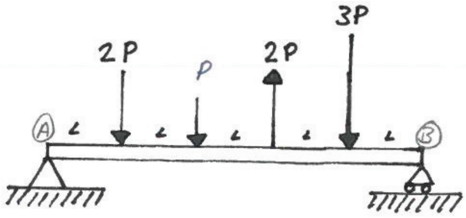
2.4.19

Givet

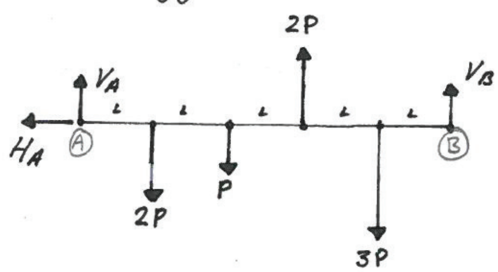


× Fritt upplagd balk
× Avstånd L
× Kraft P

Sökt: Rita T- och M-diagram

Lösning

1. Frilägg



2. Jmv

$\uparrow$: $V_A - 2P - P + 2P - 3P + V_B = 0$

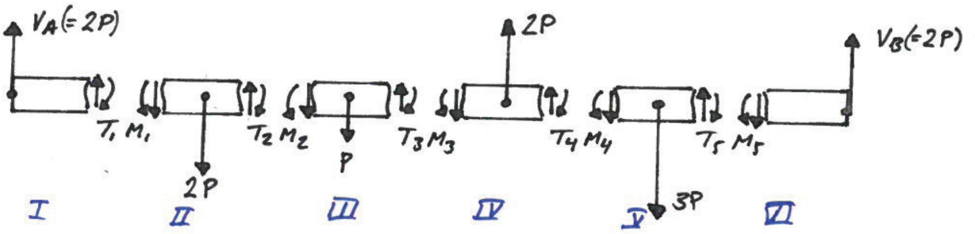
$\Rightarrow$ $\underline{V_A + V_B = 4P}$

$\rightarrow$: $\underline{-H_A = 0}$

$\overset{\curvearrowleft}{A}$: $-L\cdot 2P - 2L\cdot P + 3L\cdot 2P - 4L\cdot 3P + 5L\cdot V_B = 0$

$\Rightarrow$ $\underline{V_B = 2P}$ $\Rightarrow$ $\underline{V_A = 2P}$

3. Snitta



4. Jmv

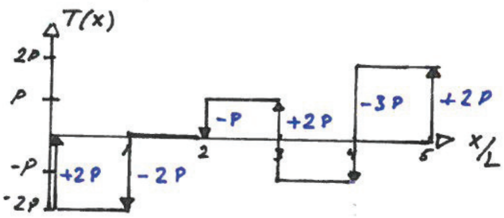
$\uparrow_{I}$: $2P + T_1 = 0$ $\Rightarrow$ $\underline{T_1 = -2P}$

$\uparrow_{II}$: $-T_1 - 2P + T_2 = 0$ $\Rightarrow$ $\underline{T_2 = 0}$

$\uparrow_{III}$: $-T_2 - P + T_3 = 0$ $\Rightarrow$ $\underline{T_3 = P}$

$\uparrow_{IV}$: $-T_3 + 2P + T_4 = 0$ $\Rightarrow$ $\underline{T_4 = -P}$

$\uparrow_{V}$: $-T_4 - 3P + T_5 = 0$ $\Rightarrow$ $\underline{T_5 = 2P}$



Randvillkor: $T(x=0) = T(x=5L) = 0$

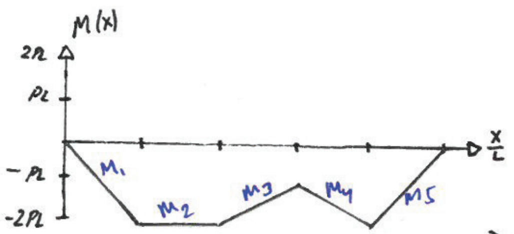
M_1, T_1: $0 \leq x \leq L$

M_2, T_2: $L \leq x \leq 2L$

M_3, T_3: $2L \leq x \leq 3L$

M_4, T_4: $3L \leq x \leq 4L$

M_5, T_5: $4L \leq x \leq 5L$



Randvillkor: $M(x=0) = M(x=5L) = 0$
ty tar ej upp moment där

$$\left[M(x) = \int T(x)\,dx \right]$$

dvs

$M_2(L) = M_1(L)$ osv...

$M_1(x) = -2Px + c_1 \rightarrow c_1 = 0$

$M_2(x) = 0 + c_2 \rightarrow c_2 = -2PL$

$M_3(x) = Px + c_3 \rightarrow c_3 = -4PL$

$M_4(x) = -Px + c_4 \rightarrow c_4 = 2PL$

$M_5(x) = 2Px + c_5 \rightarrow c_5 = -10PL$

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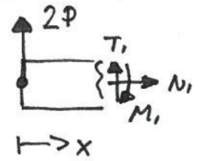
"Alternativt" sätt att lösa T- och M-diagram utifrån snittning

3. Snitta

4. Jmv

Del 1 $\{0 < x \leq L\}$

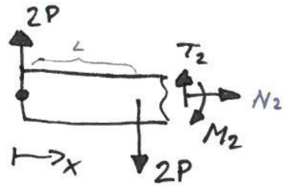


$\rightarrow: \quad \underline{N_1 = 0}$

$\uparrow: \quad 2P + T_1 = 0 \implies \underline{T_1 = -2P}$

$\curvearrowleft: \quad T_1 \cdot x - M_1 = 0 \implies \underline{M_1(x) = -2P \cdot x}$

Del 2 $\{L \leq x \leq 2L\}$

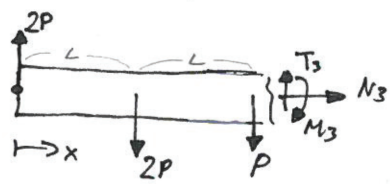


$\rightarrow: \quad N_2 = 0$

$\uparrow: \quad 2P - 2P + T_2 = 0 \implies \underline{T_2 = 0}$

$\curvearrowleft: \quad -2P \cdot L + T_2 \cdot x - M_2 = 0 \implies \underline{M_2 = -2PL}$

Del 3 $\{2L \leq x \leq 3L\}$

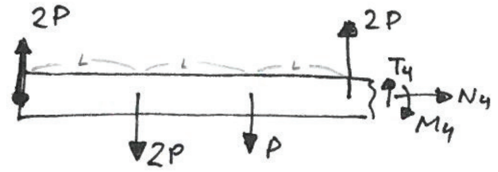


$\rightarrow: \quad N_3 = 0$

$\uparrow: \quad 2P - 2P - P + T_3 = 0 \implies \underline{T_3 = P}$

$\curvearrowleft: \quad -2P \cdot L - P \cdot 2L + T_3 \cdot x - M_3 = 0 \implies \underline{M_3(x) = P \cdot x - 4P \cdot L}$

Del 4 $\{3L \leq x \leq 4L\}$



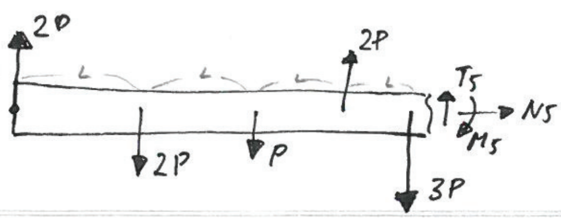
$\rightarrow: \quad N_4 = 0$

$\uparrow: \quad 2P - 2P - P + 2P + T_4 = 0 \implies \underline{T_4 = -P}$

$\curvearrowleft: \quad -2P \cdot L - P \cdot 2L + 2P \cdot 3L + T_4 \cdot x - M_4 = 0$

$\implies \underline{M_4(x) = -P \cdot x + 2PL}$

Del 5 $\{4L \leq x < 5L\}$



$\rightarrow: \quad N_5 = 0$

$\uparrow: \quad 2P - 2P - P + 2P - 3P + T_5 = 0 \implies \underline{T_5 = 2P}$

$\curvearrowleft: \quad -2P \cdot L - P \cdot 2L + 2P \cdot 3L - 3P \cdot 4L + T_5 \cdot x - M_5 = 0$

$\implies \underline{M_5(x) = 2Px - 10PL}$

Således fås för de olika intervallen:

	$x=0$	$0 \leq x \leq L$	$L \leq x \leq 2L$	$2L \leq x \leq 3L$	$3L \leq x \leq 4L$	$4L \leq x \leq 5L$	$x=5L$
$T(x)$	0	$-2P$	0	P	$-P$	$2P$	0
$M(x)$	0	$-2Px$	$-2PL$	$Px - 4PL$	$-Px + 2PL$	$2Px - 10PL$	0

... Nu är det enkelt att rita in dessa i T- resp. M-diagram

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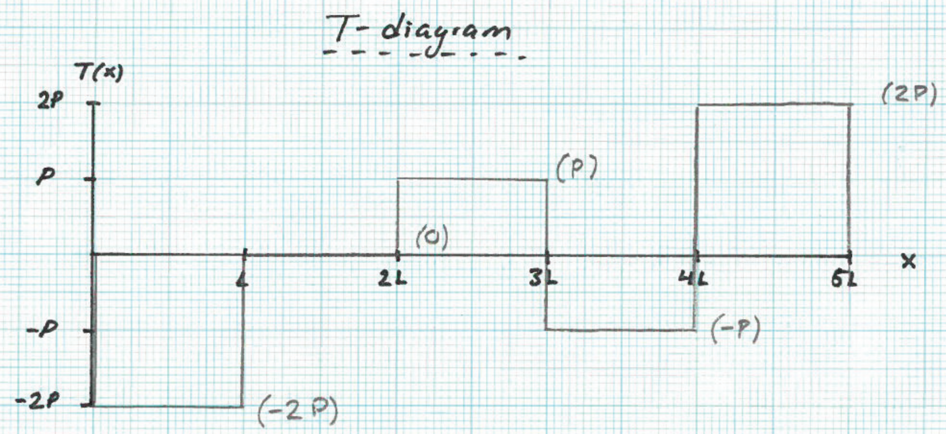
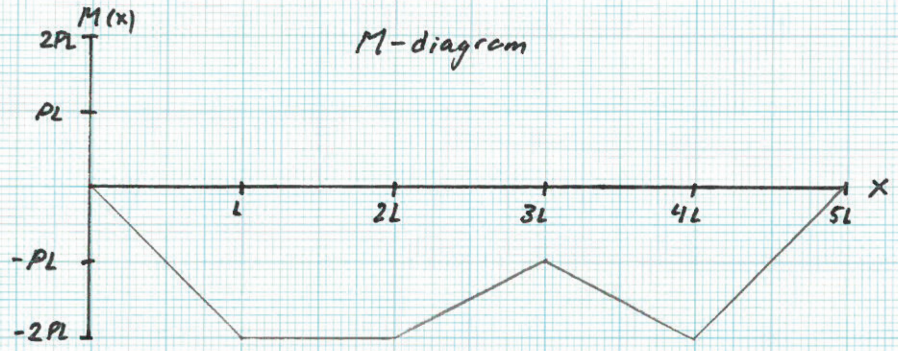
forts. 2



T-diagram
T(x)
2P
P
-P
-2P
(2P)
(P)
(0)
(-P)
(-2P)
L
2L
3L
4L
5L
x



M-diagram
M(x)
2PL
PL
-PL
-2PL
L
2L
3L
4L
5L
x