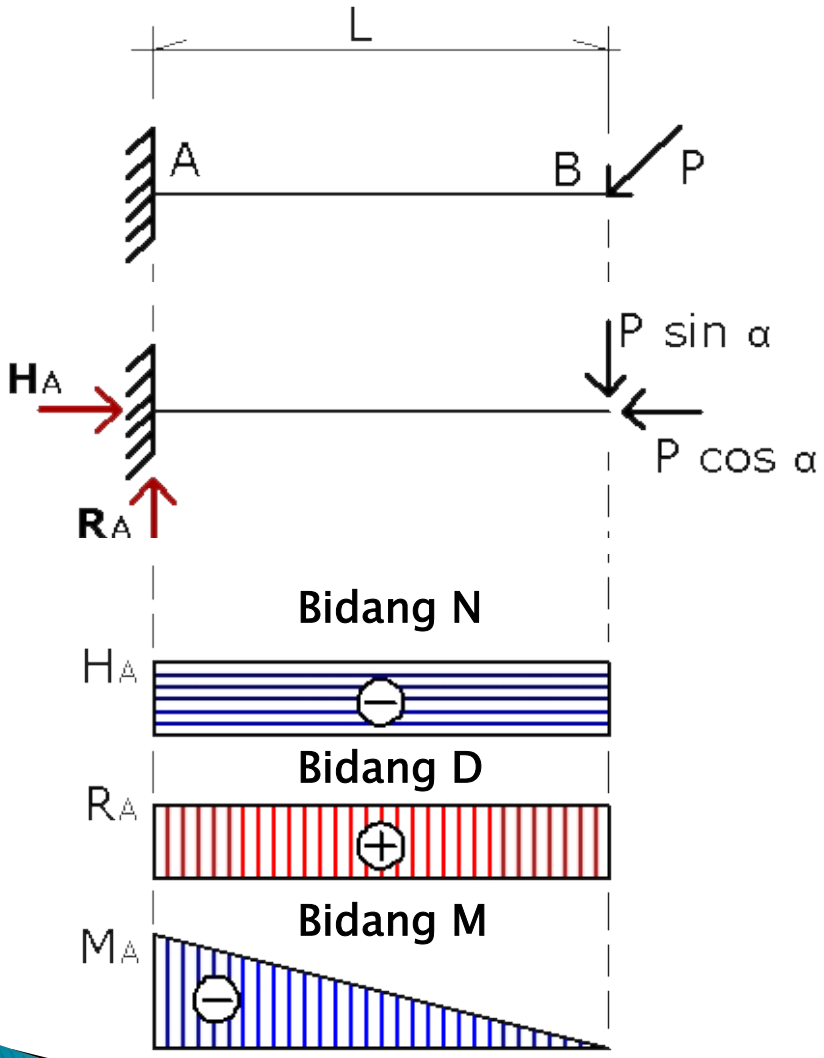
STATIKA

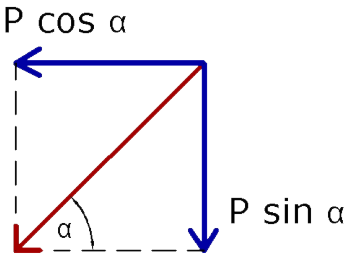
3 sks

FAKULTAS TEKNIK
JURUSAN SIPIL
UNIVERSITAS BRAWIJAYA

Balok Kantilever dengan Beban Terpusat



$\alpha = 45°$



ΣH = 0

HA – P cos α = 0

HA = P cos α

ΣV = 0

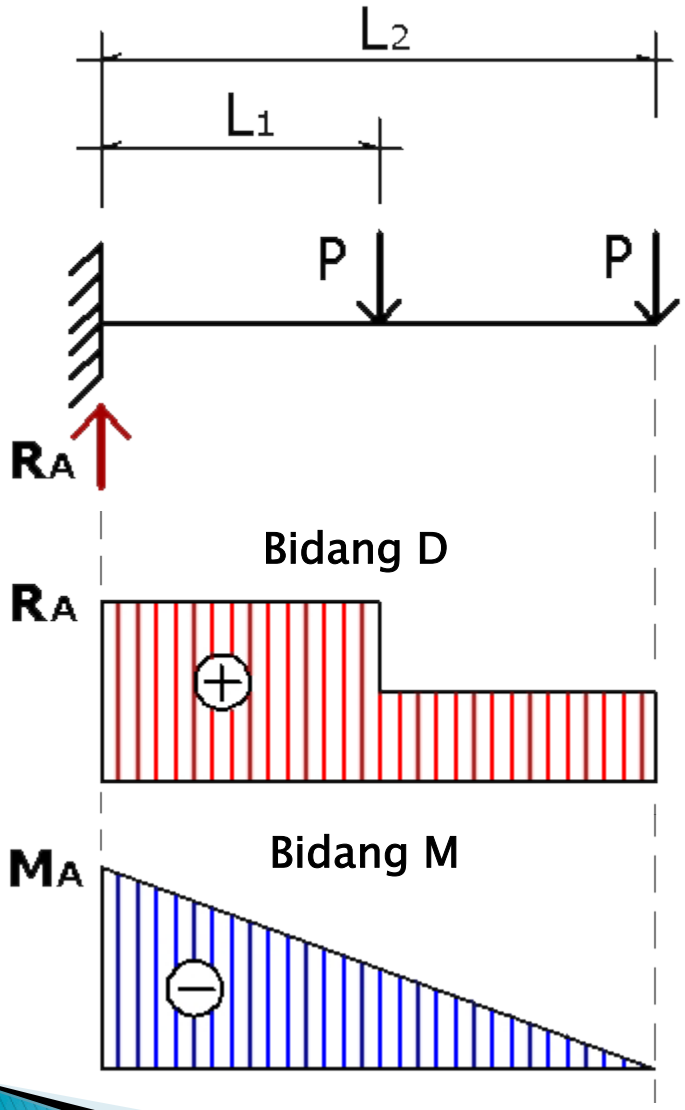
RA – P sin α = 0

RA = P sin α

ΣM = 0

MA = P sin α. L

Balok Kantilever dengan Beban Terpusat

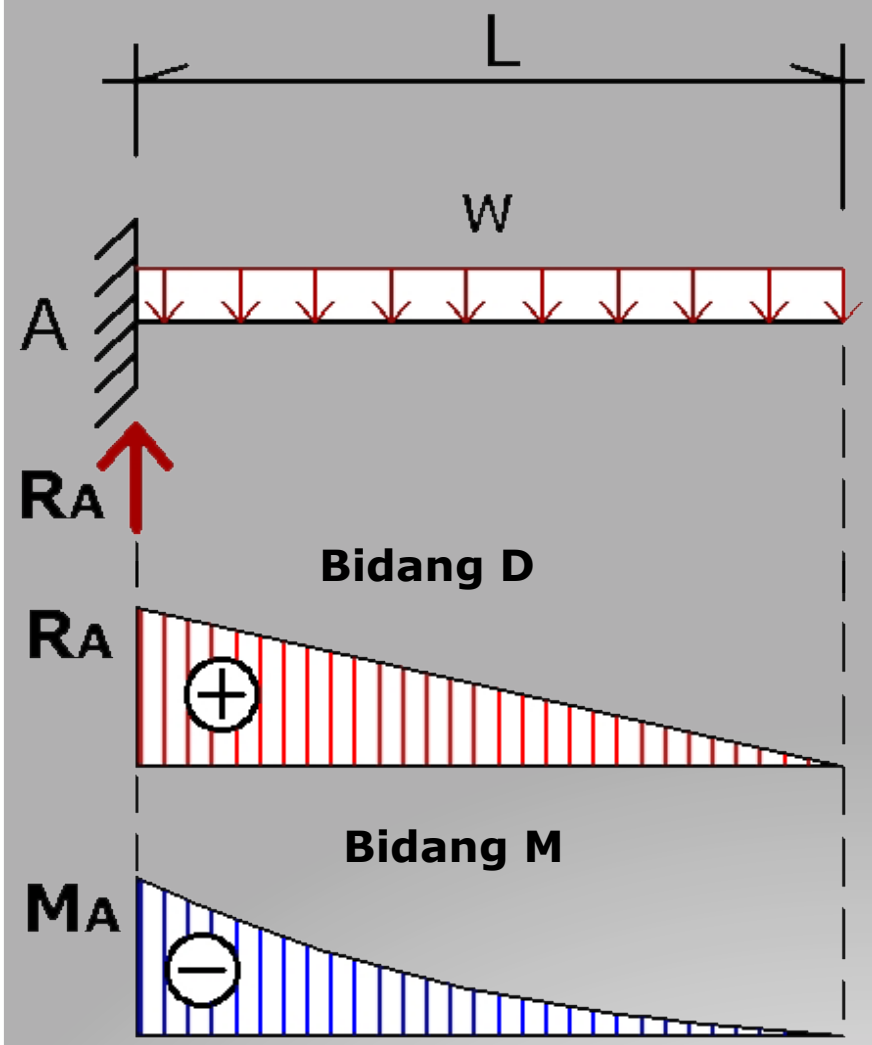


$\Sigma V = 0 \rightarrow RA - P - P = 0$

$RA = 2\,P$

$\Sigma M = 0 \rightarrow MA = P.\,L_1 + P.\,L_2$

Balok kantilever dengan Beban merata



ΣV = 0

$RA - WL = 0$

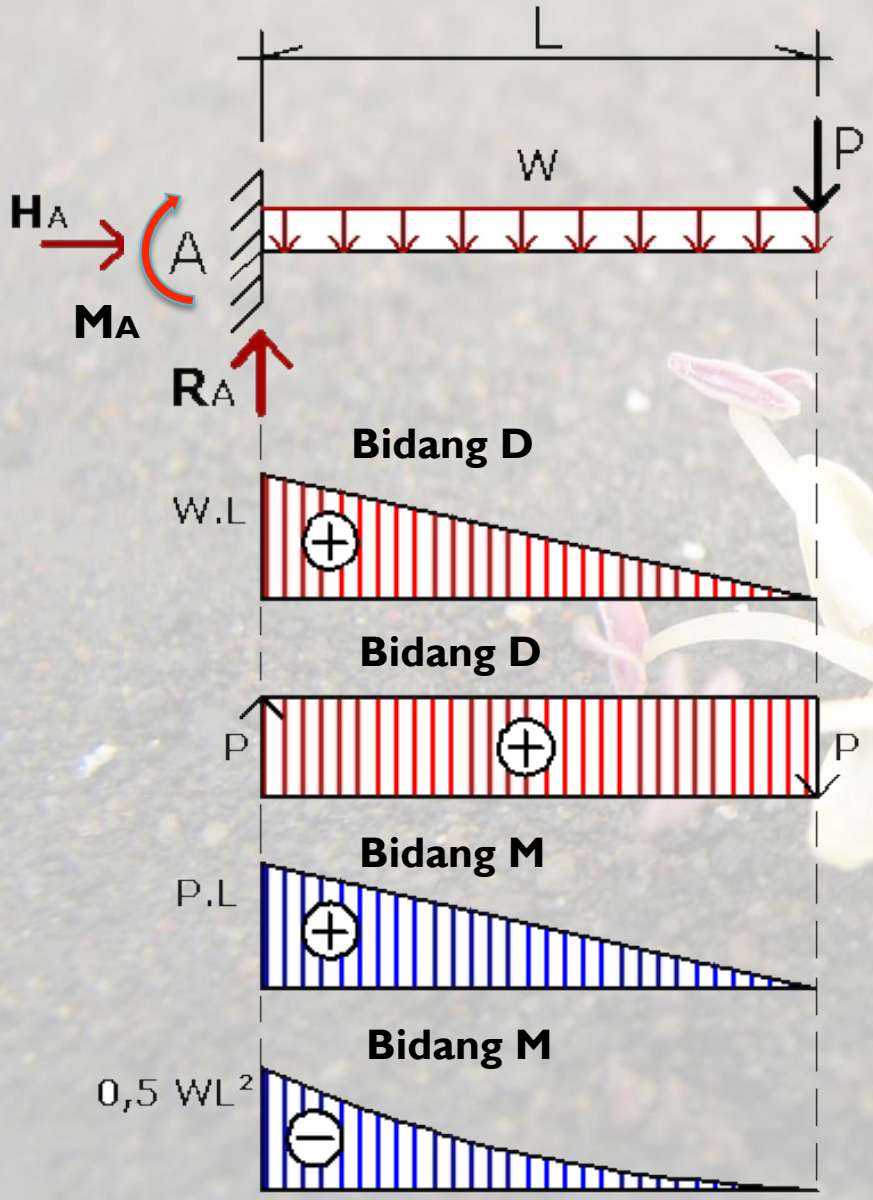
$RA = WL$

ΣM = 0

$MA = WL.\ 0{,}5\ L$

$= 0{,}5\ WL^2$

Balok kantilever dengan Beban merata + Beban Terpusat



ΣV = 0

RA – WL – P = 0

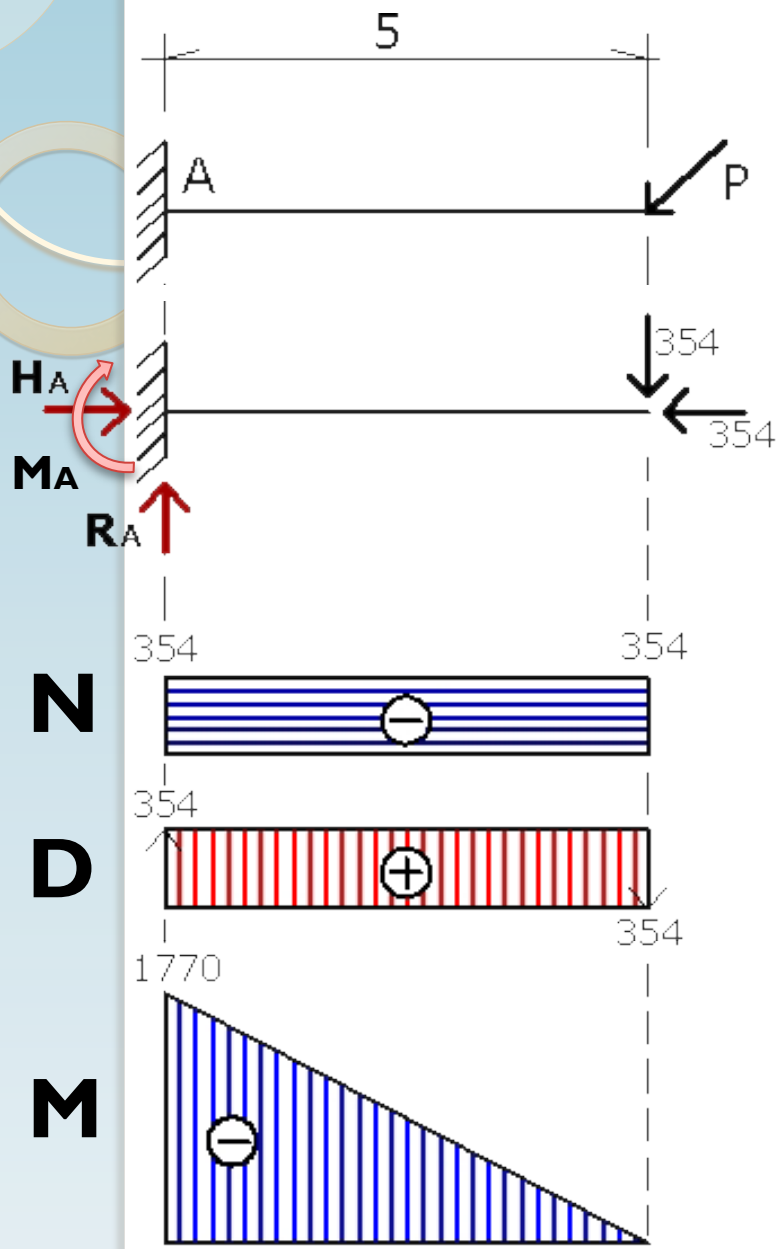
RA = WL + P

ΣM = 0

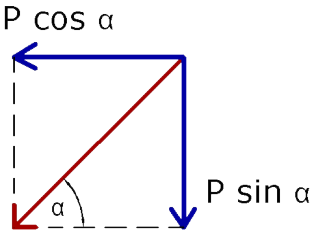
MA = P. L + WL. 0,5 L

= PL + 0,5 WL^2

AYO LATIHAN SOAL...!!!



1) Gambar bidang momen, gaya lintang dan gaya aksial.
P = 500 kg, α = 45°



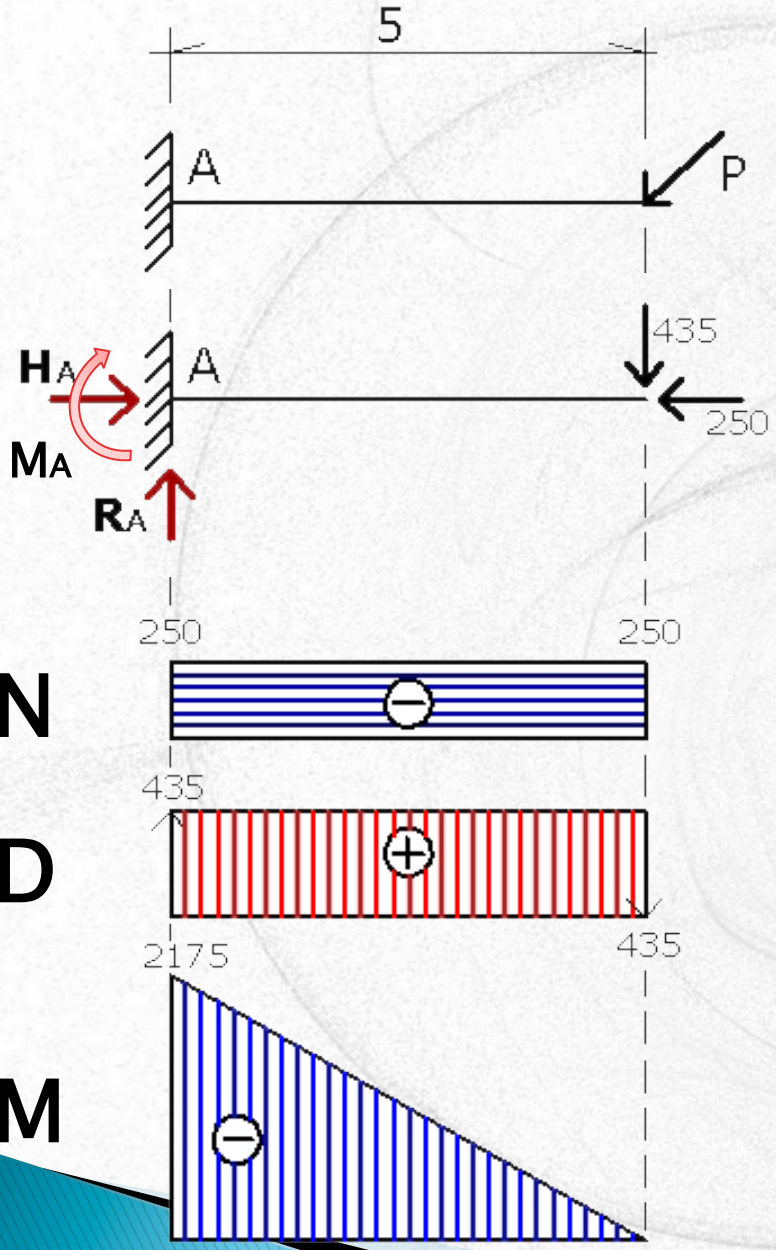
P cos 45° = 500. 0,707 = **354 kg** ←
P sin 45° = 500. 0,707 = **354 kg** ↑

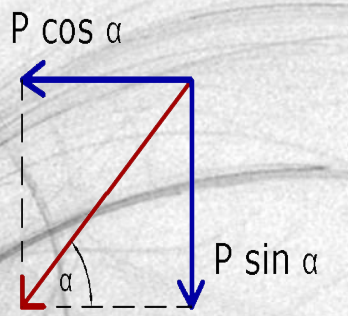
ΣH = 0
HA – 354 = 0
HA = **354 kg**

ΣV = 0
RA – 354 = 0
RA = **354 kg**

ΣM = 0
MA = 354. 5
= **1770 kgm**

2) Gambar bidang momen, gaya lintang dan gaya aksial.
P = 500 kg, α = 60°



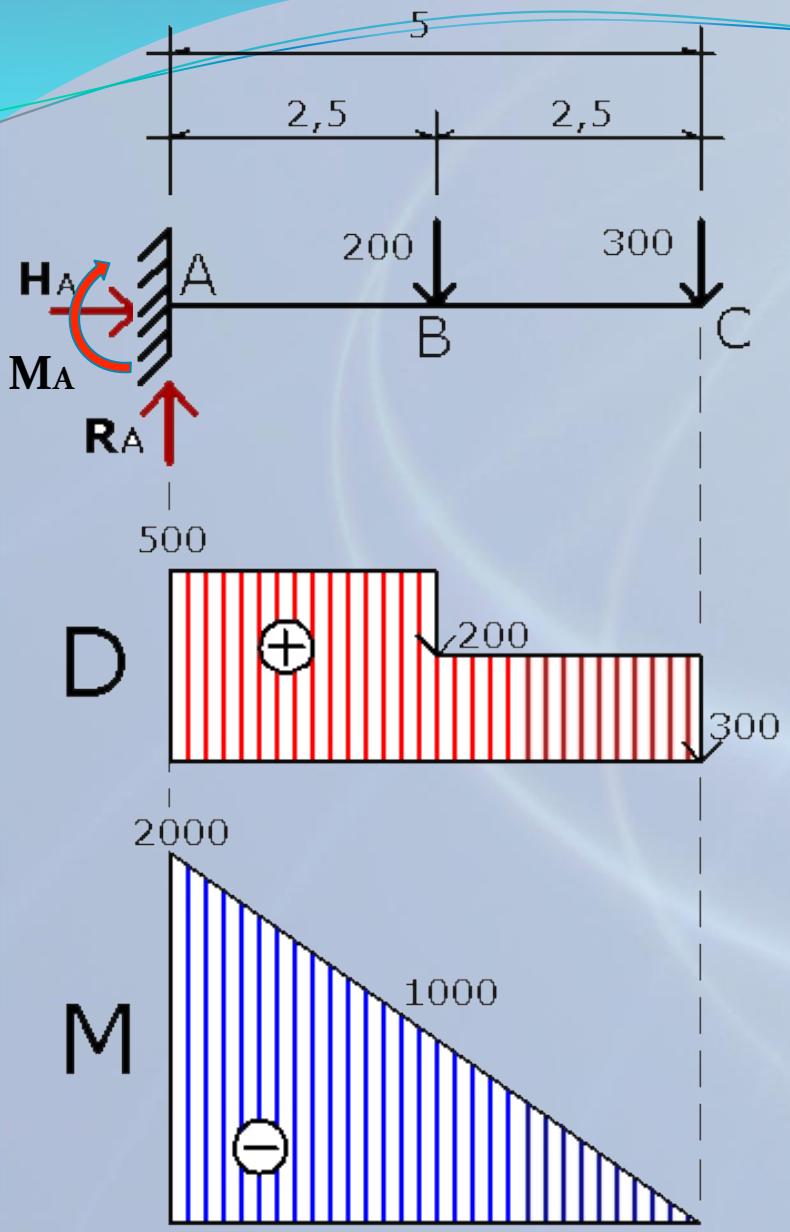


P cos 60° = 500. 0,5 = **250 kg**
P Sin 60° = 500. 0,87 = **435 kg**

ΣH = 0 →
HA – 250 = 0
HA = **250 kg**

ΣV = 0 →
RA – 435 = 0
RA = **435 kg**

ΣM = 0 →
MA = 435. 5
= **2175 kgm**



2) Gambar bidang momen, gaya lintang.
P1 = 200 kg, P2 = 300 kg,

ΣV = 0 →

$RA - P_1 - P_2 = 0$

$RA - 200 - 300 = 0$

$RA =$ **500 kg**

ΣM = 0 →

$MA = P_1 . 0{,}5 . 5 + P_2 . 5$

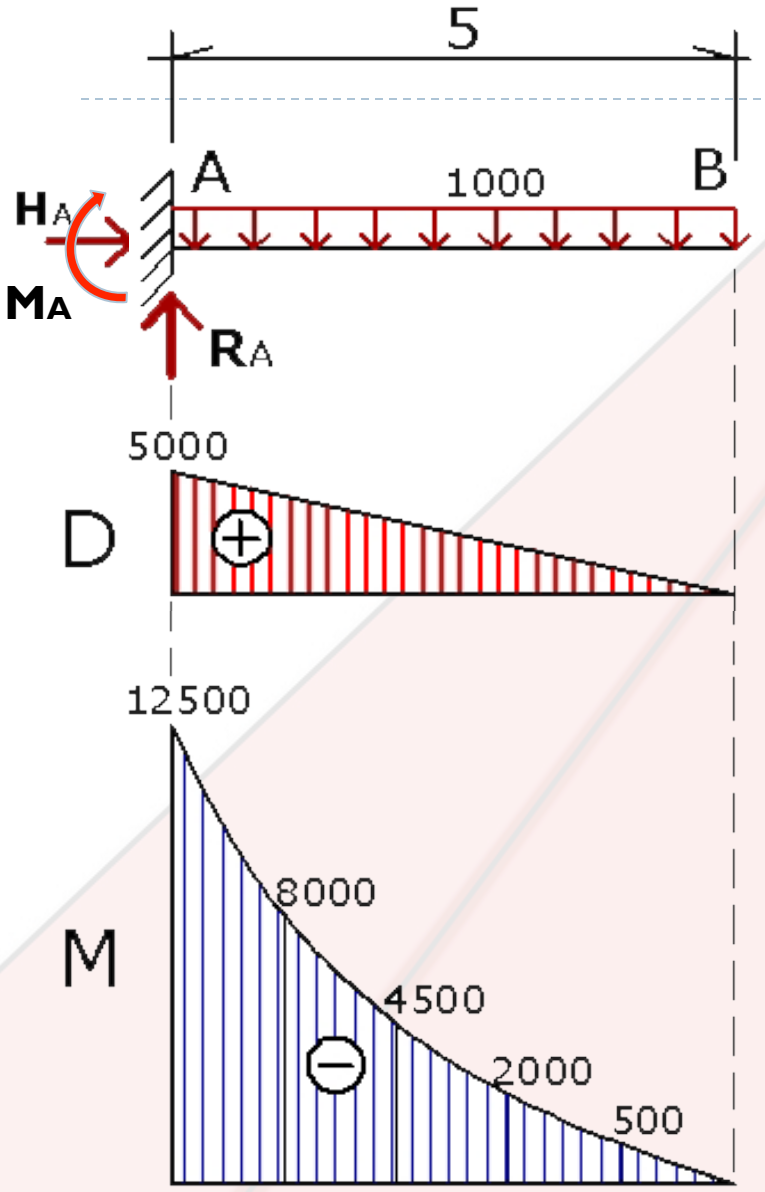
$= 200 . 2{,}5 + 300 . 5$

$=$ **2000 kgm**

$MB = P_1 . 0 + P_2 . 2{,}5$

$= 200 . 0 + 300 . 2{,}5$

$=$ **750 kgm**



2) Gambar bidang momen, gaya lintang.
W = 1000 Kg/m

$\Sigma V = 0 \rightarrow$
RA – W. 5 = 0
RA – 1000. 5 = 0
RA = **5000 kg**

$\Sigma M = 0 \rightarrow$
$MA = 0{,}5\ W.\ 5^2$
$= 0{,}5.\ 1000.\ 25$
= **12500 kgm**

x = 1 m (dari B) →
$Mx = 0{,}5\ Wx^2$
$= 0{,}5.\ 1000.\ 1^2$
= **500 kgm**

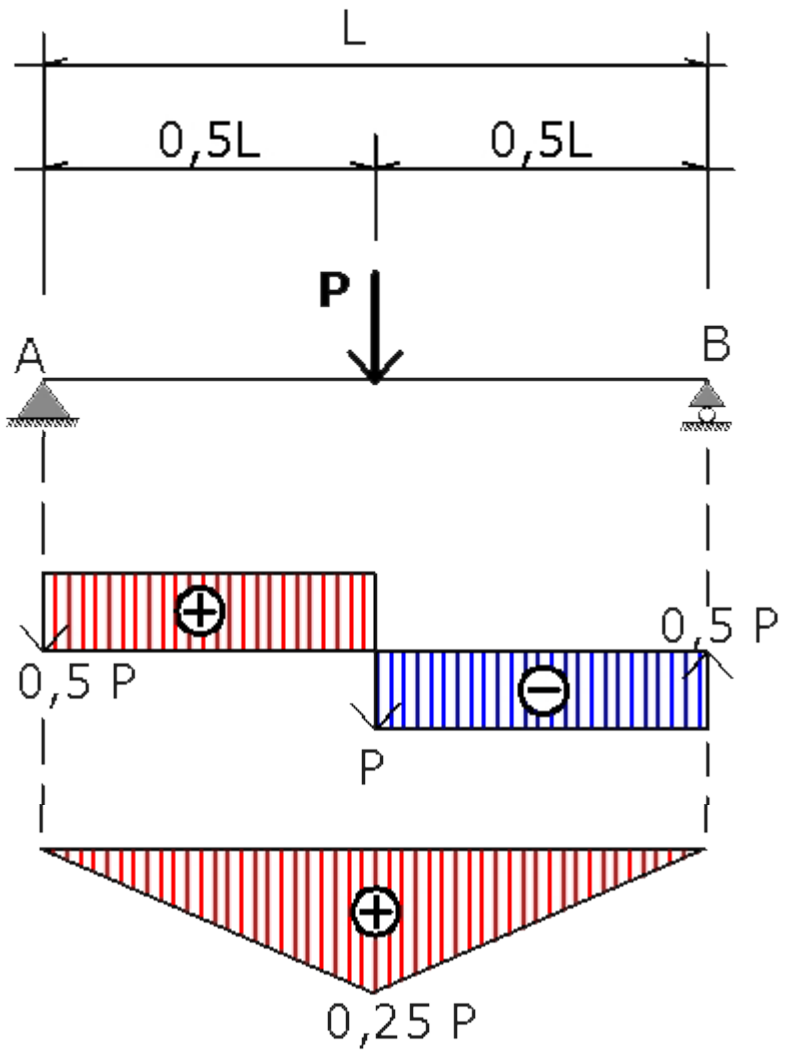
x = 2 m (dari B) →
$Mx = 0{,}5\ Wx^2$
$= 0{,}5.\ 1000.\ 2^2$
= **2000 kgm**

x = 3 m (dari B) →
$Mx = 0{,}5\ Wx^2$
$= 0{,}5.\ 1000.\ 3^2$
= **4500 kgm**

x = 4 m (dari B) →
$Mx = 0{,}5\ Wx^2$
$= 0{,}5.\ 1000.\ 4^2$
= **8000 kgm**

Balok Diatas Dua Perletakan (tumpuan).

Dengan Beban Terpusat



$\Sigma MB = 0 \rightarrow$

$RA.\ L - P.\ 0{,}5\ L = 0$

$$RA = \frac{0{,}5PL}{L} = 0{,}5\ P$$

$\Sigma MA = 0 \rightarrow$

$RB.\ L - P.\ 0{,}5\ L = 0$

$$RB = \frac{0{,}5PL}{L} = 0{,}5\ P$$

$\Sigma V = 0 \rightarrow$

$RA + RB = P$

$0{,}5\ P + 0{,}5\ P = P$

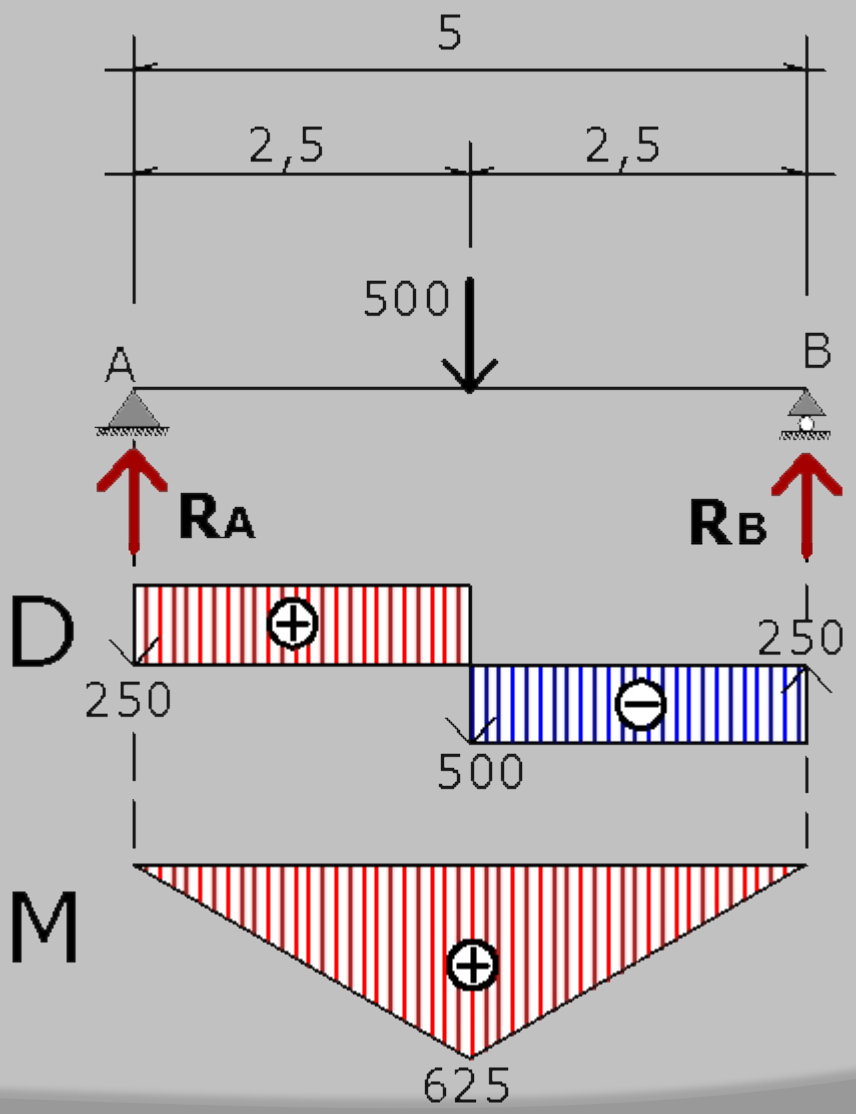
$P = P \rightarrow$ ok

$MC = RA.\ 0{,}5\ L$

$= 0{,}5\ P.\ 0{,}5\ L$

$= 0{,}25\ PL$

5) Gambar bidang momen, gaya lintang.
P = 500 Kg



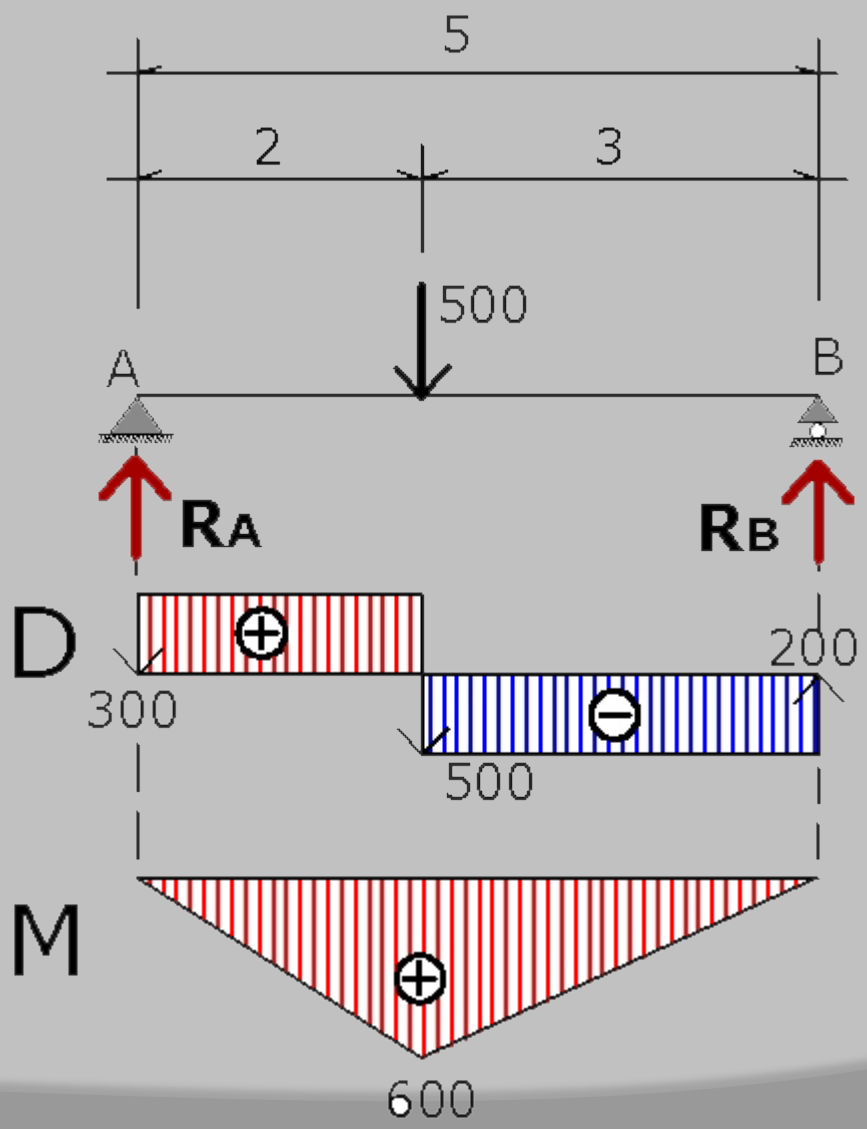
ΣMB = 0 →
RA. 5 – 500. 2,5 = 0
5 RA – 1250 = 0
RA = **250 kg**

ΣMA = 0 →
RB. 5 – 500. 2,5 = 0
5 RB – 1250 = 0
RB = **250 kg**

ΣV = 0 →
RA + RB = P
250 + 250 = 500
500 = 500 → **ok**

MC = RA. 2,5
= 250. 2,5
= **625 kgm**

6) Gambar bidang momen, gaya lintang.
P = 500 Kg



ΣMB = 0 →
RA. 5 – P. 3 = 0
RA. 5 – 500. 3 = 0
5 RA – 1500 = 0
RA = **300 kg**

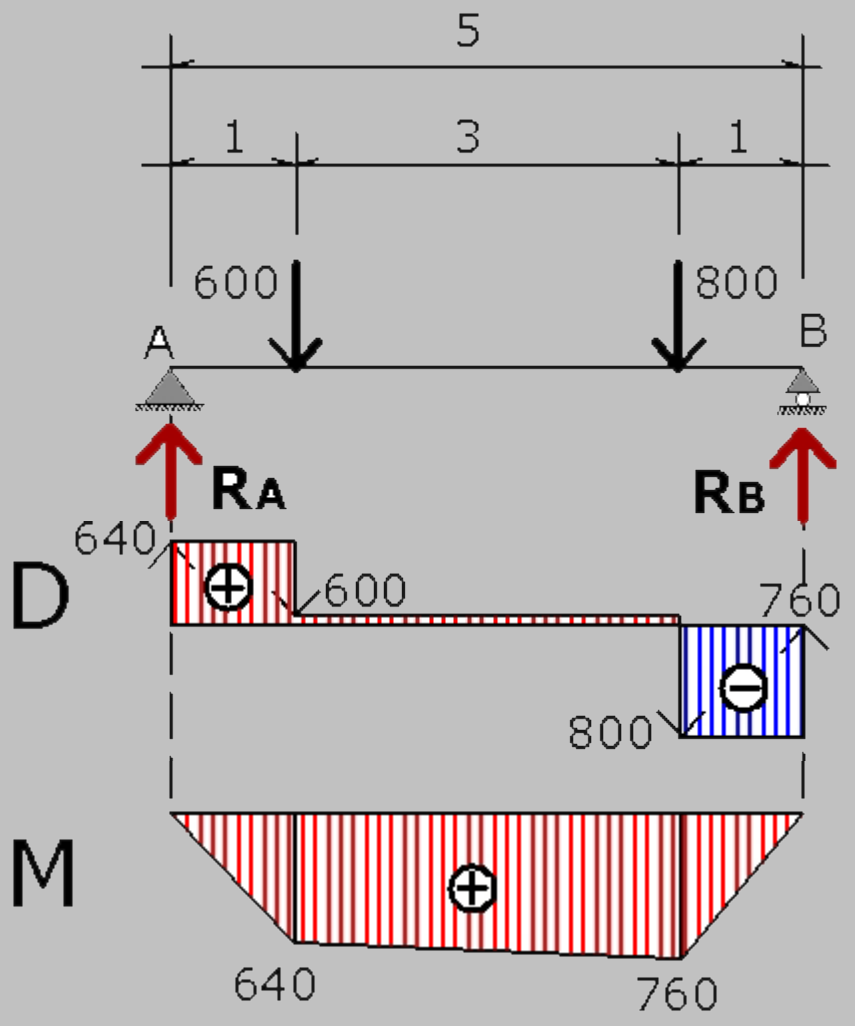
ΣMA = 0 →
RB. 5 – P. 2 = 0
RB. 5 – 500. 2 = 0
5 RB – 1000 = 0
RB = **200 kg**

ΣV = 0 →
RA + RB = P
300 + 200 = 500
500 = 500 → ok

MC = RA. 2
= 300. 2 = **600 kgm** atau

MC = RB. 3
= 200. 3 = **600 kgm**

7) Gambar bidang momen, gaya lintang.
P1 = 500 Kg, P2 = 800 Kg



$\Sigma MB = 0 \rightarrow$
$RA. 5 - P_1. 4 - P_2. 1$
$RA. 5 - 600. 4 - 800. 1 = 0$
$5\ RA - 2400 - 800 = 0$
$5\ RA - 3200 = 0$
$RA =$ **640 kg**

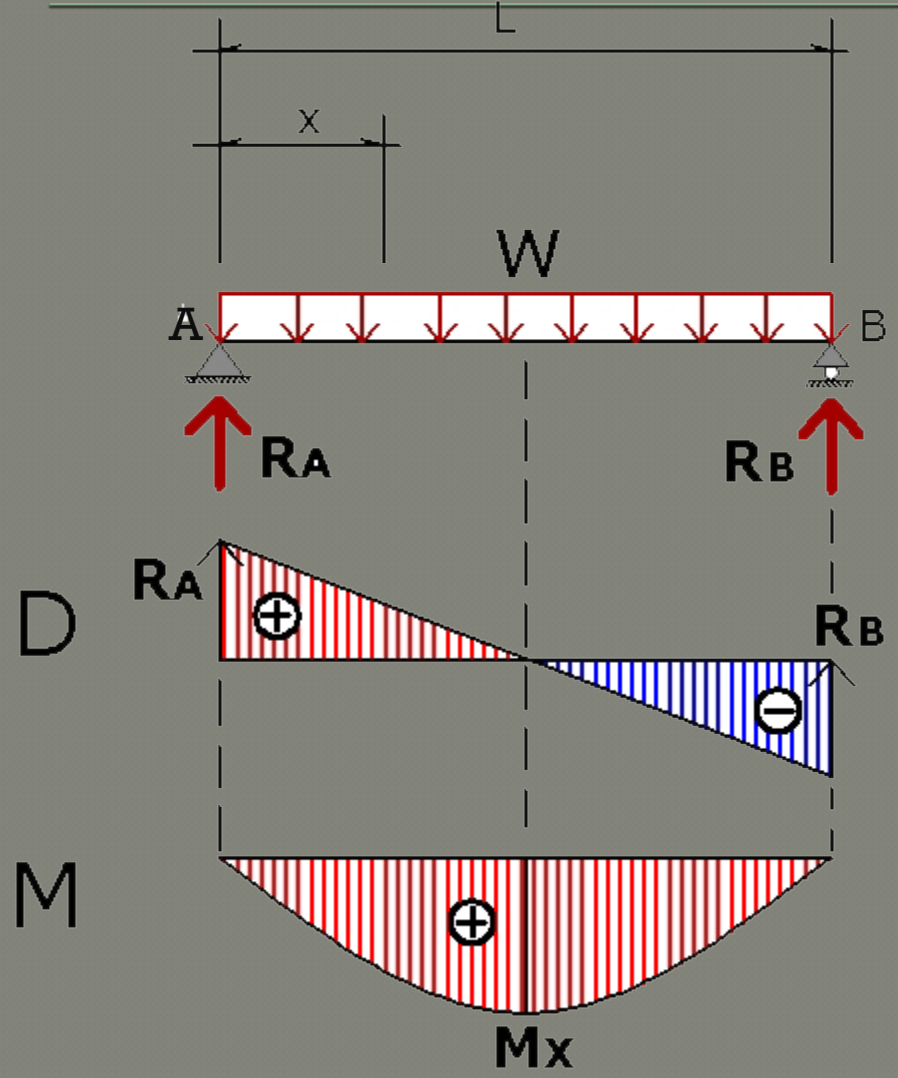
$\Sigma MA = 0 \rightarrow$
$RB. 5 - P_1. 1 - P_2. 4 = 0$
$RB. 5 - 600. 1 - 800. 4 = 0$
$5\ RB - 600 - 3200 = 0$
$5\ RB - 3800 = 0$
$RB =$ **760 kg**

$\Sigma V = 0 \rightarrow$
$RA + RB = P_1 + P_2$
$640 + 760 = 600 + 800$
$1400 = 1400 \rightarrow$ ok

$MC = RA. 1$
$= 640. 1$
= 640 kgm

$MD = RB. 1 = 760. 1$
= 760 kgm

STATIKA BEBAN TERBAGI RATA



ΣMB = 0 →

RA. L – WL. 0,5 L = 0

RA. L – 0,5 WL² = 0

$$RA = \frac{0{,}5\,WL^2}{L} = 0{,}5\,WL$$

ΣMA = 0 →

RB. L – WL. 0,5 L = 0

RB. L – 0,5 WL² = 0

$$RB = \frac{0{,}5\,WL^2}{L} = 0{,}5\,WL$$

Mx = RA. X – WX. 0,5 X

= 0,5 WLX – 0,5 WX²

$$\frac{dMX}{dX} = 0{,}5\,WL - WX \rightarrow \frac{dMX}{dX} = 0$$

WX = 0,5 WL

X = 0,5 L

MX = 0,5 WL. 0,5 L –

0,5 W (0,5 L)²

= 0,25 WL² – 0,125 WL²

= 0,125 WL²

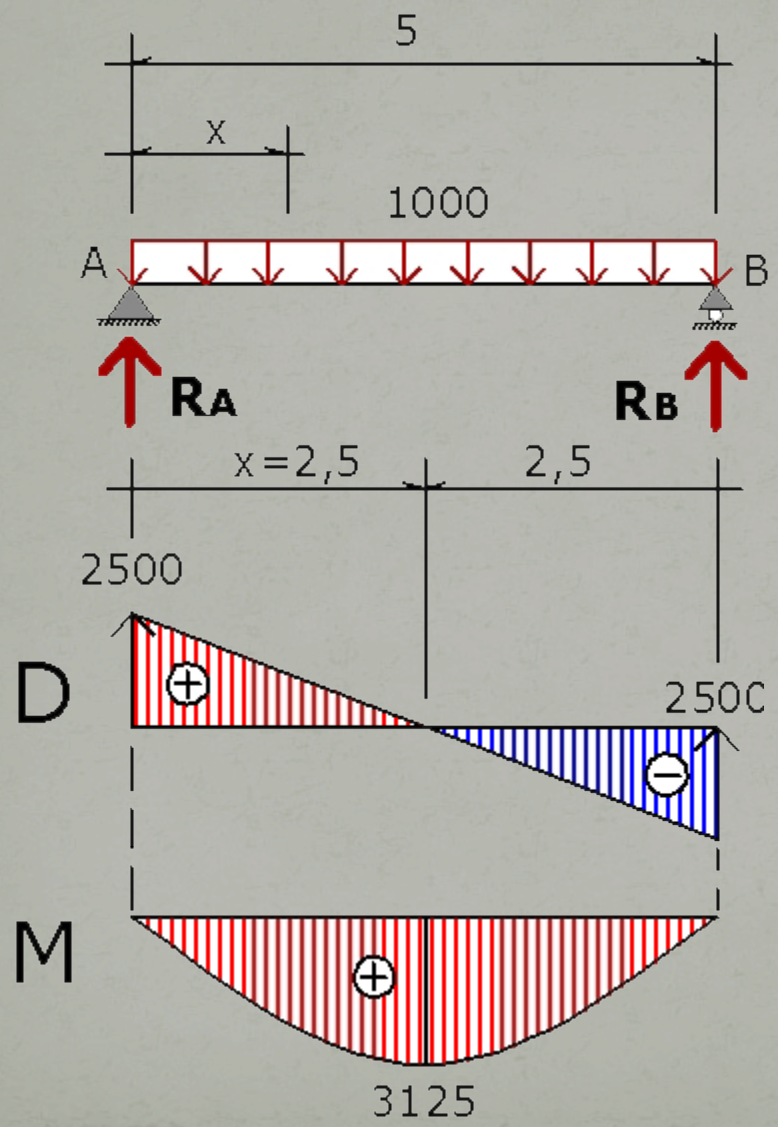
= 1/8 WL²

DX = RA – WX → X = 0,5 L

= 0,5 WL – W. 0,5 L

= 0,5 WL – 0,5 WL = 0

9) Gambar bidang momen, gaya lintang.
W = 1000 Kg/m



ΣMB = 0 →
RA. 5 – W. 5. 2,5 = 0
RA. 5 – 1000. 12,5 = 0
5 RA – 12500 = 0
RA = **2500 kg**

ΣMA = 0 →
RB. 5 – W. 5. 2,5 = 0
RB. 5 – 1000. 12,5 = 0
5 RB – 12500 = 0
RB = **2500 kg**

ΣV = 0 →
RA + RB = W. 5
2500 + 2500 = 1000. 5
5000 = 5000 → ok

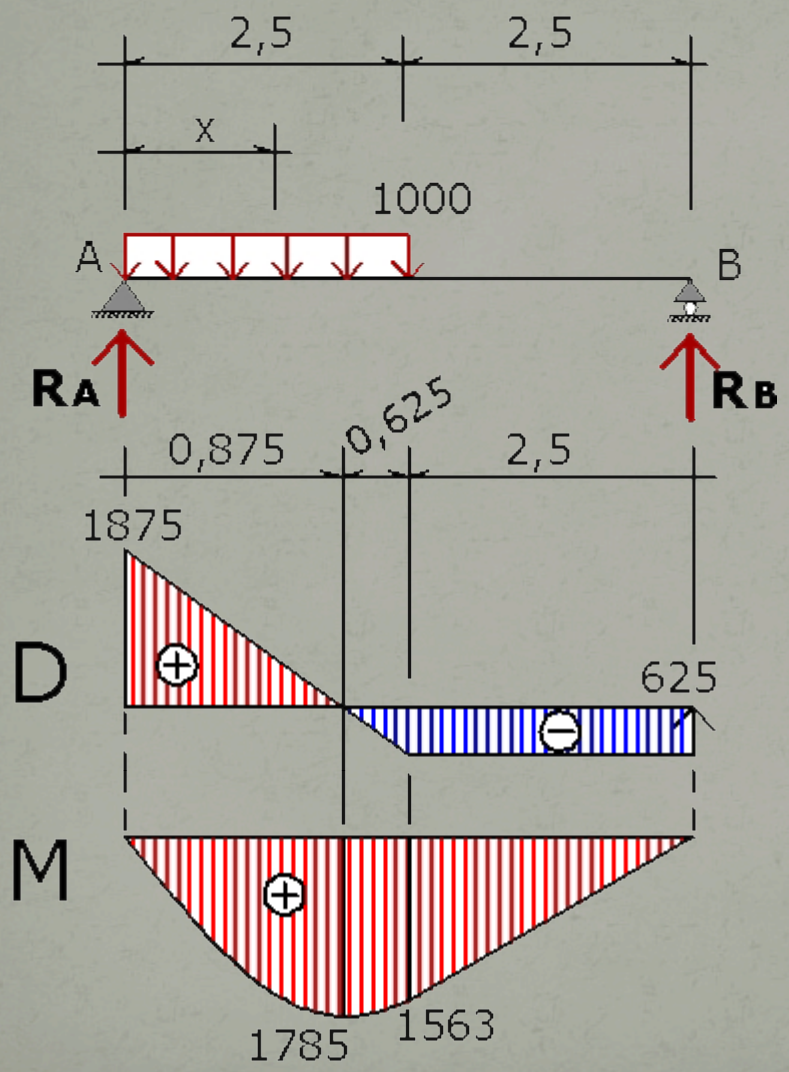
$MX = RA.\ X - WX.\ 0{,}5\ X$
$= 2500\ X - 0{,}5.\ 1000\ X^2$

$$\frac{dMX}{dX} = 2500 - 1000\ X \rightarrow \frac{dMX}{dX} = 0$$

1000 X = 2500
X = 2,5 m

M maks = $2500.\ 2{,}5 - 500.\ 2{,}5^2$
= 6250 – 3125
= **3125 kgm**

10) Gambar bidang momen, gaya lintang.
W = 1000 Kg/m



MB = 0 →
RA. 5 – W. 2,5. 3,75 = 0
5 RA – 1000. 9,375 = 0
5 RA – 9375 = 0 → RA = **1875 kg**

ΣMA = 0 →
RB. 5 – W. 2,5. 1,25 = 0
5 RB – 1000. 3,125 = 0
5 RB – 3125 = 0 → RB = **625 kg**

ΣV = 0 →
RA + RB = W. 2,5
1875 + 625 = 1000. 2,5
2500 = 2500 → ok

$$MX = RA.\ X - WX.\ 0{,}5\ X$$
$$= 1875\ X - 0{,}5.\ 1000\ X^2$$

$$\frac{dMX}{dX} = 1875 - 1000\ X$$

$$\frac{dMX}{dX} = 0 \rightarrow 1000\ X = 1875$$

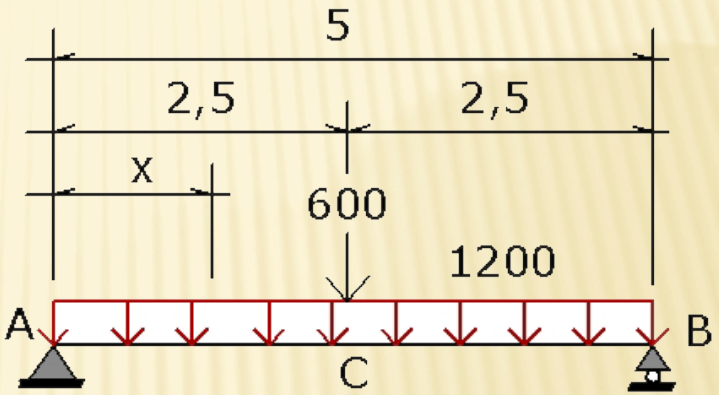
$$X = 1{,}875\ \text{m}$$

M maks = 1875. 1,875 – 500. $1{,}875^2$
= 3516 – 1758 = **1758 kgm**

MC = RB. 2,5 = 625. 2,5
= 625. 2,5 = **1563 kgm**

KOMBINASI BEBAN TERPUSAT dengan BEBAN TERBAGI RATA

12) Gambar bidang momen, gaya lintang.
P = 600 Kg, W = 1000 Kg/m



ΣMB = 0 →
RA. 5 – P. 2,5 – W. 5. 2,5 = 0
5 RA – 600. 2,5 – 1200. 12,5
5 RA – 1500 – 15000 = 0
5 RA – 16500 = 0
RA = **3300 kg**

ΣMA = 0 →
RB. 5 – P. 2,5 – W. 5. 2,5 = 0
5 RB – 1500 – 15000 = 0
5 RB – 16500 = 0
RB = **3300 kg**

ΣV = 0 →
RA + RB = W. 5 + P
3300 + 3300 = 1200. 5 + 600
6600 = 6600 → **ok**

MX = RA. X – WX. 0,5 X

= 3300 X – 0,5. 1200 X^2

$\frac{dMX}{dX}$ = 3300 – 1200 X

$\frac{dMX}{dX}$ = 0 → 1200 X = 3300

X = 2,75 m > 2,5 m → **tidak mungkin**

M maks = MC = RA. 2,5 – W. 2,5. 1,25

= 3300. 2,5 – 1200. 3,125

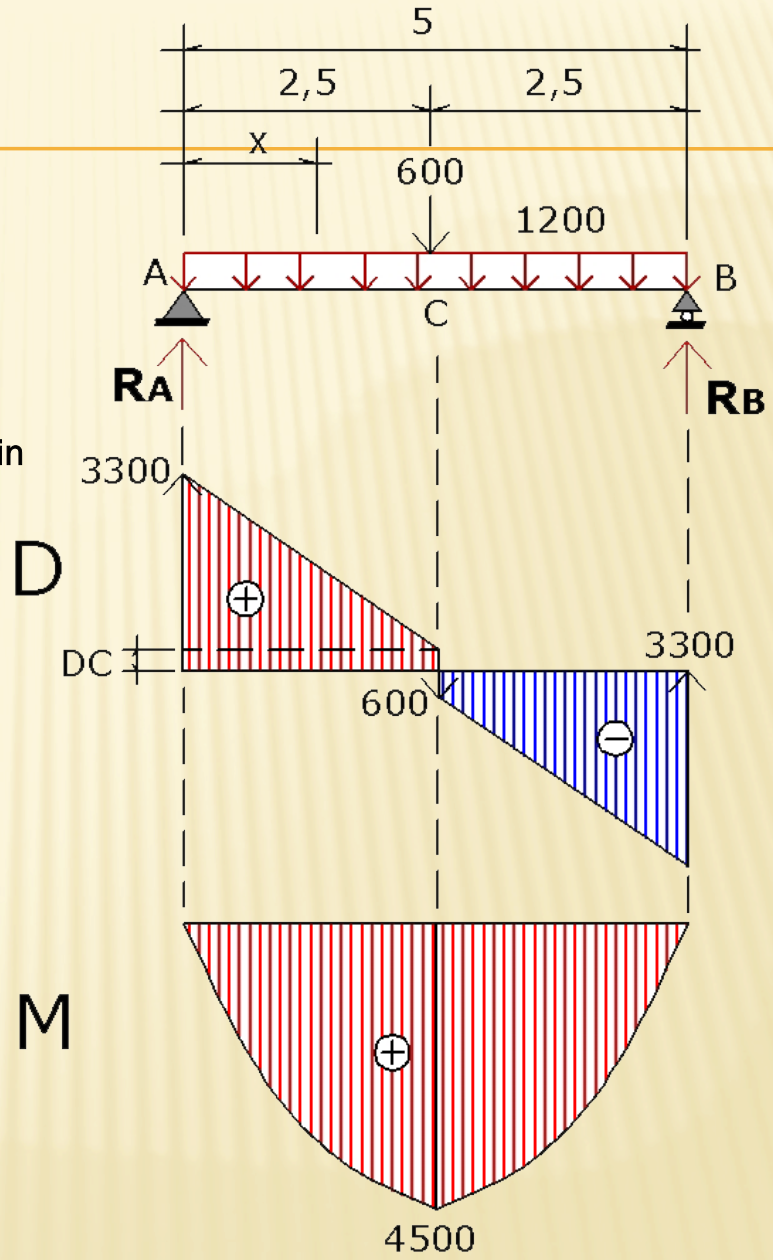
= 8250 – 3750

= **4500 kgm**

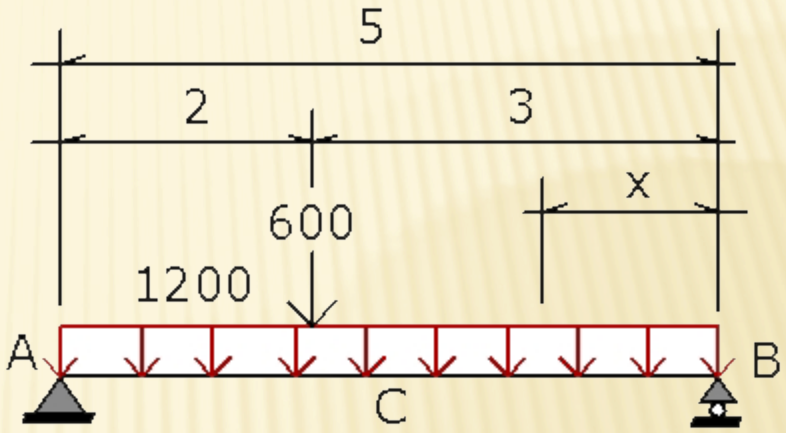
DC = RA – W. 2

= 3300 – 1200. 2,5

= **300 kg**



12) Gambar bidang momen, gaya lintang.
P = 600 Kg, W = 1000 Kg/m



ΣMB = 0 →

RA. 5 – P. 3 – W. 5. 2,5 = 0

5 RA – 600. 3 – 1200. 12,5 = 0

5 RA – 1800 – 15000 = 0

RA = **3360 kg**

ΣMA = 0 →

RB. 5 – P. 2 – W. 5. 2,5 = 0

5 RB – 600. 2 – 1200. 12,5 = 0

5 RB – 1200 – 15000 = 0

RB = **3240 kg**

ΣV = 0 →

RA + RB = W. 5 + P

3360 + 3240 = 1200. 5 + 600

6600 = 6600 → ok

DC = RA – W. 2
= 3360 – 1200. 2
= **960 kg**

MX = RB. X – WX. 0,5 X
= 3240 X – 0,5. 1200 X^2

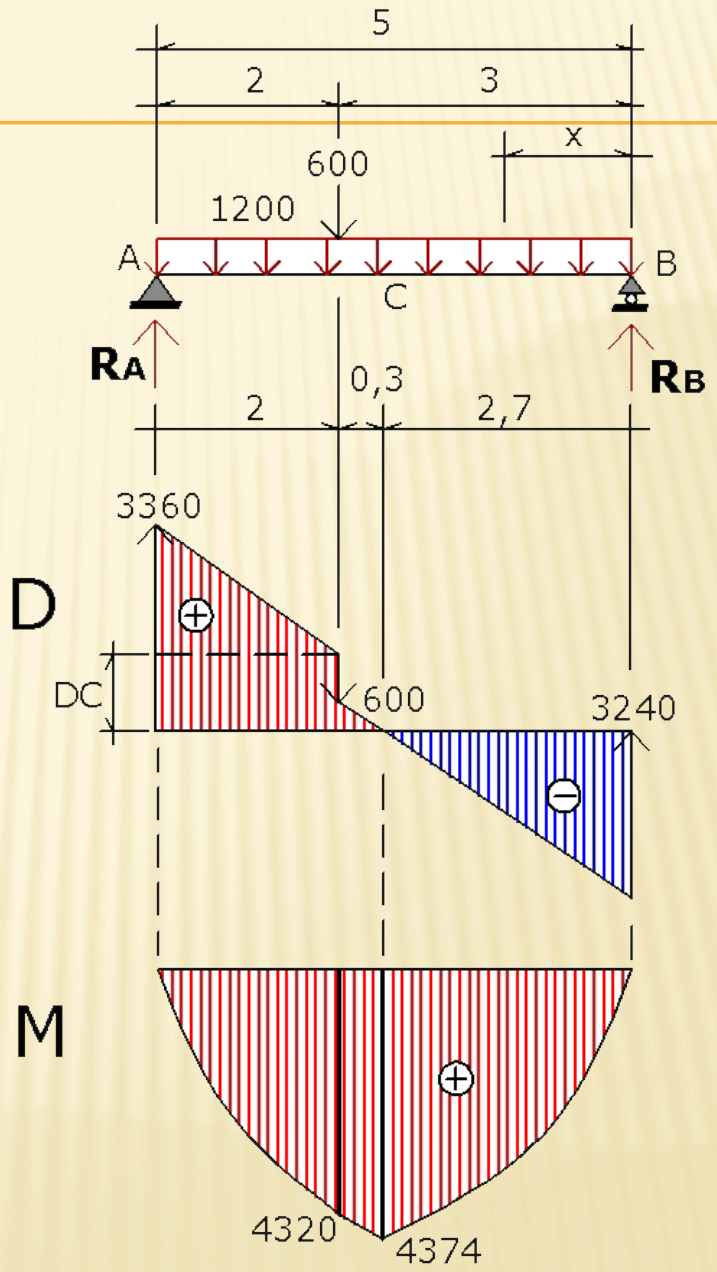
$$\frac{dMX}{dX} = 3240 - 1200\,X$$

$$\frac{dMX}{dX} = 0 \rightarrow 120\,X = 2{,}70 \text{ m}$$

X = 2,70 m

M maks = 3240. 2,70 – 600. $2{,}70^2$
= 8748 – 4374
= **4374 kgm**

MC = RA. 2 – W. 2. 1
= 3360. 2 – 1200. 2
= 6720 – 2400
= **4320 kgm**



15) Gambar bidang momen dan gaya lintang.
P = 600 kg, W = 1500 kg/m

ΣMB = 0

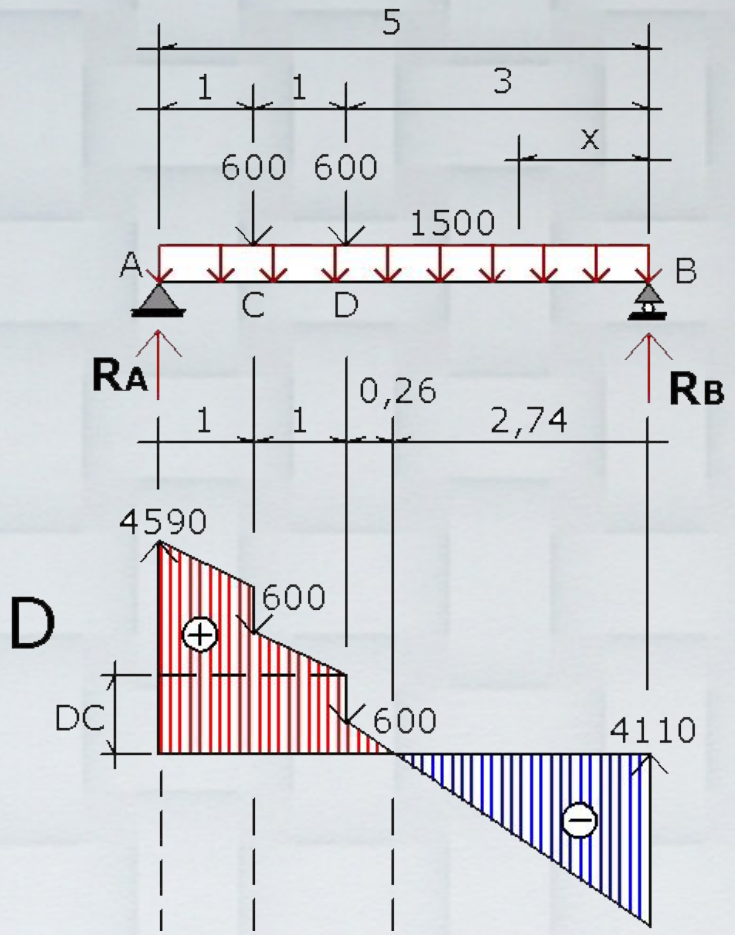
RA. 5 – P. 4 – P. 3 – W. 5. 0,5. 5 = 0
RA 5 – 600. 4 – 600. 3 – 1500. 5. 2,5 = 0
5 RA – 2400 – 1800 – 18750 = 0
5 RA – 22950 = 0
RA = 4590 kg

ΣMA = 0

RB. 5 – P. 1 – P. 2 – 0,5 W $(5)^2$ = 0
RB 5 – 600. 1 – 600. 2 – 0,5. 1500. 5^2 = 0
5 RB – 600 – 1200 – 18750 = 0
5 RB – 20550 = 0
RB = 4110 kg

ΣV = 0 →

RA + RB = 2P + W. 5
4590 + 4110 = 1200 + 1500. 5
8700 = 8700 → ok



$MX = RB.\ X - 0{,}5\ WX^2$

$= 4110\ X - 0{,}5.\ 1500\ X^2$

$\frac{dMX}{dX} = 4110 - 1500\ X$

$\frac{dMX}{dX} = 0 \rightarrow 1500\ X = 4110$

$X = 2{,}74\ m$

M maks = $4110.\ 2{,}74 - 750.\ 2{,}74^2$

$= 1126`1 - 5631$

$=$ **5630 kgm**

$MC = RA.\ 1 - 0{,}5\ W\ (1)^2$

$= 4590.\ 1 - 0{,}5\ .1500.\ 1$

$= 4590 - 750$

$=$ **3840 kgm**

$MD = RB.\ 3 - 0{,}5\ W\ (3)^2$

$= 4110.\ 3 - 0{,}5.1500.\ 9$

$= 12330 - 6750$

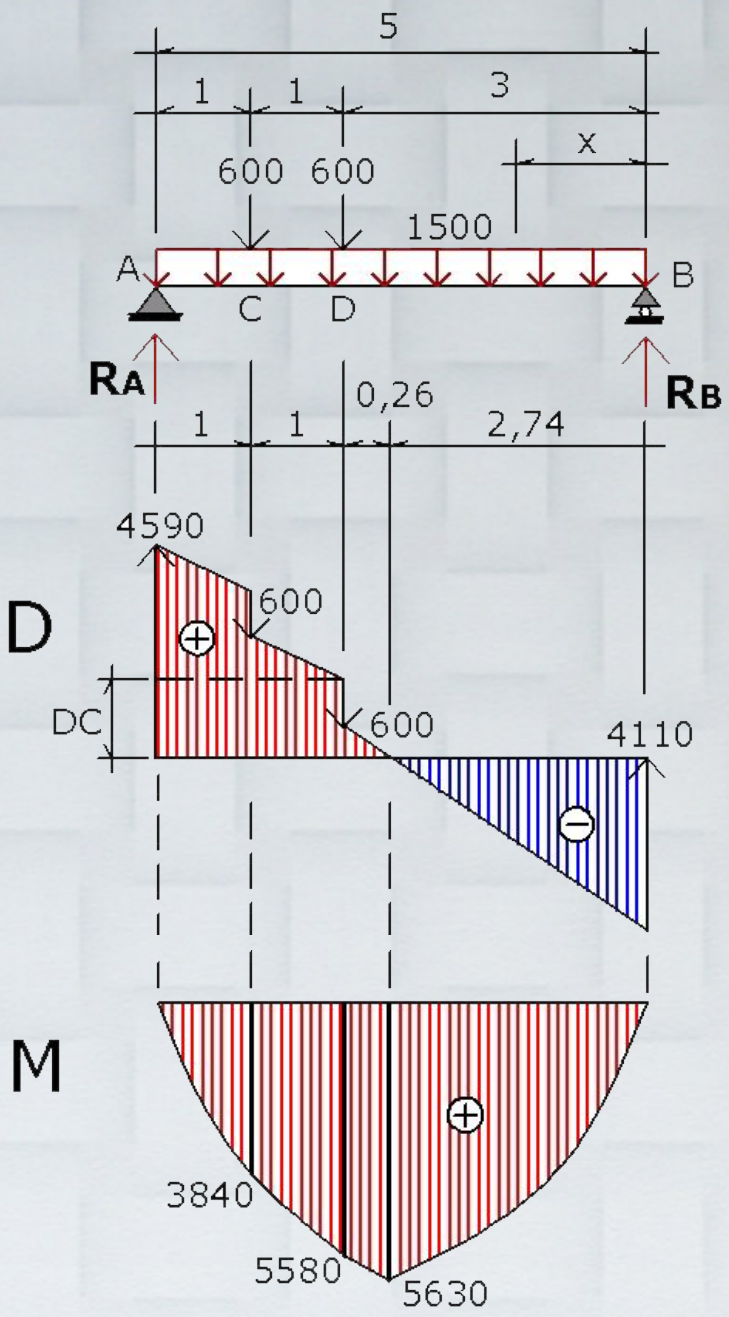
$=$ **5580 kgm**

DC = RA – 1 W

= 4590 – 1. 1500 = **3090 kg**

DD = RB – 3 W

= 4110 – 3. 1500 = **- 390 kg**



17) Gambar bidang momen dan gaya lintang.
W = 1000 kg/m

Resultante gaya : R = 0,5 W. 5
R = 0,5. 1000. 5
= **2500 kg**

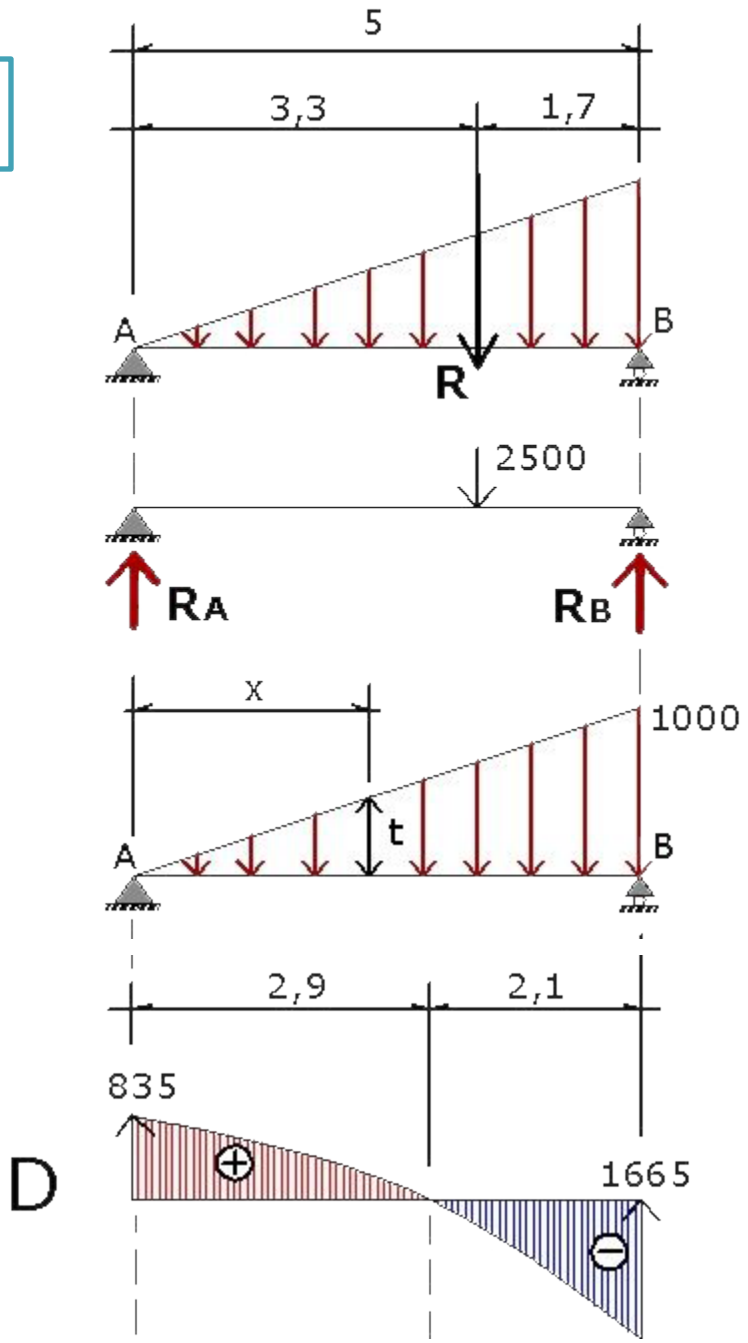
ΣMB = 0 →
RA. 5 – R 1/3. 5 = 0
RA 5 – 2500. 1,67 = 0
5 RA – 4175 = 0
RA = 835 kg

ΣMA = 0 →
RB. 5 – R 2/3. 5 = 0
RB 5 – 2500. 3,33 = 0
5 RB – 8325 = 0
RB = 1665 kg

ΣV = 0 →
RA + RB = R
835 + 1665 = 2500
2500 = 2500 → **ok**

$$t = \frac{W\,X}{L} = \frac{1000\,X}{5} = 200\ X$$

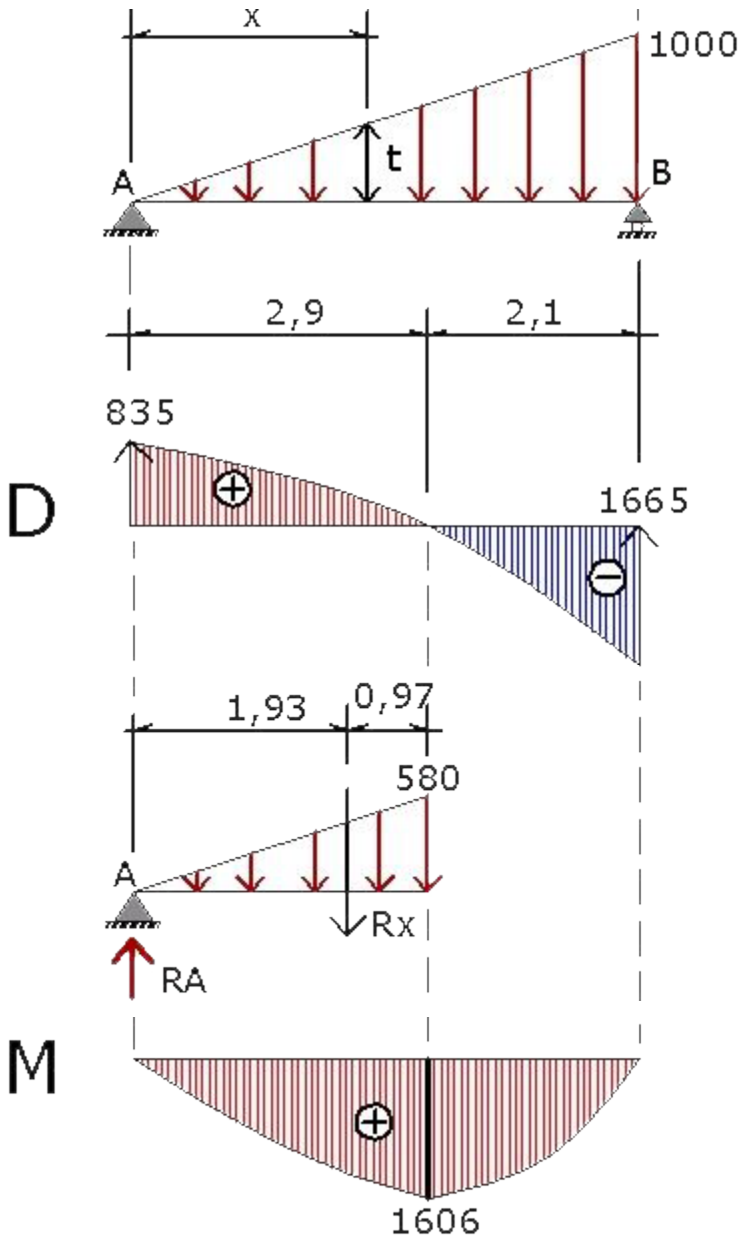
DX = RA – 0,5 t X
= 835 – 0,5. 200 X^2 = 835 – 100 X^2
DX = 0 →
100 X^2 = 835
X = 2,90 m



t = 200 X
= 200. 2,90
= **580 kg/m**

RX = 0,5 t X
= 0,5. 580. 2,90
= **841 kg**

M maks = RA. X – RX. 0,97
= 835. 2,90 – 841. 0,97
= **1606 kgm**



22) Gambar bidang momen dan gaya lintang
P_1 = 800 kg, P_2 = 600 kg

ΣMB = 0 →

$RA. 5 + P_2. 2 – P_1. 2,5 = 0$

$RA\ 5 + 600. 2 – 800. 2,5 = 0$

$5\ RA + 1200 – 2000 = 0$

$5\ RA – 800 = 0$

RA = **160 kg**

ΣMA = 0 →

$RB. 5 – P_1. 2,5 – P_2. 7 = 0$

$RB\ 5 – 800. 2,5 – 600. 7 = 0$

$5\ RB – 2000 – 4200 = 0$

$5\ RB – 6200 = 0$

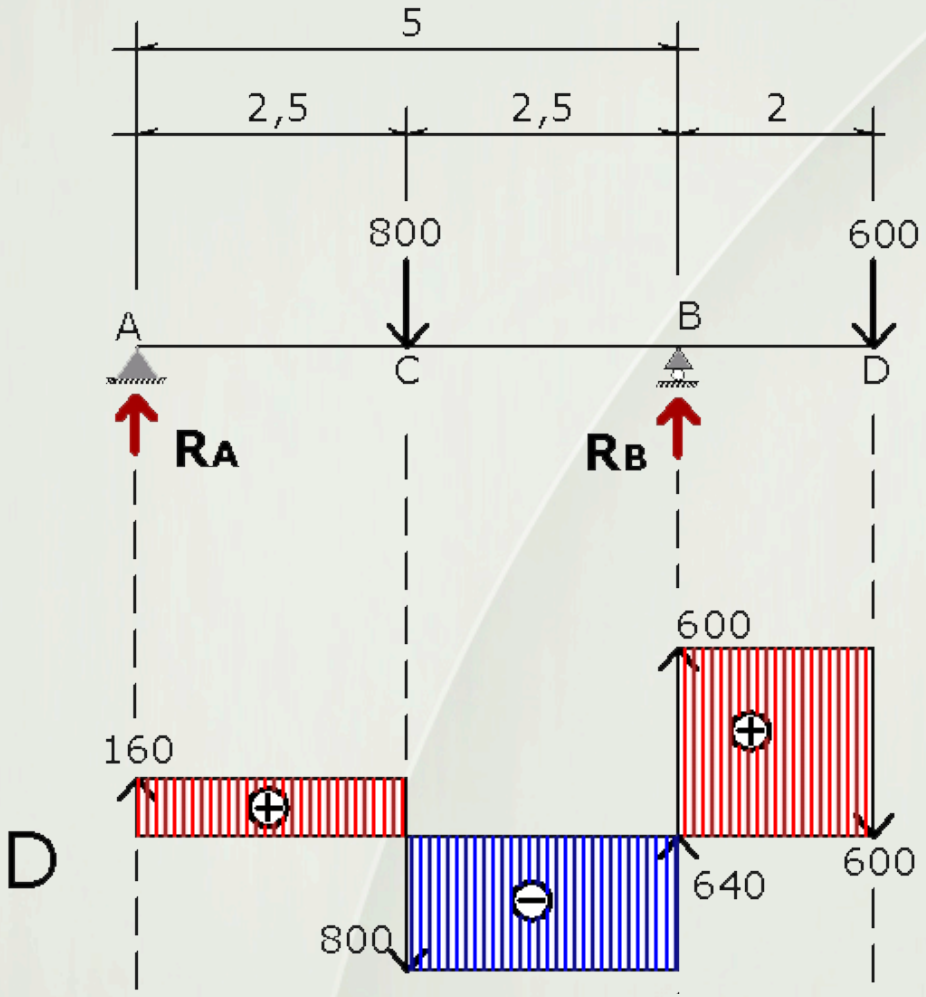
RB = **1240 kg**

ΣV = 0 →

$RA + RB = P_1 + P_2$

$160 + 1240 = 800 + 600$

1400 = 1400 → **ok**

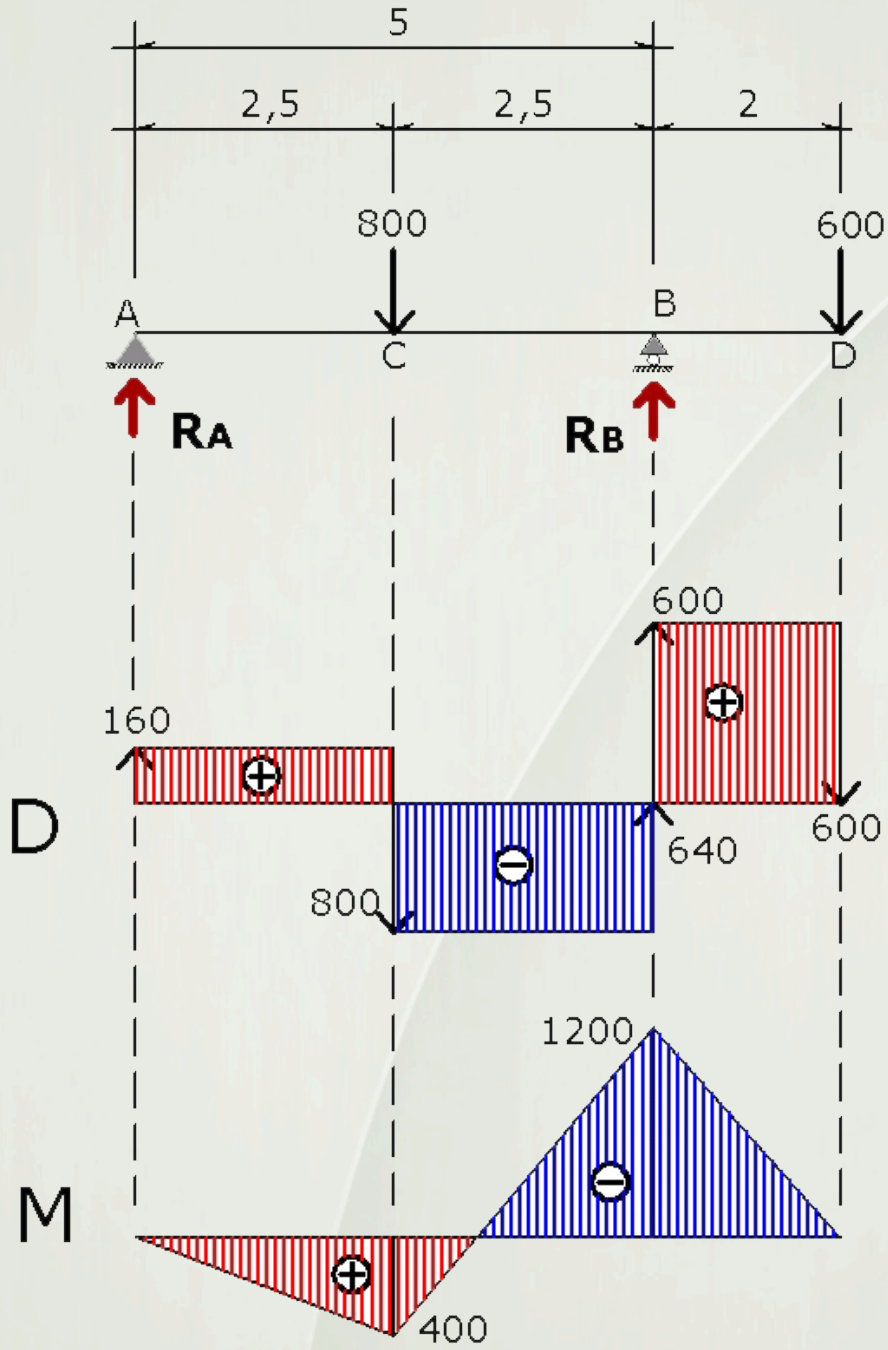


RBD = P_2 = **600 kg**

RBA = RB – RBD
= 1240 – 600
= **640 kg**

MB = P_2. 2
= 600. 2
= **1200 kgm**

MC = RA. 2,5
= 160. 2.5
= **400 kgm**



24) Gambar bidang momen dan gaya lintang
W = 1000 kg/m

ΣMB = 0 →
RA. 5 + W. 2. 1 = 0
RA 5 + 1000. 2. 1 = 0
5 RA + 2000 = 0
RA **= - 400 kg**

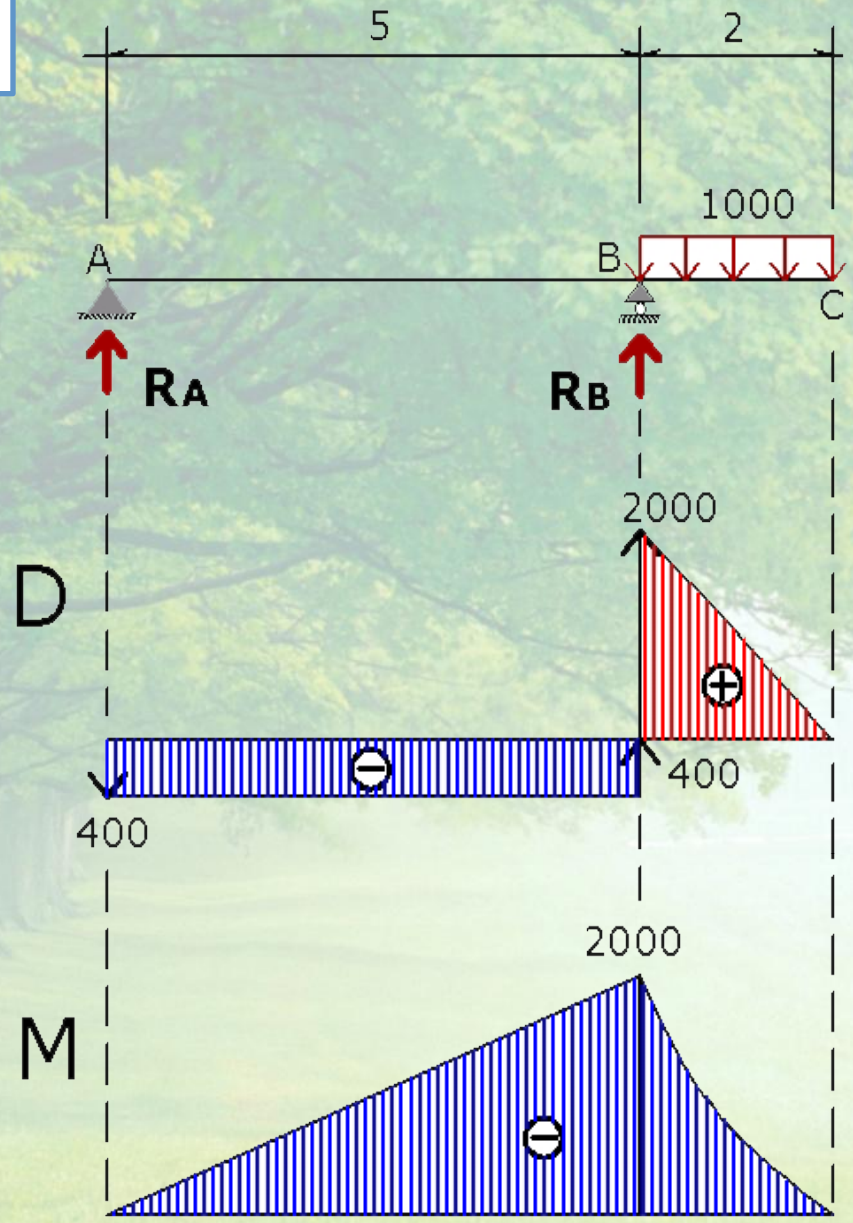
ΣMA = 0 →
RB. 5 – W. 2. 6 = 0
RB 5 – 1000. 2. 6= 0
5 RB – 12000 = 0
RB = **2400 kg**

ΣV = 0 →
RA + RB = W. 2
- 400 + 2400 = 1000. 2
2000 = 2000 → **ok**

RBC = Q = 2. 1000
= 2000 kg

RBA = RB – RBC
= 2400 – 2000
= **400 kg**

MB = W. 2. 1
= 1000. 2. 1
= **2000 kgm**



26) Gambar bidang momen dan gaya lintang
W = 1000 kg/m

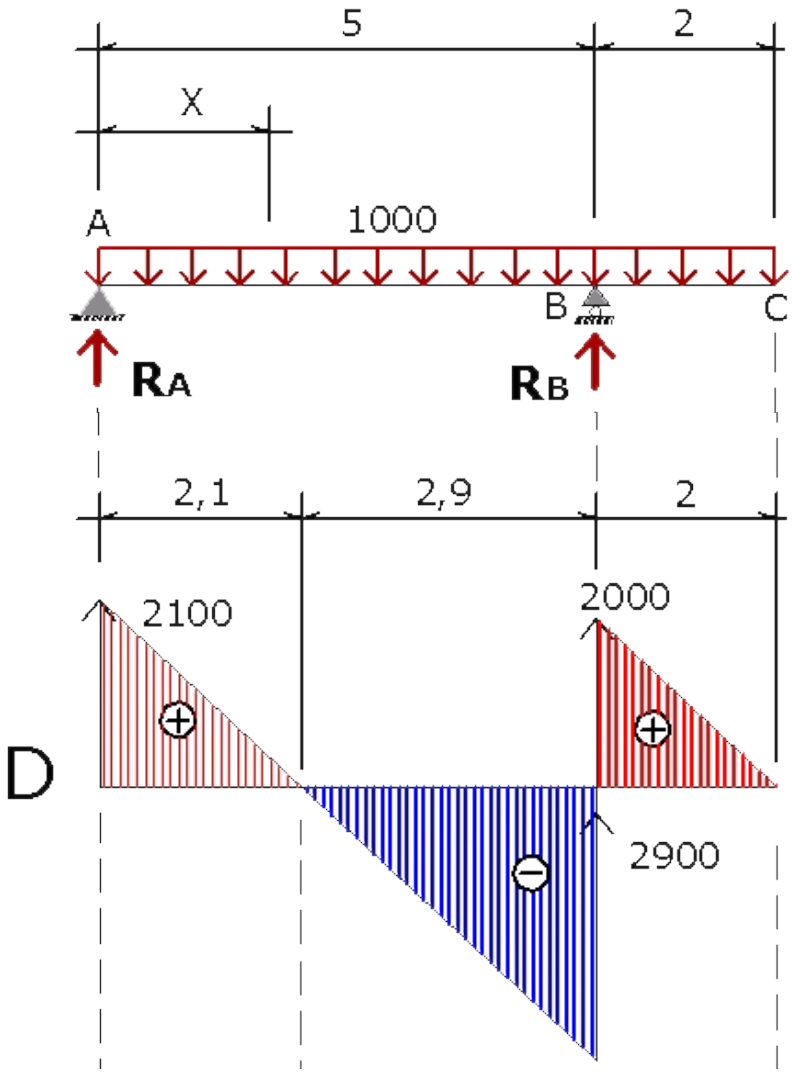
ΣMB = 0 →
RA. 5 + W 2. 1 – W. 5. 2,5 = 0
RA 5 + 1000. 2 – 1000. 12,5 = 0
5 RA + 2000 – 12500 = 0
5 RA – 10500 = 0
RA = **2100 kg**

ΣMA = 0 →
RB. 5 – W. 5. 2,5 – W. 2. 6 = 0
RB. 5 – 1000. 12,5 – 1000. 12 = 0
5 RB – 12500 – 12000 = 0
5 RB – 24500 = 0
RB = **4900 kg**

ΣV = 0 →
RA + RB = W. 5 + W. 2
2100 + 4900 = 1000. 5 + 1000. 2
7000 = 7000 → **ok**

RBC = Q = 2. 1000
= **2000 kg**

RBA = RB – RBC
= 4900 – 2000
= **2900 kg**



$MX = RA.\ X - 0{,}5\ WX^2$

$= 2100\ X - 0{,}5.\ 1000\ X^2$

$$\frac{dMX}{dX} = 2100 - 1000x$$

$$\frac{dMX}{dX} = 0$$

$1000\ X = 2100$

X = 2,1 m

M maks $= 2100.\ 2{,}1 - 500.\ 2{,}1^2$

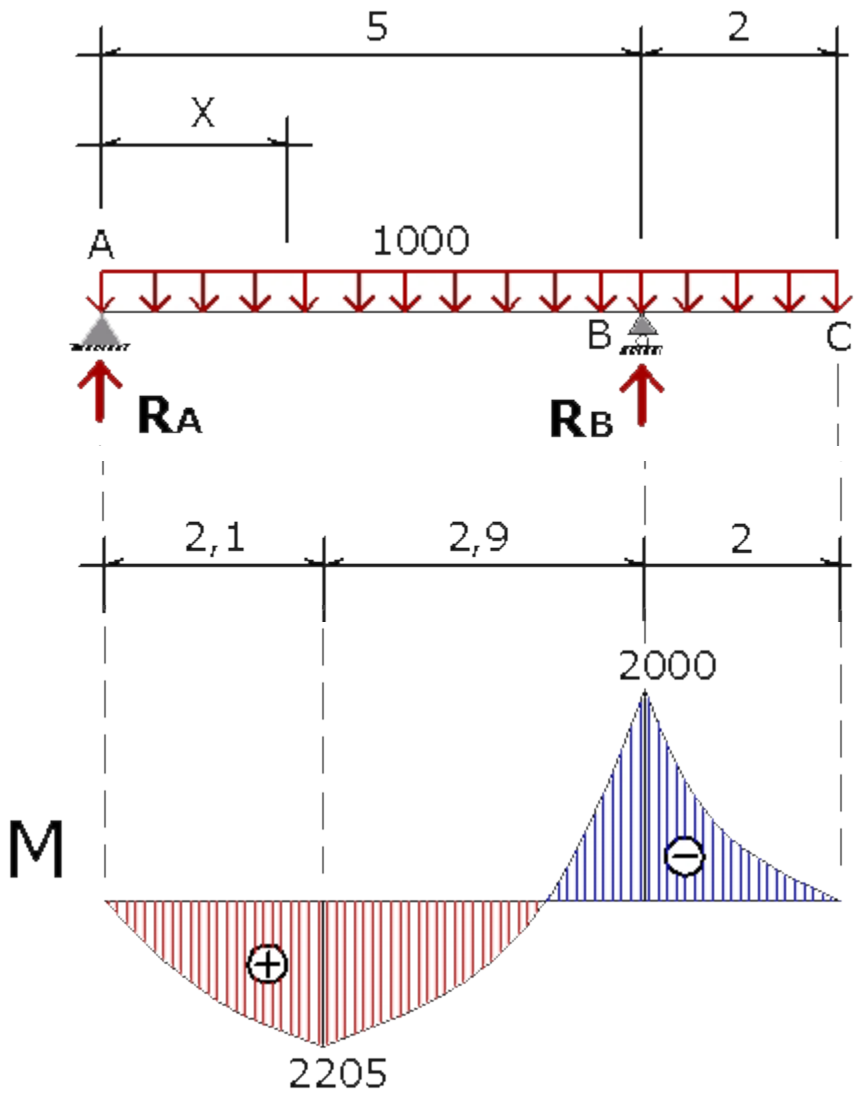
$= 4410 - 2205$

= 2205 kgm

MB $= W.\ 2.\ 1$

$= 1000.\ 2$

= 2000 kgm



30) Gambar bidang momen dan gaya lintang.
P = 400 kg, W = 800 kg/m

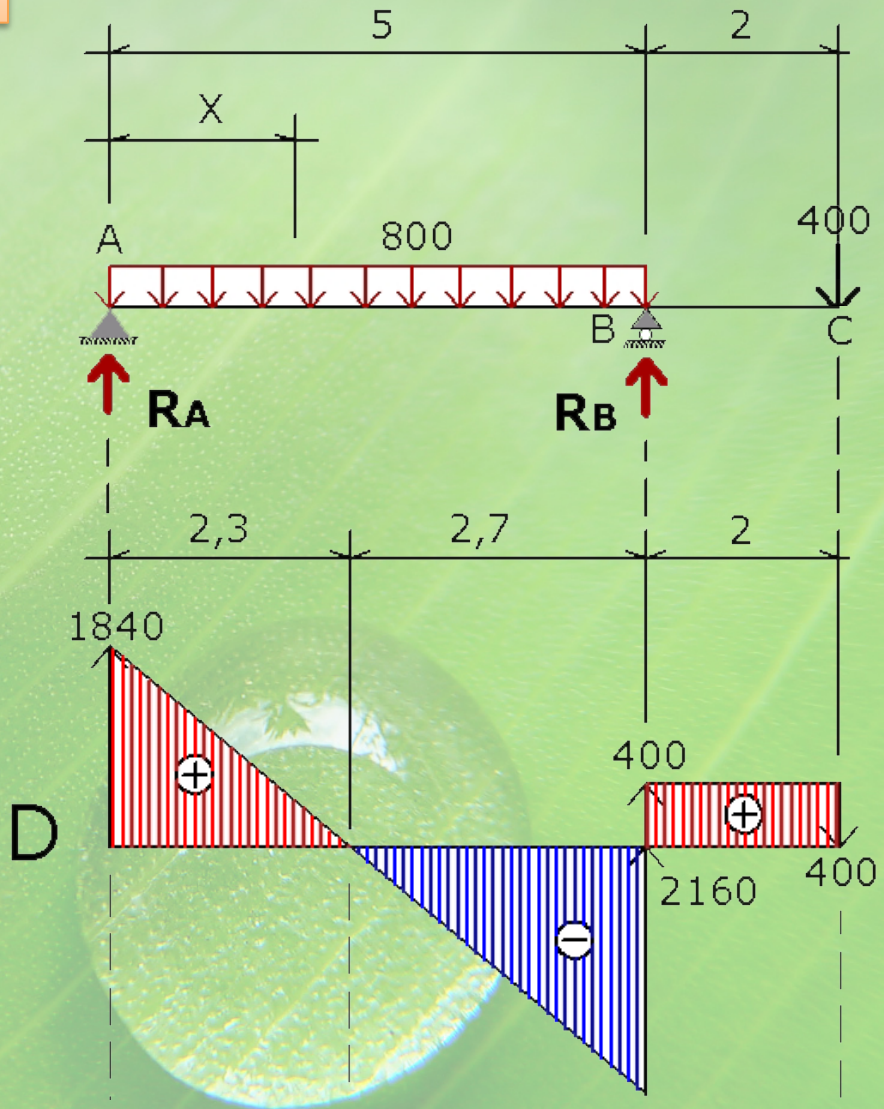
ΣMB = 0 →
RA. 5 + P. 2 – W. 5. 2,5 = 0
5 RA + 400. 2 – 800. 12,5 = 0
5 RA + 800 – 10000 = 0
RA = **1840 kg**

ΣMA = 0 →
RB. 5 – W. 5. 2,5 – P. 7 = 0
RB. 5 - 800. 12,5 – 400. 7 = 0
5 RB – 10000 – 2800 = 0
5 RB – 12800 = 0
RB = **2560 kg**

ΣV = 0 →
RA + RB = P + W 5
1840 + 2560 = 400 + 800. 5
4400 = 4400 → **ok**

RBC = P = **400 kg**

RBA = RB – RBC
= 2560 – 400
= **2160 kg**



MX = RA. X – 0,5 W. X^2

= 1840 X – 0,5. 800 X^2

$$\frac{dMx}{dx} = 1840 - 800\,x$$

$$\frac{dMx}{dx} = 0$$

800 X = 1840

X = 2,3 m

M maks = 1840. 2,3 – 400. $2,3^2$

= 4232 - 2116

= **2116 kgm**

MB = P 2

= 400. 2

= **800 kgm**