

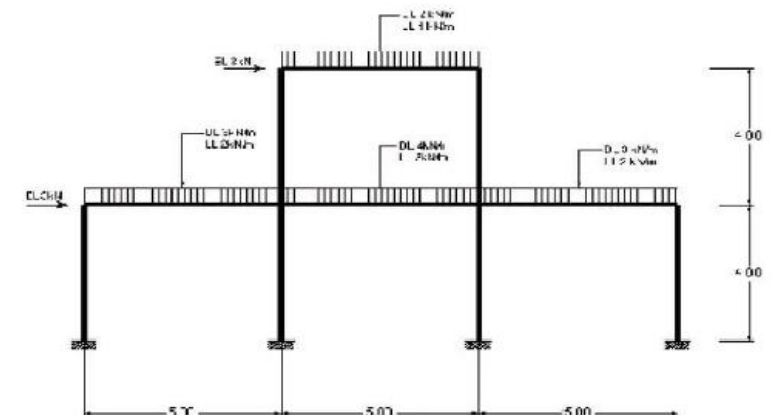
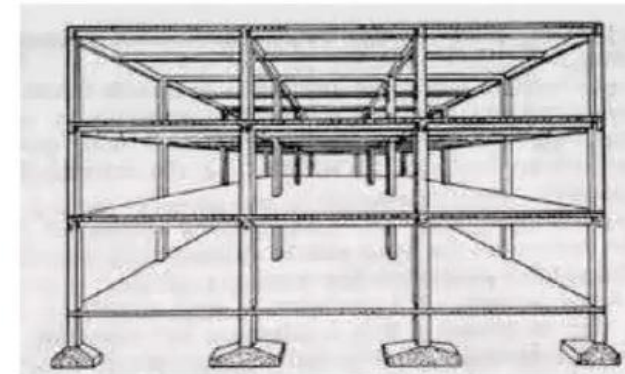
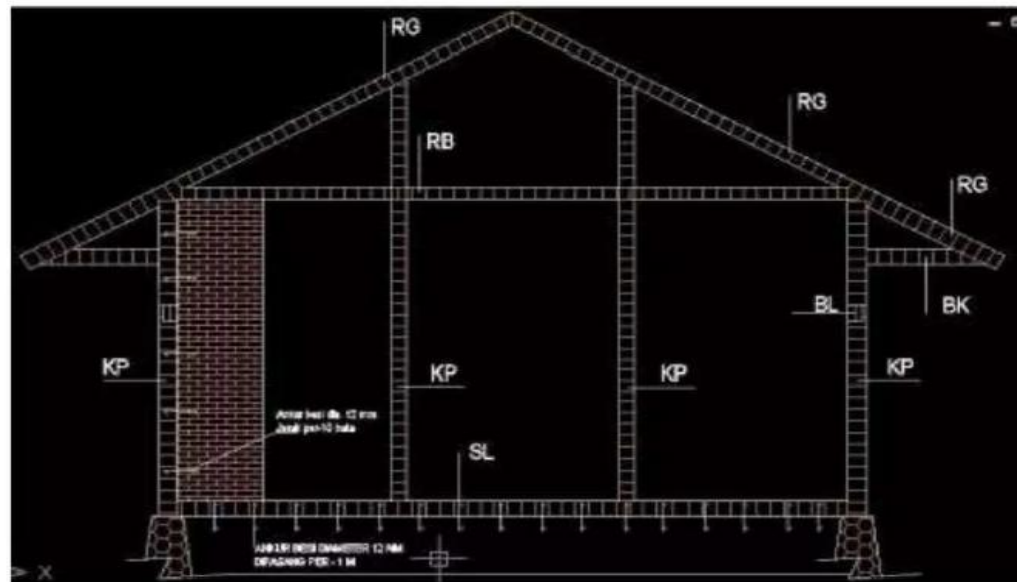
PORTAL
Sarjono Puro, MT

PENGERTIAN BANGUNAN PORTAL

Bangunan portal banyak dijumpai sebagai konstruksi bangunan **gudang, hangar dan jembatan**.

Prinsip perhitungan tetap sama dengan balok diatas dua perletakan selagi masih dalam bentuk **statis tertentu**, yaitu $\Sigma V = 0$, $\Sigma H = 0$, $\Sigma M = 0$.

Contoh bentuk bangunan portal:

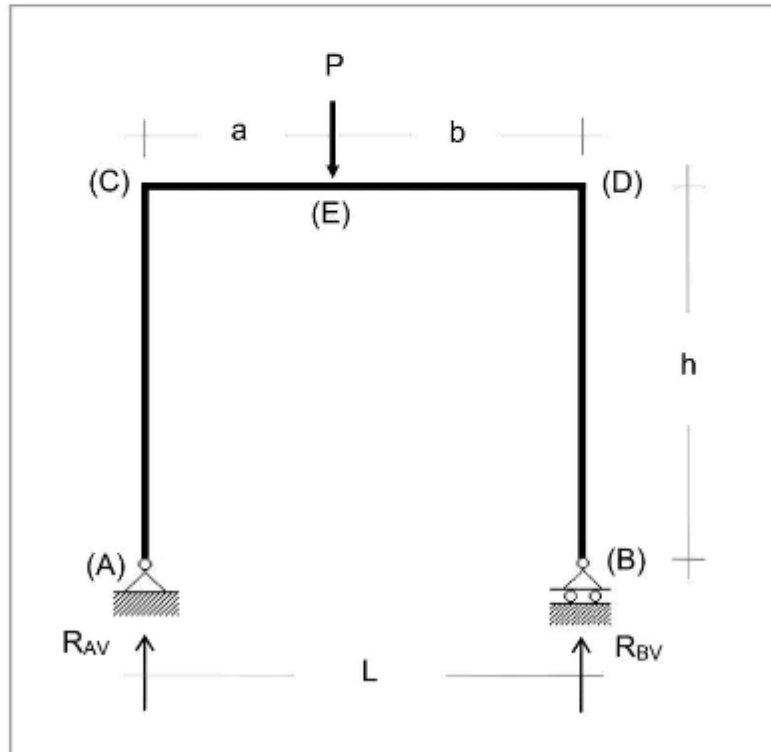


BANGUNAN PORTAL

Bangunan portal banyak dijumpai sebagai konstruksi bangunan gudang, hangar dan jembatan. Prinsip perhitungan tetap sama dengan balok diatas dua perletakan selagi masih dalam bentuk statis tertentu, yaitu $\Sigma V = 0$, $\Sigma H = 0$ dan $\Sigma M = 0$.

1. PORTAL SIMETRIS.

a). Memikul muatan terpusat tunggal.



Gambar 1 : Bangunan portal simetris, memikul beban terpusat P

Penyelesaian :

a. Reaksi Perletakan.

$$\begin{aligned}\Sigma M_B &= 0, \\ R_{AV} \cdot L - P \cdot b &= 0 \\ R_{AV} &= P \cdot b/L \text{ (ton)}.\end{aligned}$$

$$\begin{aligned}\Sigma M_A &= 0, \\ -R_{BV} \cdot L + P \cdot a &= 0 \\ R_{BV} &= P \cdot a/L \text{ (ton)}.\end{aligned}$$

Kontrol :

$$\begin{aligned}\Sigma V &= 0, \\ R_{AV} + R_{BV} - P &= 0\end{aligned}$$

b. Gaya lintang.

$$\begin{aligned}D_{A-C} &= 0 \\ D_{C-E} &= + R_{AV} \text{ (ton)}. \\ D_{E-D} &= + R_{AV} - P \text{ (ton)}. \\ D_{D-B} &= 0\end{aligned}$$

c. Momen.

$$M_A = 0$$

$$M_C = 0$$

$$M_E = R_{AV} \cdot a = P \cdot a \cdot b / L$$

$$M_D = R_{AV} \cdot L - P \cdot b = + P \cdot b / L \cdot L - P \cdot b = 0$$

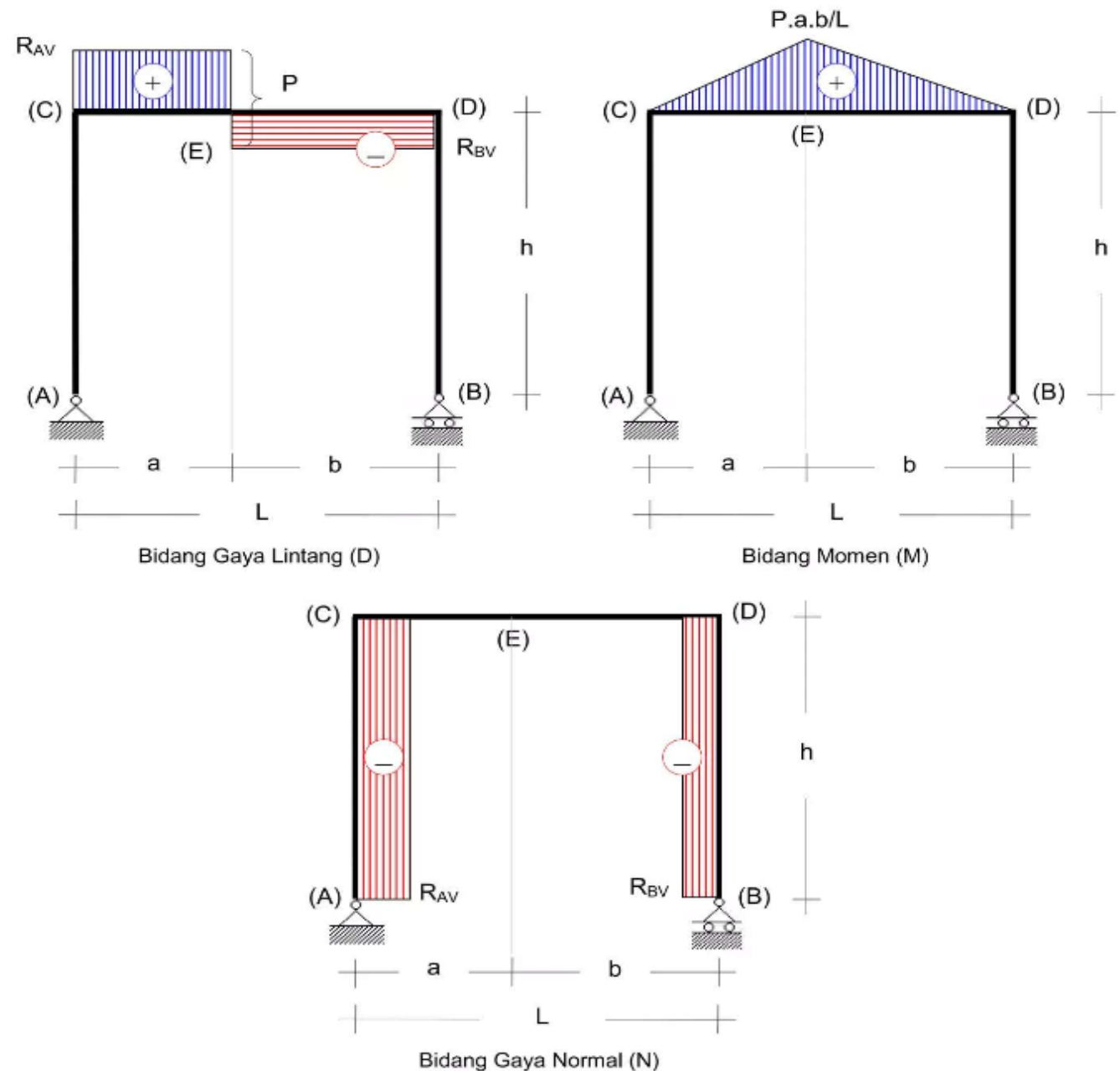
$$M_B = 0$$

d. Gaya Normal.

$$N_{A-C} = - R_{AV} \text{ (ton).}$$

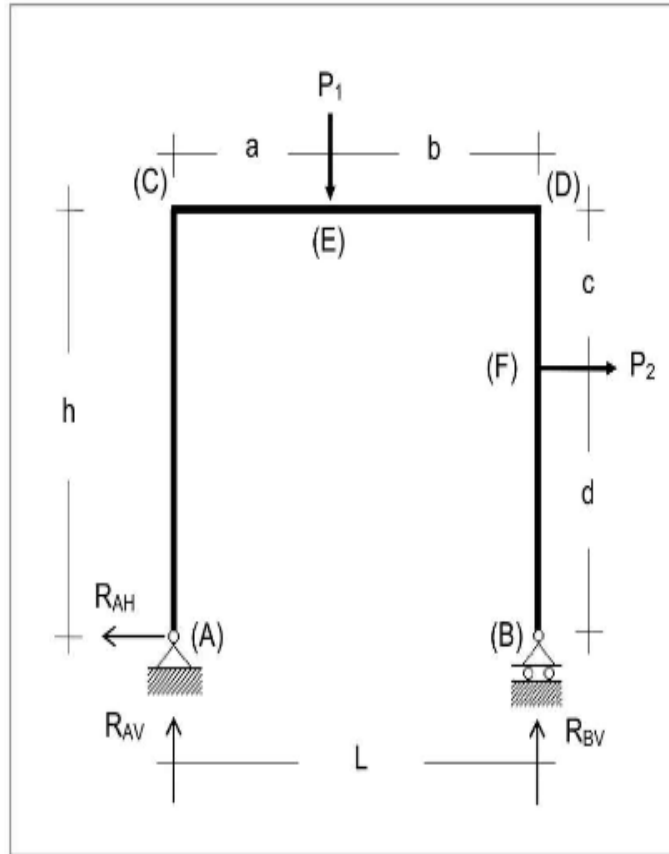
$$N_{C-D} = 0$$

$$N_{B-D} = - R_{BV} \text{ (ton).}$$



Gambar 2 : Bidang gaya lintang, momen dan gaya normal.

b). Memikul muatan terpusat vertikal dan horisontal.



Gambar 3 : Bangunan portal simetris, memikul beban terpusat vertikal P_1 dan beban horisontal P_2 .

d. Gaya Normal.

$$\begin{aligned} N_{A-C} &= -R_{AV} \text{ ton (tekan, kalau reaksi } R_{AV} \text{ keatas).} \\ N_{C-D} &= +R_{AH} \text{ ton (tarik).} \\ N_{B-D} &= -R_{BV} \text{ ton (tekan).} \end{aligned}$$

Penyelesaian :

a. Reaksi Perletakan.

$$\begin{aligned} \Sigma M_B &= 0, \\ R_{AV} \cdot L - R_{AH} \cdot 0 - P_1 \cdot b + P_2 \cdot d &= 0 \\ R_{AV} &= P_1 \cdot b/L - P_2 \cdot d/L \text{ (ton).} \\ \Sigma M_A &= 0, \\ -R_{BV} \cdot L + P_1 \cdot a + P_2 \cdot d &= 0 \\ R_{BV} &= P_1 \cdot a/L + P_2 \cdot d/L \text{ (ton).} \\ \Sigma H &= 0, \\ -R_{AH} + P_2 &= 0 \\ R_{AH} &= P_2 \text{ (ton, kekiri).} \end{aligned}$$

Kontrol :

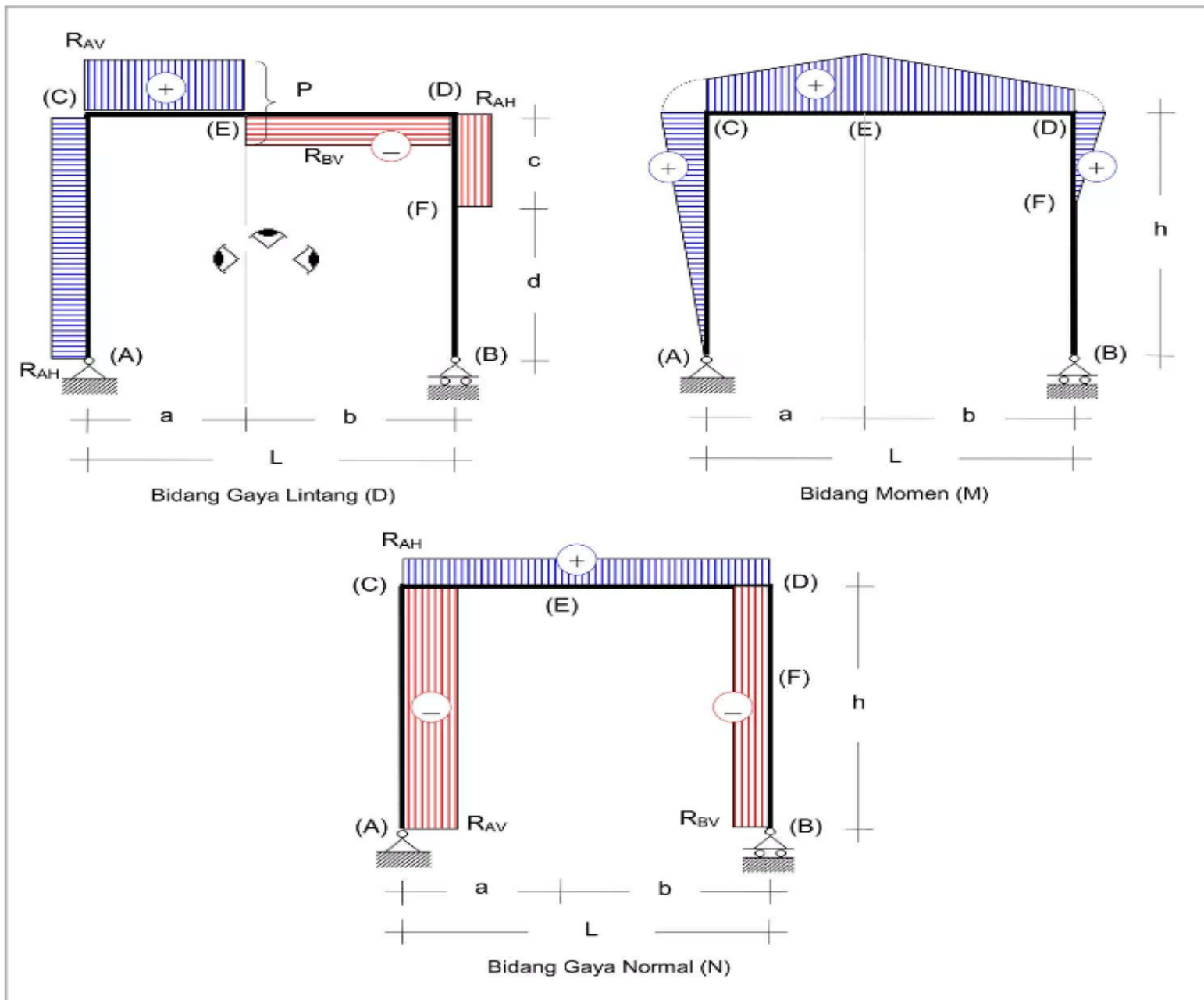
$$\begin{aligned} \Sigma V &= 0, \\ R_{AV} + R_{BV} - P_1 &= 0 \end{aligned}$$

b. Gaya lintang.

$$\begin{aligned} D_{A-C} &= +R_{AH} \text{ (ton).} \\ D_{C-E} &= +R_{AV} \text{ (ton).} \\ D_{E-D} &= +R_{AV} - P_1 \text{ (ton).} \\ D_{D-F} &= -R_{AH} \text{ (ton).} \\ D_{F-B} &= -R_{AH} + P_2 = 0 \text{ (ton).} \end{aligned}$$

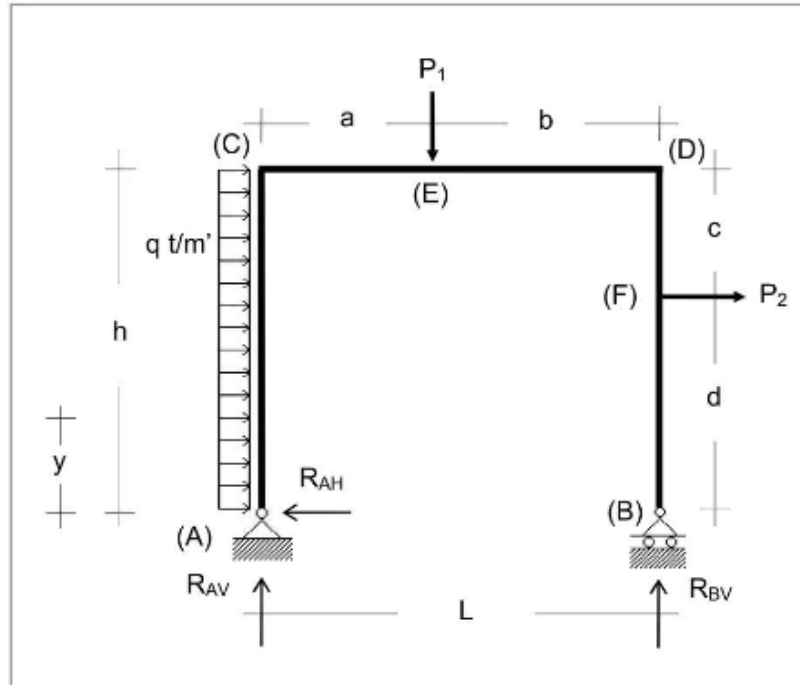
c. M o m e n .

$$\begin{aligned} M_A &= 0 \\ M_C &= +R_{AH} \cdot h \text{ (t.m')}. \\ M_E &= R_{AV} \cdot a + R_{AH} \cdot h \text{ (t.m')}. \\ M_D &= R_{AV} \cdot L + R_{AH} \cdot h - P_1 \cdot b \text{ (t.m')}. \\ M_F &= R_{AV} \cdot L + R_{AH} \cdot d - P_1 \cdot b \text{ (t.m')} = 0. \\ M_B &= 0 \end{aligned}$$



Gambar 4 : Bidang gaya lintang (D), momen (M) dan gaya normal (N).

c). Memikul muatan campuran.



Gambar 6 : Bangunan portal simetris, memikul beban terpusat vertikal P_1 , beban horisontal P_2 dan $q \text{ t/m'}$.

Diketahui : Konstruksi seperti tergambar.
 $L = 10 \text{ m}$, $h = 5 \text{ m}$, $a = 4 \text{ m}$, $b = 6 \text{ m}$, $c = 2 \text{ m}$, $d = 3 \text{ m}$.
 $P_1 = 5 \text{ ton}$, $P_2 = 2 \text{ ton}$, $q = 1 \text{ t/m'}$.
Diminta : Hitung dan gambarkan M, D dan N pada seluruh bentang.

Penyelesaian :

a. Reaksi Perletakan.

$$\Sigma M_B = 0,$$

$$R_{AV} \cdot L - R_{AH} \cdot 0 + q \cdot h \cdot \frac{1}{2} h - P_1 \cdot b + P_2 \cdot d = 0$$

$$R_{AV} = P_1 \cdot b/L - P_2 \cdot d/L - \frac{1}{2} q \cdot h^2/L = 5 \cdot 6/10 - 2 \cdot 3/10 - \frac{1}{2} \cdot 1 \cdot 5^2/10 \\ = 3 - 0,6 - 1,25$$

$$R_{AV} = + 1,15 \text{ ton (keatas).}$$

$$\Sigma M_A = 0,$$

$$- R_{BV} \cdot L + P_1 \cdot a + P_2 \cdot d + q \cdot h \cdot \frac{1}{2} h = 0$$

$$R_{BV} = P_1 \cdot a/L + P_2 \cdot d/L + \frac{1}{2} q \cdot h^2/L = 5 \cdot 4/10 + 2 \cdot 3/10 + \frac{1}{2} \cdot 1 \cdot 5^2/10 \\ = 2 + 0,6 + 1,25$$

$$R_{BV} = + 3,85 \text{ ton (keatas).}$$

$$\Sigma H = 0,$$

$$- R_{AH} + q \cdot h + P_2 = 0$$

$$R_{AH} = P_2 + q \cdot h = 2 + 1 \cdot 5$$

$$R_{AH} = + 7 \text{ ton (kekiri).}$$

Kontrol :

$$\Sigma V = 0,$$

$$R_{AV} + R_{BV} - P_1 = 0$$

$$1,15 + 3,85 - 5 = 0 \quad (\text{memenuhi}).$$

b. Gaya lintang.

$$D_{AC} = + R_{AH} = + 7 \text{ (ton).}$$

$$D_y = + R_{AH} - q \cdot y$$

$$D_{y=5m} = D_{CA} = + R_{AH} - q \cdot h = + 7 - 1 \cdot 5 = + 2 \text{ (ton).}$$

$$D_{C-E} = + R_{AV} = + 1,15 \text{ (ton).}$$

$$D_{E-D} = + R_{AV} - P_1 = 1,15 - 5 = - 3,85 \text{ (ton).}$$

$$D_{D-F} = - R_{AH} + q \cdot h = - 7 + 1 \cdot 5 = - 2 \text{ (ton), atau}$$

$$D_{D-F} = - P_2 = - 2 \text{ (ton)}$$

c. Momen.

$$M_A = 0$$

$$M_y = + R_{AH} \cdot y - \frac{1}{2} \cdot q \cdot y^2$$

$$M_C = + R_{AH} \cdot h - \frac{1}{2} q \cdot h^2 = 7 \cdot 5 - \frac{1}{2} \cdot 1 \cdot 5^2 = 35 - 12,5 = + 22,5 \text{ (t.m')}. \\ M_E = + R_{AH} \cdot h - \frac{1}{2} q \cdot h^2 + R_{AV} \cdot a = + 7 \cdot 5 - \frac{1}{2} \cdot 1 \cdot 5^2 + 1,15 \cdot 4$$

$$= 35 - 12,5 + 4,6$$

$$M_E = + 27,1 \text{ (t.m')}. \\ M_D = + R_{AH} \cdot h - \frac{1}{2} q \cdot h^2 + R_{AV} \cdot L - P_1 \cdot b$$

$$= + 7 \cdot 5 - \frac{1}{2} \cdot 1 \cdot 5^2 + 1,15 \cdot 10 - 5 \cdot 6 = 35 - 12,5 + 11,5 - 30$$

$$M_D = + 4 \text{ (t.m')}. \\ \text{Atau,}$$

$$M_D = + P_2 \cdot c = + 2 \cdot 2 = + 4 \text{ (t.m')}. \\ M_F = + R_{AH} \cdot d - q \cdot h \cdot (d - \frac{1}{2} h) + R_{AV} \cdot L - P_1 \cdot b$$

$$= + 7 \cdot 3 - 1 \cdot 5 \cdot (3 - \frac{1}{2} \cdot 5) + 1,15 \cdot 10 - 5 \cdot 6 \\ = 21 - 2,5 + 11,5 - 30$$

$$M_F = 0$$

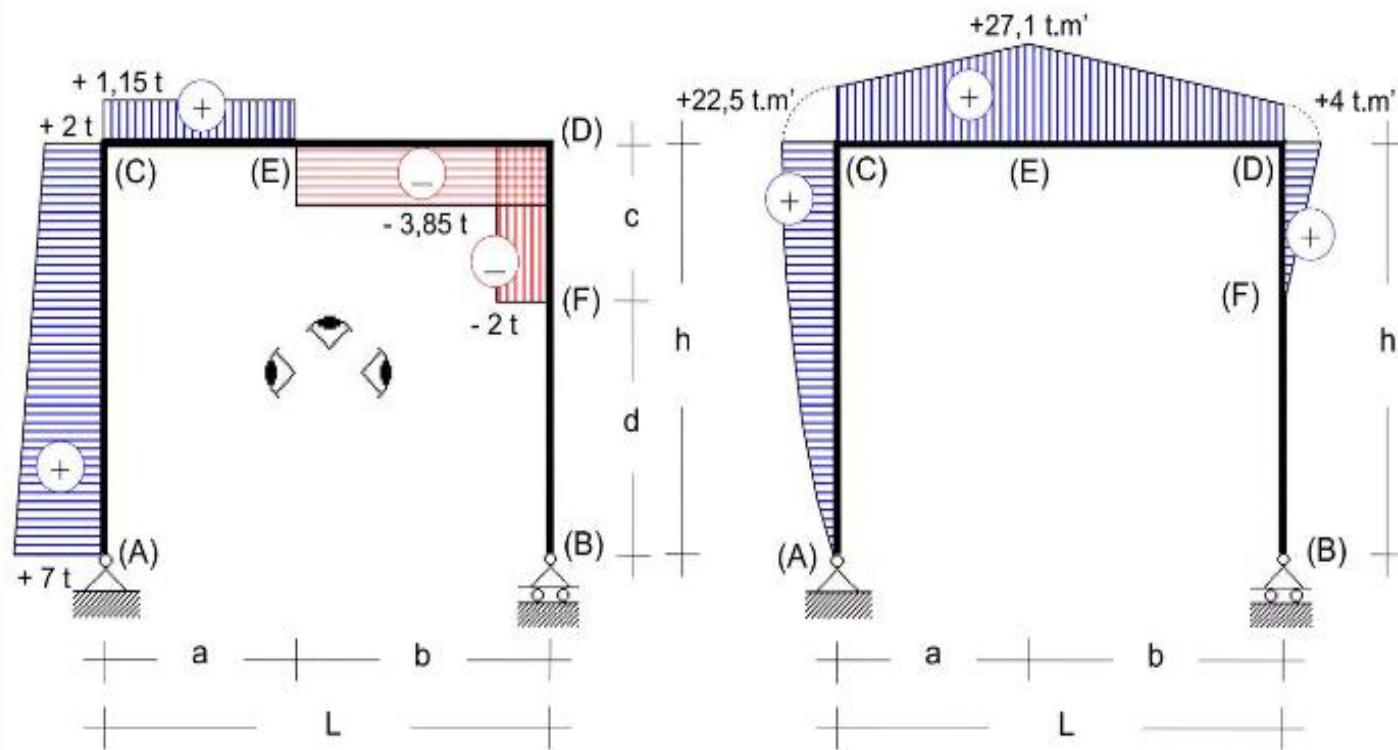
$$M_B = 0$$

d. Gaya Normal.

$$N_{A-C} = - R_{AV} = - 1,15 \text{ ton (tekan).}$$

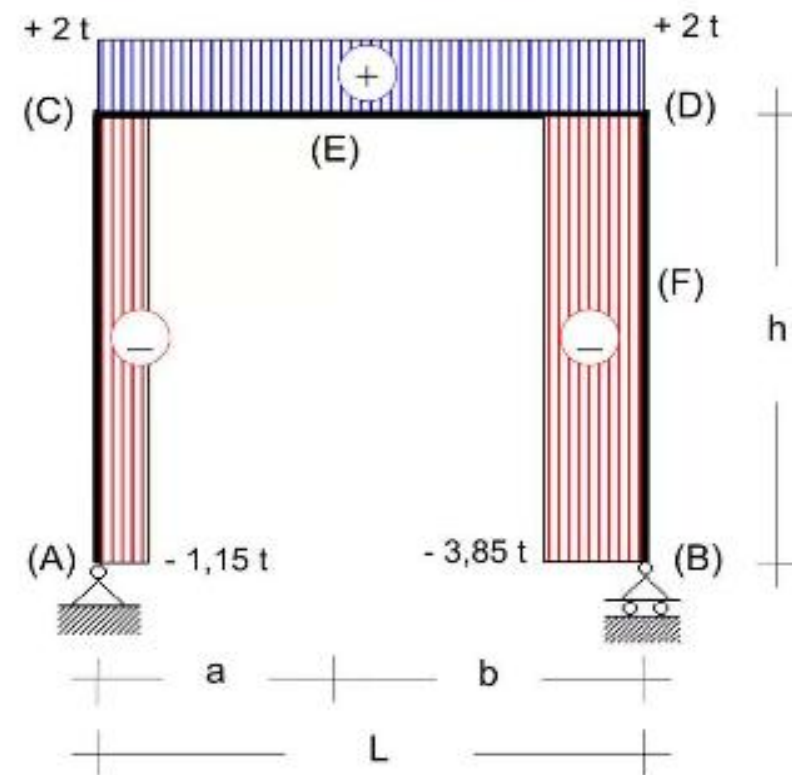
$$N_{C-D} = + R_{AH} - q \cdot h = 7 - 1 \cdot 5 = + 2 \text{ ton (tarik).}$$

$$N_{B-D} = - R_{BV} = - 3,85 \text{ ton (tekan).}$$



Bidang Gaya Lintang (D)

Bidang Momen (M)



Bidang Gaya Normal (N)

TUGAS

