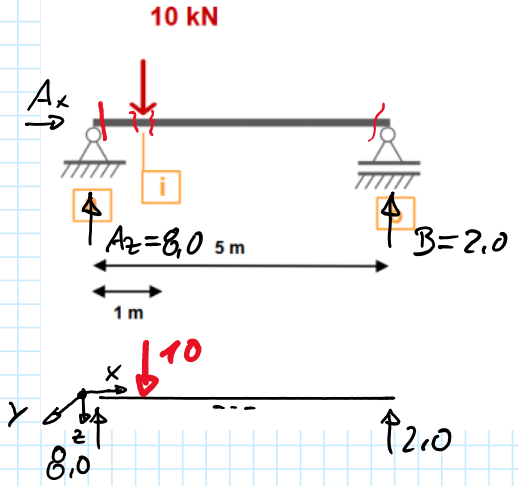


gesucht: Schnittkräfte N, V, M

1. Auflagerkräfte:

$\rightarrow: \sum F_x \rightarrow A_x = 0$

$\curvearrowleft: \sum M_a = 0 = -10 \cdot 1{,}0 + B \cdot 5{,}0$

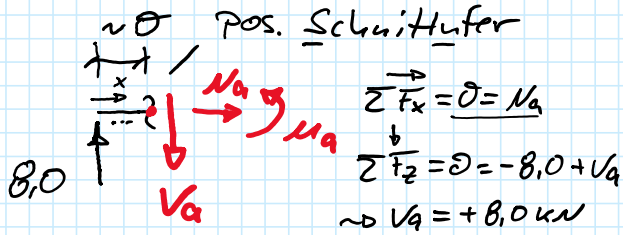
$\rightarrow B = \frac{10}{5{,}0} = 2{,}0\ kN$

$\downarrow: \sum F_z = 0 = 10 - 2{,}0 - A_z$

$\rightarrow A_z = 8{,}0\ kN$

Schnitt rechts von A:

ragt $\vec{x}$ aus dem SU heraus
$\rightarrow$ pos. Schnittufer



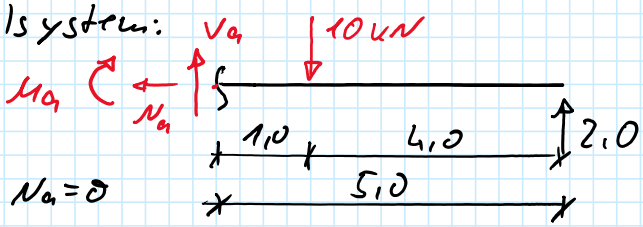
$\rightarrow: \sum F_x = 0 = N_a$

$\downarrow: \sum F_z = 0 = -8{,}0 + V_a$

$\rightarrow V_a = +8{,}0\ kN$

$\curvearrowleft: \sum M = 0 = -8{,}0 \cdot 0 + M_a \rightarrow M_a = 0$

Alternativ: rechtes Teilsystem:

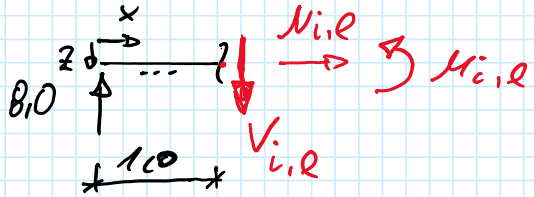


$\rightarrow: \sum F_x = 0 \rightarrow N_a = 0$

$\downarrow: \sum F_z = 0 = -V_a + 10 - 2{,}0 \rightarrow V_a = +8{,}0$ (s.o.)

$\curvearrowleft: \sum M = 0 = -M_a - 10 \cdot 1{,}0 + 2{,}0 \cdot 5{,}0 \rightarrow M_a = -10 + 10 = 0$ (s.o.)

Schnitt links von i:

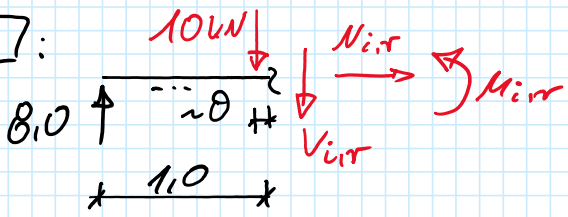


$\rightarrow: \sum F_x \rightarrow N_{i,l} = 0$

$\downarrow: \sum F_z = 0 = -8{,}0 + V_{i,l} \rightarrow V_{i,l} = +8{,}0$

$\curvearrowleft: \sum M = 0 = -8{,}0\ kN \cdot 1{,}0\ m + M_{i,l} \rightarrow M_{i,l} = 8{,}0\ kNm$

Schnitt rechts von i:



$\rightarrow: \sum F_x \rightarrow N_{i,r} = 0$

$\downarrow: \sum F_z = 0 = -8{,}0 + 10{,}0 + V_{i,r}$

$\rightarrow V_{i,r} = -2{,}0\ kN$

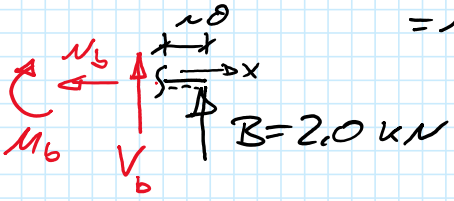
$\rightarrow V_{i,r} = -2{,}0\ kN$

$\curvearrowleft \Sigma M = 0 = -8{,}0\ kN \cdot 1{,}0\ m + 10\ kN \cdot 0\ m + M_{i,r} \rightarrow M_{i,r} = 8{,}0\ kNm$

$= M_{i,l}$

Schnitt links von b:

rechtes Teilsystem;
x-Achse zeigt in das Schnittufer hinein
$\rightarrow$ negatives SM



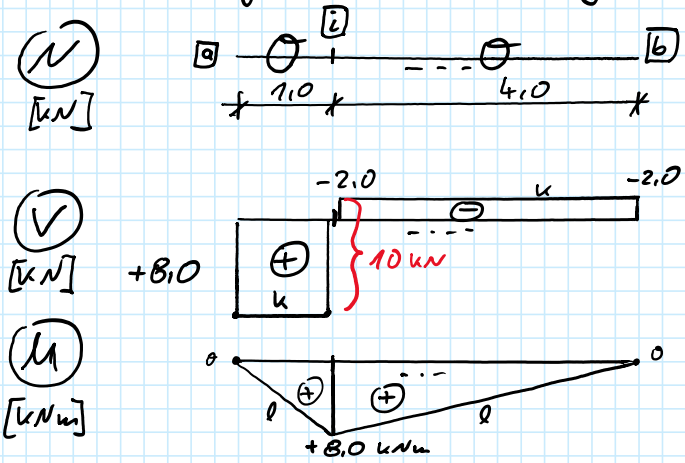
$\Sigma F_x \rightarrow N_b = 0$

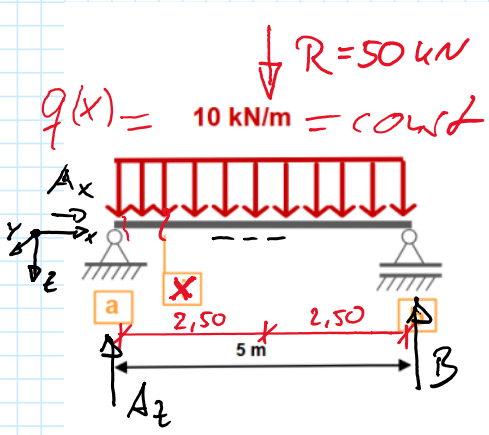
$\downarrow \Sigma F_z = 0 = -V_b - 2{,}0\ kN$

$\rightarrow V_b = -2{,}0\ kN$

$\curvearrowleft \Sigma M = 0 = -M_b + B \cdot 0 \rightarrow M_b = 0$

Darstellung der Schnittgrößen:





Einfeldträger mit Gleichstreckenlast

Resultierende bilden: $R = 10\frac{kN}{m} \cdot 5\ m = 50\ kN$

Auflager:

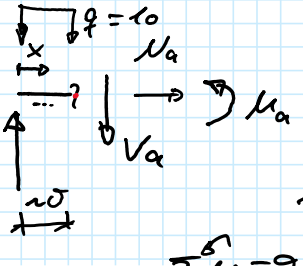
$\curvearrowleft \Sigma M_a = 0 = -50 \cdot 2{,}50 + B \cdot 5{,}0 \rightarrow B = 25\ kN$

$\Sigma F_z = 0 = -A_z + 50 - 25 \rightarrow A_z = 25$

$\Sigma F_x = 0 \rightarrow A_x = 0$

Schnitt rechts von a:

$A_z = 25$



$\Sigma F_x \rightarrow N_a = 0$

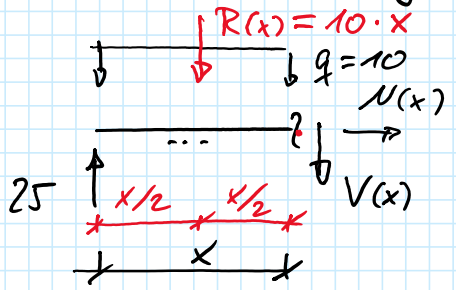
$\Sigma F_z = 0 = -25 + 10 \cdot 0 + V_a$

$\rightarrow V_a = +25\ kN$

$\rightarrow V_a = +25\ kN$

$\sum M = 0 = -25 \cdot 0 + M_a \rightarrow M_a = 0$

Schnitt bei beliebiger Koordinate x:



$\sum F_x \rightarrow N(x) = 0$

$\sum F_z = 0 = -25 + R(x) + V(x)$

$\rightarrow V(x) = 25 - 10 \cdot x$ (kN; kN/m) Geradengleichung

$\sum M = 0 = -25 \cdot x + R(x) \cdot \frac{x}{2} + M(x)$

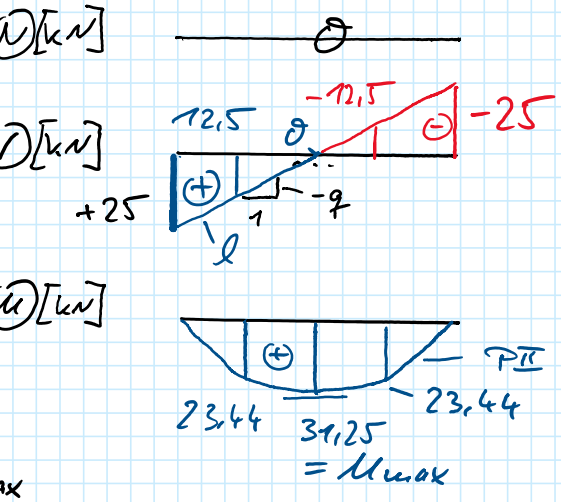
$\rightarrow M(x) = 25 \cdot x - 10 \cdot x \cdot \frac{x}{2} = 25x - 5 \cdot x^2$

quadratische Parabel

Auswertung:

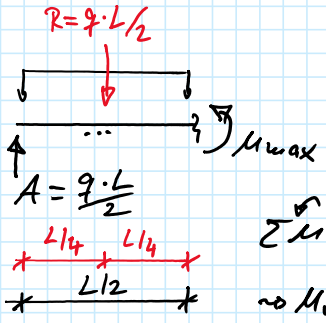
x	x/L	V(x) [kN]	M(x) [kNm]
0	0	25	0
1,25	1/4	12,5	23,44
2,5	1/2	0	31,25
3,75	3/4	-12,5	23,44
5,0	1,0	-25	0

Verläufe:



Hier: $V_{max} = \frac{q \cdot L}{2}$

M_{max} in Feldmitte:

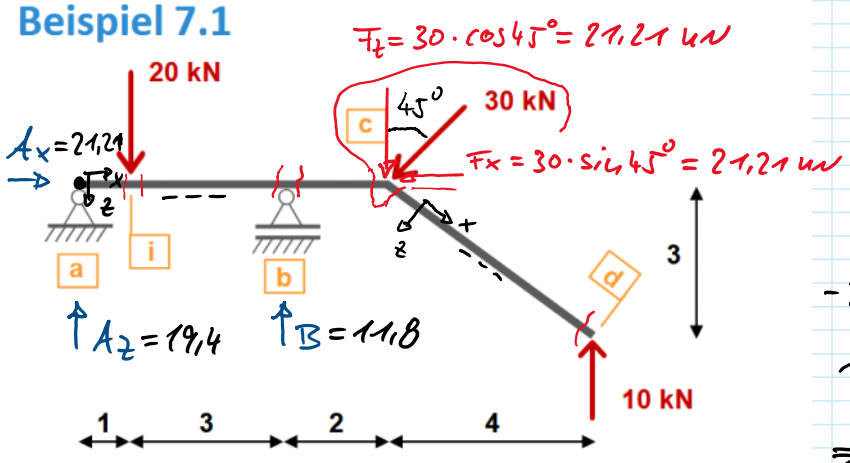


$\sum M = 0 = -A \cdot L/2 + R \cdot L/4 + M_{max}$

$\rightarrow M_{max} = \frac{q \cdot L}{2} \cdot \frac{L}{2} - \frac{q \cdot L}{2} \cdot \frac{L}{4}$

$$M_{max} = \frac{q L^2}{8}$$

Beispiel 7.1



ges.: N, V, M

$\rightarrow: \quad \sum F_x = 0 = A_x - 21{,}21$

$\rightsquigarrow A_x = 21{,}21$ kN

$\circlearrowleft: \quad \sum M_a = 0 = -20 \cdot 1{,}0 + B \cdot 4{,}0 - 21{,}21 \cdot 6{,}0 + 21{,}21 \cdot 0 + 10 \cdot 10{,}0$

$\rightsquigarrow B = 11{,}8$ kN

$\downarrow: \quad \sum F_z = 0$

$= -A_z + 20 - 11{,}8 + 21{,}21 - 10$

$\rightsquigarrow A_z = 19{,}4$ kN

$A_x = 21{,}21$

[a]: $\rightarrow$ … $\downarrow V_a = 19{,}4$, $\rightarrow N_a$, $\circlearrowleft M_a = 0$

$19{,}4 \uparrow$

$\rightarrow: \quad \sum F_x = 0 = 21{,}21 + N_a \rightsquigarrow N_a = -21{,}21$ kN

links von [i]:

$21{,}21 \rightarrow$ … $\downarrow V_{i,l}$, $\rightarrow N_{i,l}$, $\circlearrowleft M_{i,l}$

$19{,}4 \uparrow$, 1,0

$\sum F_x \rightsquigarrow N_{i,l} = -21{,}21$ kN

$\sum F_z \rightsquigarrow V_{i,l} = +19{,}4$ kN

$\circlearrowleft: \quad \sum M = 0 = 21{,}21 \cdot 0 - 19{,}4 \cdot 1{,}0 + M_{i,l}$

$\rightsquigarrow M_{i,l} = 19{,}4$ kNm

rechts von [i]:

20 kN, $\rightarrow N_{i,r}$, $\downarrow V_{i,r}$, $\circlearrowleft M_{i,r}$

$21{,}21 \rightarrow$, $19{,}4 \uparrow$, 1,0

$N_{i,r} = N_{i,l} = -21{,}21$ kN

$\downarrow: \quad \sum F_z = 0 = -19{,}4 + 20 + V_{i,r}$

$\rightsquigarrow V_{i,r} = -0{,}6$ kN

$M_{i,l} = M_{i,r} = 19{,}4$ kNm

links von [b]:

20 kN, $21{,}21 \rightarrow$, $19{,}4 \uparrow$, $\rightarrow N_{b,l}$, $\downarrow V_{b,l}$, $\circlearrowleft M_{b,l}$

1,0 | 3,0

$N_{b,l} = N_{i,r} = -21{,}21$

$V_{b,l} = V_{b,r} = -0{,}6$

$\circlearrowleft: \quad \sum M = 0 = -19{,}4 \cdot 4{,}0 + 20 \cdot 3{,}0 + M_{b,l}$

$\rightsquigarrow M_{b,l} = 17{,}6$ kNm

rechts von [b]:

20 kN, $21{,}21 \rightarrow$, $19{,}4 \uparrow$, $11{,}8 \uparrow$, $\rightarrow N_{b,r}$, $\downarrow V_{b,r}$

$N_{b,r} = -21{,}21$

$M_{b,r} = M_{b,l} = 17{,}6$

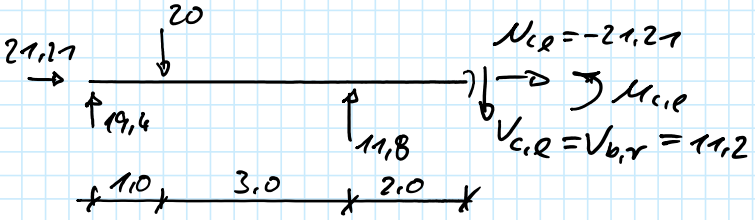
$\downarrow: \quad \sum F_z = 0 = -19{,}4 + 20 - 11{,}8 + V_{b,r}$

17,4 11,8

$\sum F_z = 0 = -19{,}4 + 20 - 11{,}8 + V_{6,r}$

$\rightsquigarrow V_{6,r} = 11{,}2$

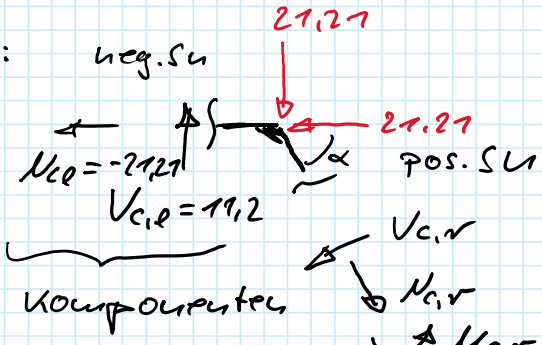
links von [C]:



$\sum M = 0 = -19{,}4 \cdot 6{,}0 + 20 \cdot 5{,}0 - 11{,}8 \cdot 2{,}0 + M_{c,l}$

$\rightsquigarrow M_{c,l} = 40{,}0$ kNm

Schnitt $c_l - c_r$: neg. Sn



$M_{c,l} = 40$

in Komponenten ⊥ und ∥ zu schrägem Stab zerlegen

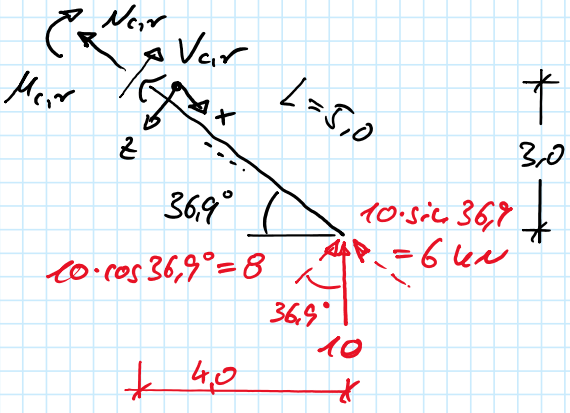
$\rightsquigarrow$ aufwändig ☹

einfach:

$\sum M = 0 = -M_{c,l} + M_{c,r} \rightsquigarrow M_{c,l} = M_{c,r}$

$\rightsquigarrow M_{c,r} = 40$ kNm

hier einfacher rechtes TS



$\sum F_x = 0 = -N_{c,r} - 6$ kN

$\rightsquigarrow N_{c,r} = -6$ kN

$\sum F_z = 0 = -V_{c,r} - 8$

$\rightsquigarrow V_{c,r} = -8$ kN

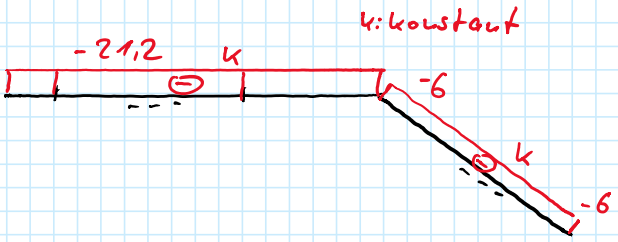
$\sum M = 0 = -M_{c,r} + 10 \cdot 4{,}0 \Rightarrow M_{c,r} = 40$ kNm

Schnitt [d] links: $M_d = 0$; $V_d = V_{c,r} = -8$

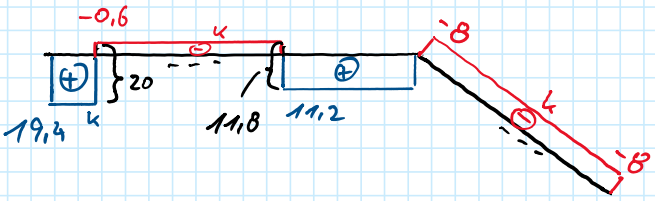
$N_d = N_{d,r} = -6{,}0$

Schnittgrößen:

N
[kN]



V
[kN]



M
[kNm]