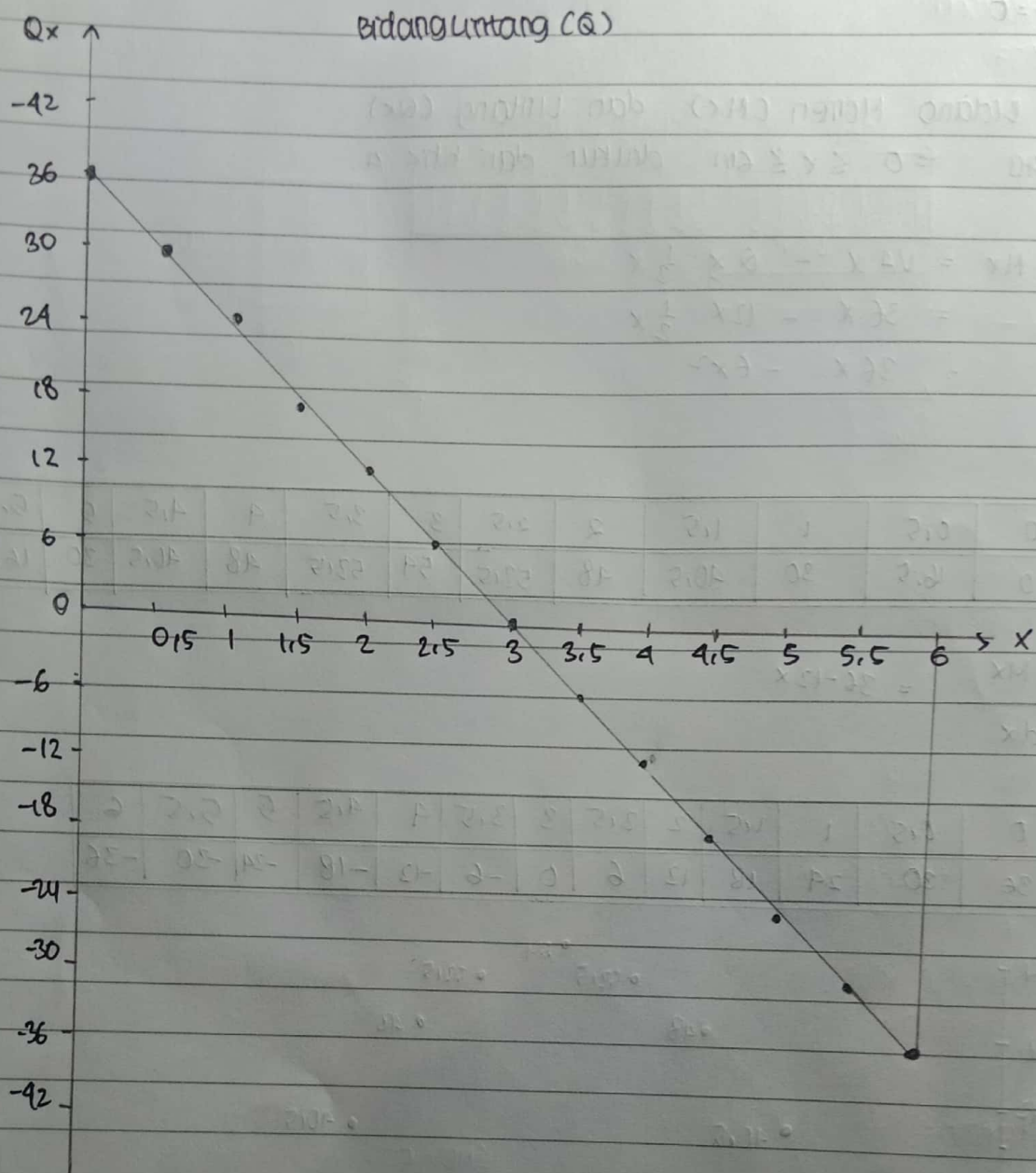
x (m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
M_x (kN-m)	0	16,5	30	40,5	48	52,5	54	52,5	48	40,5	30	16,5	0

$$Q_x = \frac{dM_x}{dx} = 36 - 12x$$

x (m)	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6
M_x (kN-m)	36	30	24	18	12	6	0	-6	-12	-18	-24	-30	-36



- Bidang Momen -



• regangan normal di potongan melintang pq :

$$\sigma_x = -\frac{My}{I} = -\frac{(48 \cdot 10^6)y}{\frac{1}{12}(100)(300)^3}$$

$$= -0.23y$$

• regangan geser di potongan melintang pq :

$$Q = b\left(\frac{h}{2} - y\right)\left(y + \frac{h/2 - y}{2}\right)$$

$$= \frac{b}{2}\left(\frac{h^2}{4} - y^2\right)$$

$$\tau = \frac{VQ}{Ib}$$

$$\tau = \frac{V \left(\frac{b}{2} \left(\frac{h^2}{4} - y^2 \right) \right)}{\left(\frac{1}{12} b h^3 \right) b} = \frac{-6V}{bh^3} \left(\frac{h^2}{4} - y^2 \right)$$

$$\tau = \frac{6(10^4)}{100 \cdot 300^3} \left(\frac{300^2}{4} - y^2 \right)$$

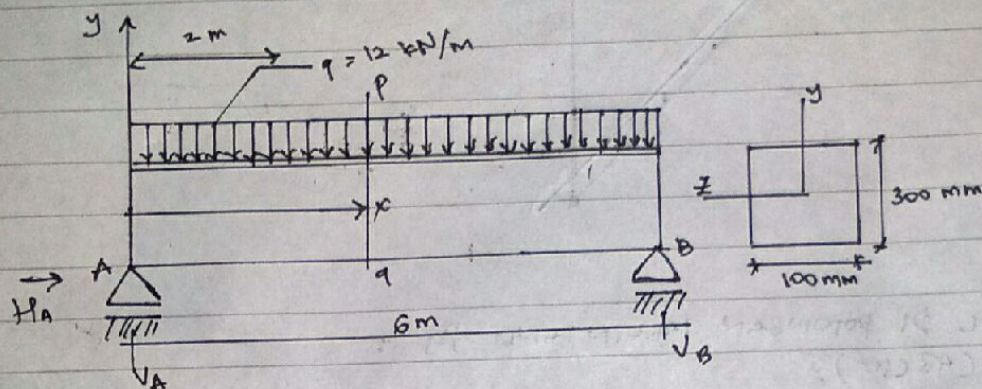
$$= -2.22 \cdot 10^{-5} (22500 - y^2)$$

tegangan utama & geser max.

NAMA : DESMARITA
 NIM : 182710025

TUGAS 12 :

* SUATU BALOK SEDERHANA DENGAN BEBAN TERBAGI MERATA SEPERTI TERGAMBAR. BALOK INI TERBUAT DARI BAJA DENGAN PENAMPANG BERBENTUK PERSEGI PANJANG. SELIDIKILAH TEGANGAN UTAMA DAN TEGANGAN GESER MAKSIMUM DI POTONGAN MELINTANG PQ YANG TERLETAK JARAK $x = 2$ m DARI TITIK A.



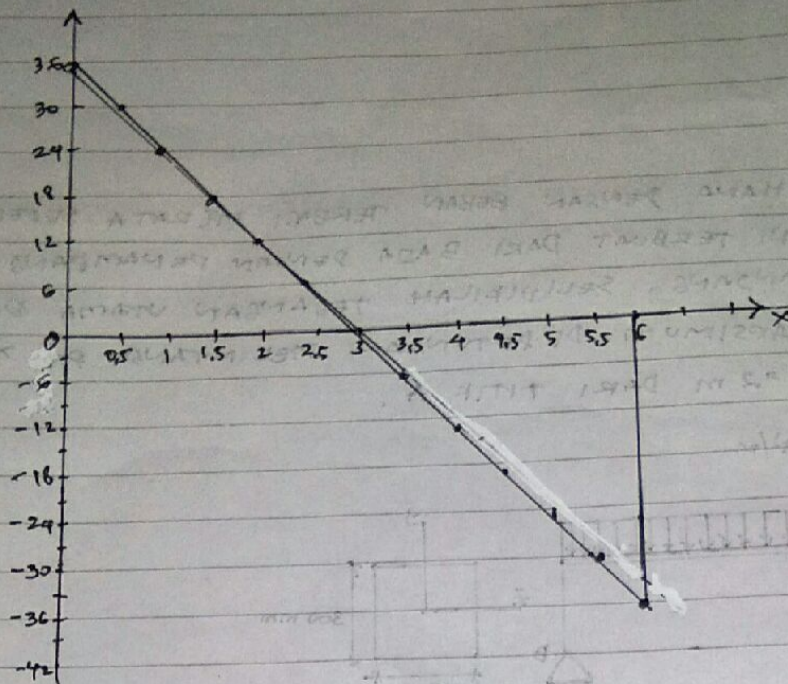
$$\begin{aligned} \text{Syarat : } \sum M &= 0 & Q &= q \cdot l & Q_x &= qx \\ \sum V &= 0 & &= 12(6) & &= 72 \text{ kN} \\ \sum H &= 0 & & & & \end{aligned}$$

REAKSI PERLETAKAN

$$\begin{aligned} \sum M_A &= 0 & \sum M_B &= 0 \\ Q(3) - V_B(6) &= 0 & V_A(6) - Q(3) &= 0 \\ 72(3) - 6V_B &= 0 & 6V_A - 72(3) &= 0 \\ 216 - 6V_B &= 0 & 6V_A &= 72(3) \\ V_B &= 36 \text{ kN} & V_A &= 36 \end{aligned}$$

KONTROL $\sum V = 0$

$$\begin{aligned} V_A + V_B - P &= 0 \\ 36 + 36 - 72 &= 0 \\ 0 &= 0 \quad \text{OK!} \end{aligned}$$



*) TEGANGAN NORMAL DI POTONGAN MELINTANG Pa :

$$\sigma_x = -\frac{M_y}{I} = \frac{-(48(10^6))}{\frac{1}{12}(100)(300)^3}$$

$$= -0,212 y$$

*) TEGANGAN GESEK DI POTONGAN MELINTANG Pa :

$$Q = b \left(\frac{h}{2} - y \right) \left(y + \frac{h/2 - y}{2} \right)$$

$$= \frac{b}{2} \left(\frac{h^2}{4} - y^2 \right)$$

$$C = \frac{VQ}{Ib}$$

$$C = \frac{V \left(\frac{b}{2} \left(\frac{h^2}{4} - y^2 \right) \right)}{\left(\frac{1}{12} b h^3 \right)} = \frac{-6V}{bh^3} \left(\frac{h^2}{4} - y^2 \right)$$

$$C = \frac{6(10^4)}{100 \cdot 300^3} \left(\frac{300^2}{4} - y^2 \right)$$

$$= -2,22 \cdot 10^{-5} (22500 - y^2)$$

BATANG CB = $2\text{ m} \leq x_2 \leq 4\text{ m}$ diukur dari titik A

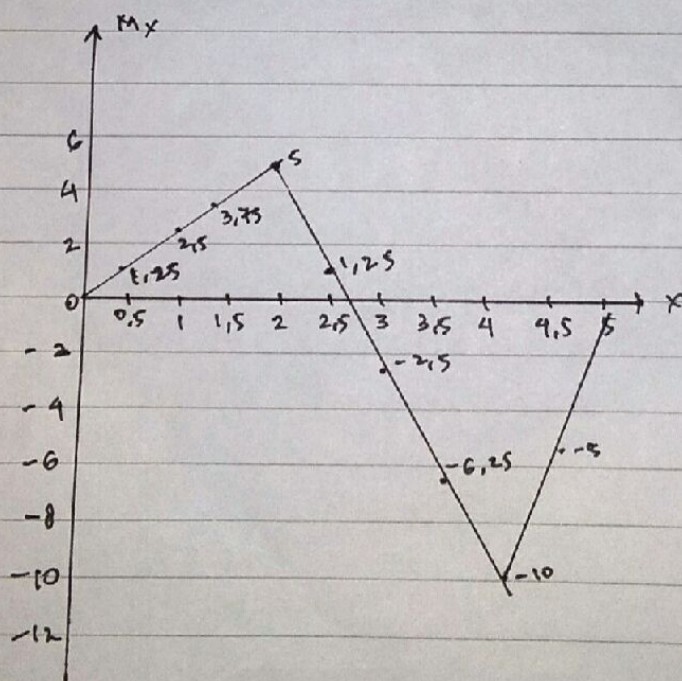
$$\begin{aligned} M_{x_2} &= V_A \cdot x_2 - P_1 (x_2 - 2) \\ &= \frac{5}{2} x_2 - 10 (x_2 - 2) \\ &= \frac{-15}{2} x_2 + 20 \end{aligned}$$

$x_2 (\text{m})$	2	2,5	3	3,5	4
$M_{x_2} (\text{kNm})$	5	1,25	-2,5	-6,25	-10

BATANG BD = $4\text{ m} \leq x_3 \leq 5\text{ m}$ diukur dari titik A

$$\begin{aligned} M_{x_3} &= V_A (x_3) - P_1 (x_3 - 2) + V_B (x_3 - 4) \\ &= \frac{5}{2} (x_3) - 10 (x_3 - 2) + \frac{35}{2} (x_3 - 4) \\ &= 10x_3 - 50 \end{aligned}$$

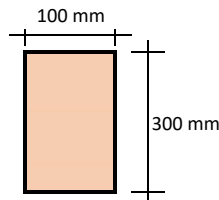
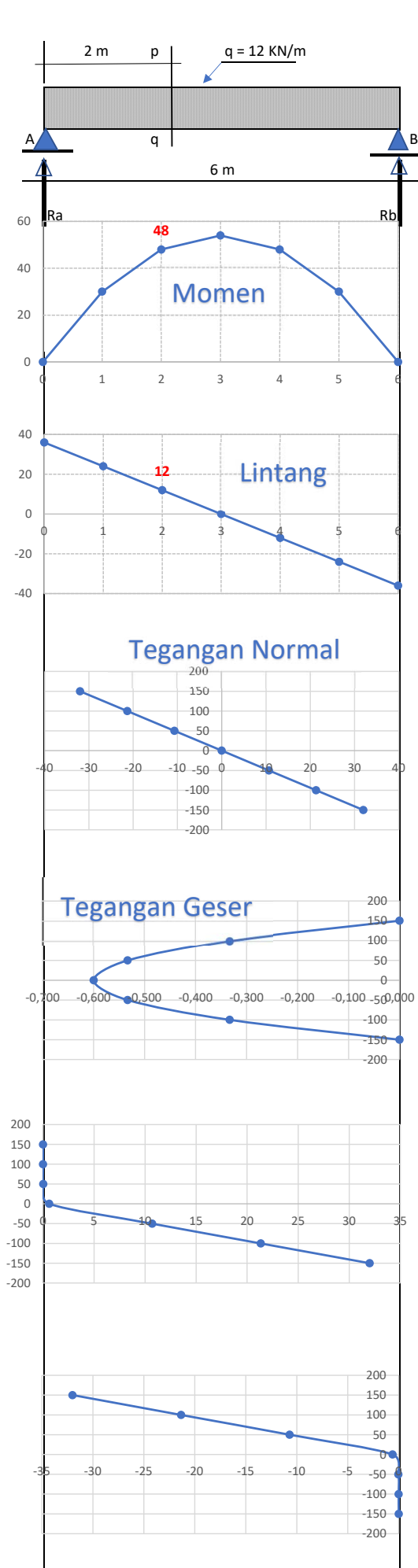
$x_3 (\text{m})$	4	4,5	5
$M_{x_3} (\text{kNm})$	-10	-5	0



Kesimpulan :

- momen (+) max $\rightarrow 5 \text{ kNm}$
- momen (-) max $\rightarrow -10 \text{ kNm}$

TUGAS PERTEMUAN 12



Diketahui :

$q = 12 \text{ kN/m}$
 $Q = 12.6 \text{ kN/m}$
 $Q = 72 \text{ kN/m}$

$b = 100 \text{ mm}$

$h = 300 \text{ mm}$

$L = 6 \text{ m}$

$$\sum MB = 0$$

$$\begin{aligned}
 &= R_a \cdot L - Q \cdot \frac{1}{2} \cdot L = 0 \\
 R_a &= \frac{(1/2 \cdot Q \cdot L)}{L} \\
 &= \frac{(1/2 \cdot 72 \cdot 6)}{6} \\
 &= 36 \text{ kN}
 \end{aligned}$$

$$\sum V = 0$$

$$\begin{aligned}
 &= R_a + R_b - Q = 0 \\
 R_b &= Q - R_a \\
 &= 72 - 36 \\
 &= 36 \text{ kN}
 \end{aligned}$$

Perhitungan bidang momen (Mx) dan Gaya Lintang(Qx)

Batang AB : $0 < x < 6 \text{ m}$ diukur dari titik A

$$M_x = R_a \cdot x - Q_x \cdot \frac{1}{2} \cdot x$$

$$Q_x = dM_x/dx$$

$$M_x = 36 \cdot x - 12 \cdot x \cdot \frac{1}{2} \cdot x$$

$$Q_x = 36 - 12 \cdot x$$

$$M_x = 36 \cdot x - 6 \cdot x^2$$

x (m)	0	1	2	3	4	5	6
Mx (KN-m)	0	30	48	54	48	30	0
Qx (KN)	36	24	12	0	-12	-24	-36

Momen di potongan pq (x=2 m) adalah = 48 kN-m

$$= 48.000.000 \text{ N-mm}$$

$$I_x = \frac{1}{12} \cdot b \cdot h^3$$

$$= \frac{1}{12} \cdot 100 \cdot 300^3$$

$$= 225.000.000 \text{ mm}^4$$

Lintang di potongan pq (x=2 m) adalah = 12 kN

$$= 12.000 \text{ N}$$

Tegangan normal pada potongan pq :

Rumus :

$$\sigma_x = -\frac{M_y}{I} = -\frac{M_y}{\frac{1}{12} b h^3}$$

Tegangan Geser pada potongan pq :

Rumus :

$$\tau = \frac{V \left[\frac{b}{2} \left(\frac{h^2}{4} - y^2 \right) \right]}{\left(\frac{1}{12} b h^3 \right) b} = -\frac{6V}{b h^3} \left(\frac{h^2}{4} - y^2 \right)$$

Tegangan utama pada potongan pq :

Rumus :

$$\sigma_{1,2} = \frac{\sigma_x}{2} \pm \sqrt{\left(\frac{\sigma_x}{2} \right)^2 + \tau_{xy}^2}$$

Tegangan Geser Maks pada potongan pq :

Rumus :

$$\tau_{maks} = \sqrt{\left(\frac{\sigma_x}{2} \right)^2 + \tau_{xy}^2}$$

Titik	y (mm)	σ_x	τ_{xy}	σ_1	τ_1	τ_2	τ_{maks}
A	150	-32,00	0,000	0,000	0,000	-32,000	16,000
B	100	-21,33	-0,333	0,005	0,005	-21,339	10,672
C	50	-10,67	-0,533	0,027	0,027	-10,693	5,360
D	0	0,00	-0,600	0,600	0,600	-0,600	0,600
E	-50	10,67	-0,533	10,693	10,693	-0,027	5,360
F	-100	21,33	-0,333	21,339	21,339	-0,005	10,672
G	-150	32,00	0,000	32,000	32,000	0,000	16,000

Nama : Idwan Rozanova

NIM : 182710028