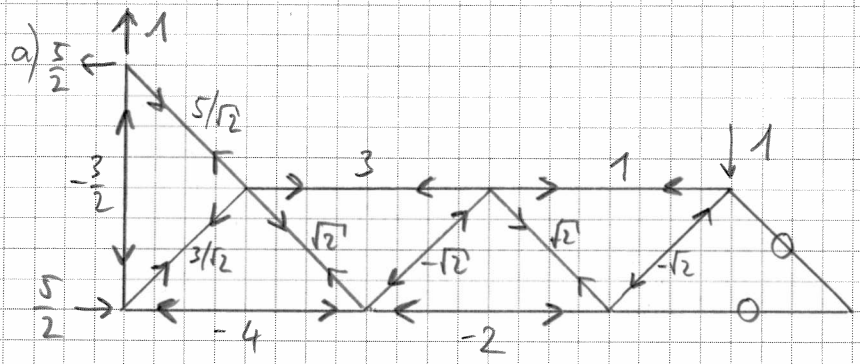
Aufgabe 1

a)

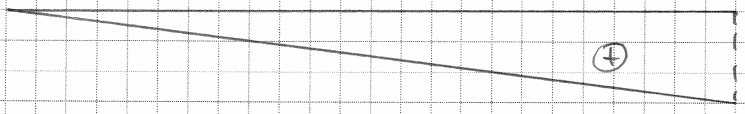


$[\alpha]$

b) $A_v^{\oplus}$ vertikal nach oben

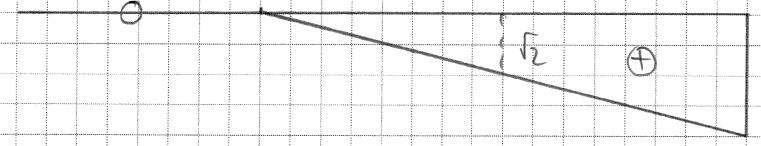
η_{A_v}

A_h^{+} horizontal nach links



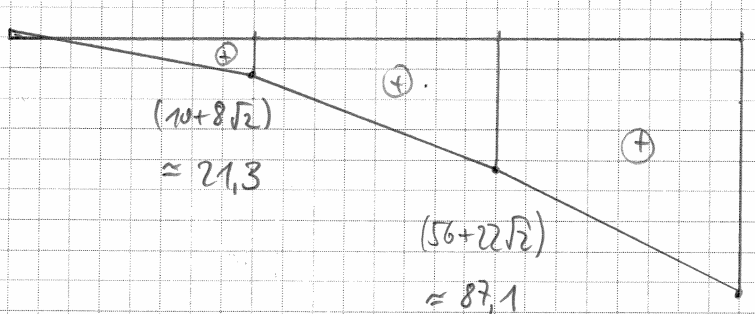
η_{A_h}

Zugkraft Stab BC



$\eta_{S_{BC}}$

c)

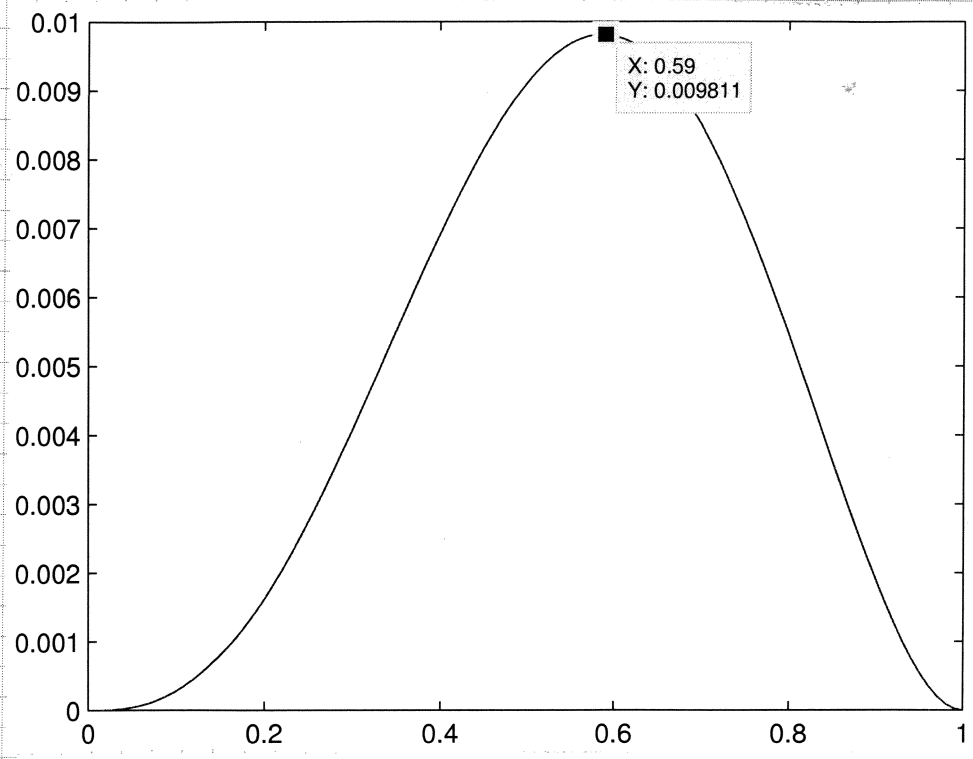


η_{WH} $\left[\frac{L}{EA}\right]$

Aufgabe 2

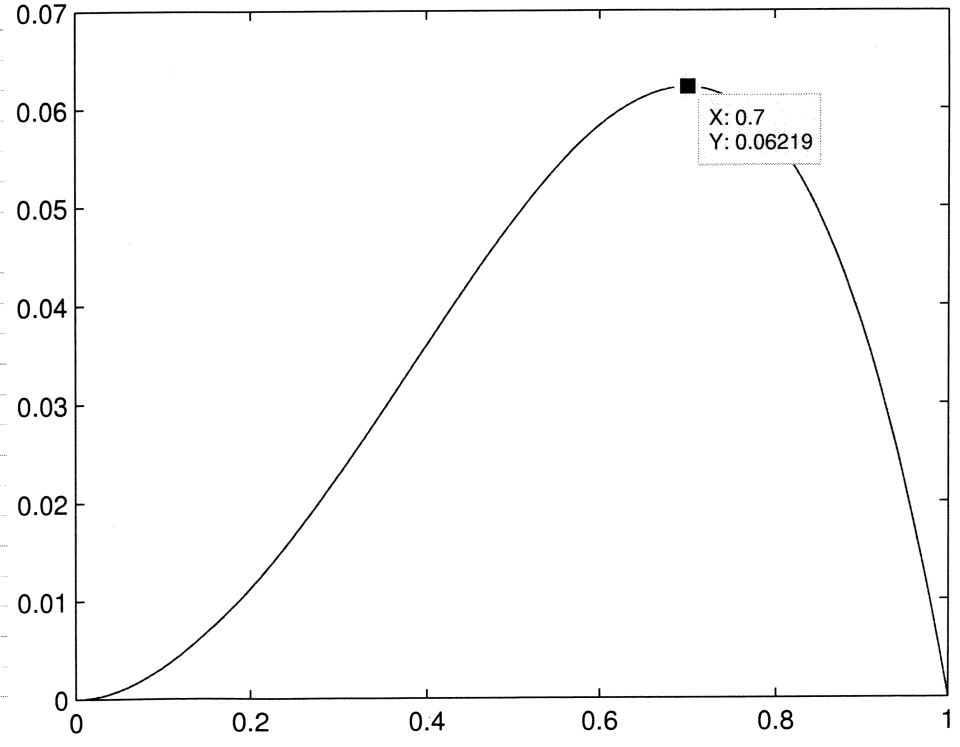
a) $$\frac{w\,EI}{Q\,L^3} = \frac{1}{12}\,\xi^3\,(4-\xi)(\xi-1)^2$$

b) $$\frac{\varphi_A\,EI}{Q\,L^2} = \frac{1}{6}\,\xi^2\,\frac{(4-\xi)}{(\xi-2)}\,(\xi-1)$$



$\frac{wEI}{QL^3}$

$\xi = x/l$

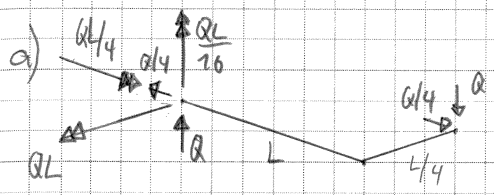


$\frac{\varphi_A EI}{QL^2}$

$\xi = \frac{x}{l}$

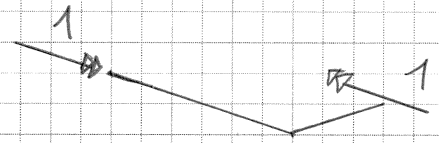
Aufgabe 3

a)

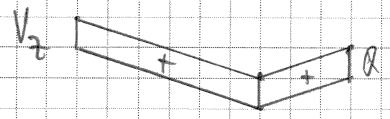


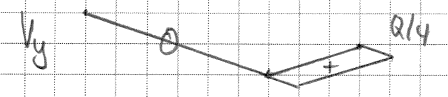
SKD

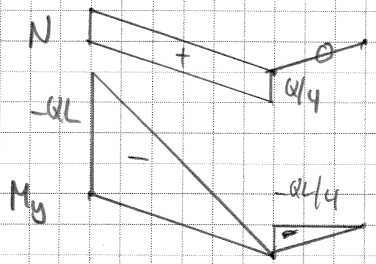
b)

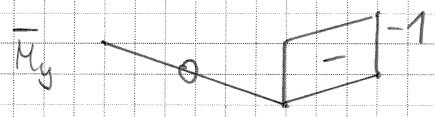


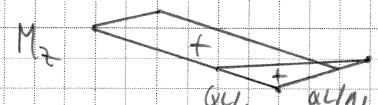
SKD

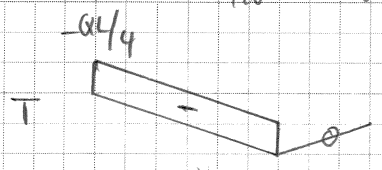


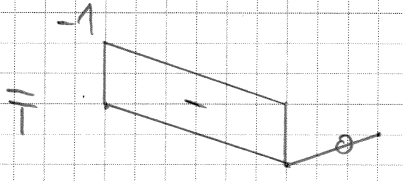












$$\varphi = \frac{QL^2}{32EI} + \frac{QL^2}{46K} \approx 1{,}72 \cdot 10^{-3}\ \text{rad} \triangleq 9{,}85 \cdot 10^{-2}\,^\circ$$

$E = 205'000\ N/mm^2$

$G = \frac{E}{2(1+\nu)} \approx 78'846\ N/mm^2$

$A = 15'600\ mm^2$

$A_0 = 152'100\ mm^2$

$I = 3{,}9572 \cdot 10^8\ mm^4$

$K = 5{,}9319 \cdot 10^8\ mm^4$

c) Schnittgrössen: $N = 75\ kN$

$V_y = 0$

$V_z = 300\ kN$

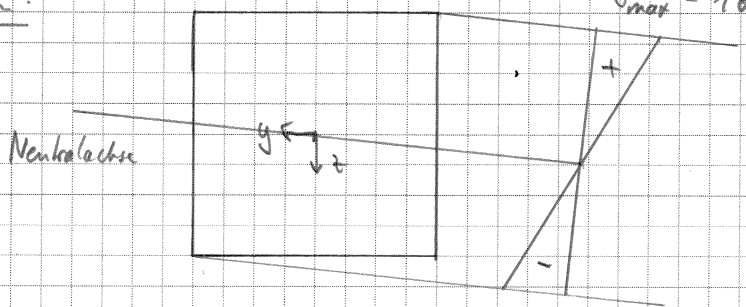
$M_y = -300\ kNm$

$M_z = 18{,}75\ kNm$

$T = -75\ kNm$

Querschnittswerte: siehe S. 3

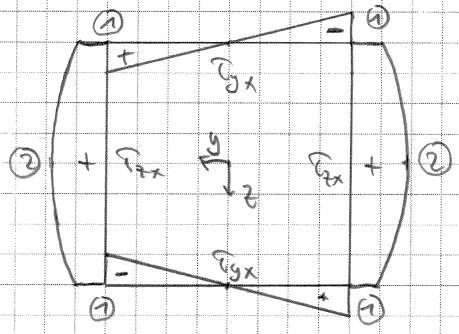
Normalspannungen:



$\sigma_{max} = 165{,}91\ N/mm^2$

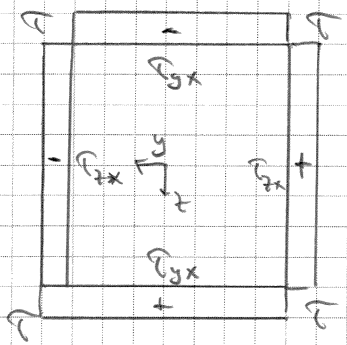
$\sigma_{min} = -156{,}29\ N/mm^2$

Schubspannungen:



① $\tau = 28{,}83\ N/mm^2$

② $\tau = 43{,}25\ N/mm^2$



$\tau = 24{,}65\ N/mm^2$

d) $\sigma_x = -4{,}93\ N/mm^2$, $\sigma_z = 0\ N/mm^2$, $\tau_{zx} = 18{,}60\ N/mm^2$

$\Rightarrow \sigma_1 = 16{,}52\ N/mm^2$, $\sigma_2 = -20{,}95\ N/mm^2$, $\varphi_1 = 48{,}39°$

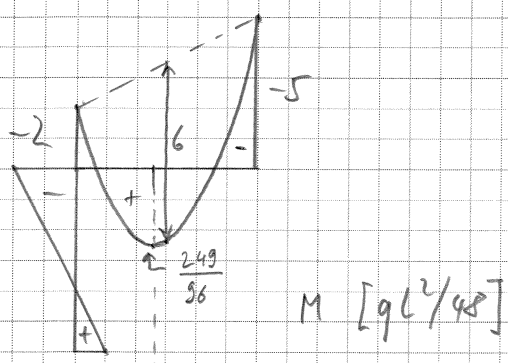
Aufgabe 4

Traglast: $Q_u = \frac{5 M_u}{2L}$

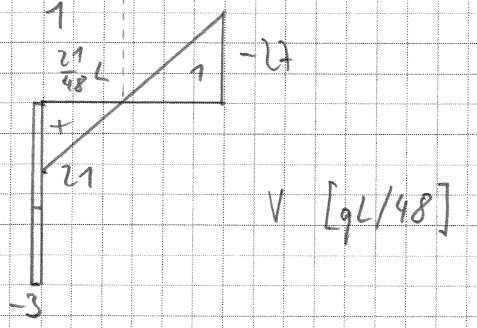
Aufgabe 5

a) $\varphi_2 = \frac{-qL^3}{48 EI} \cdot \frac{1+4k}{2+7k}$

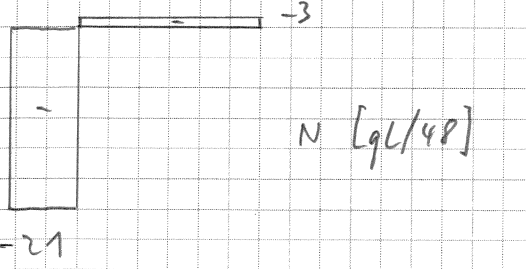
b) $k \to 0$: Einspannung bei Knoten 1 — $k \to \infty$: gelenkige Lagerung bei Knoten 1



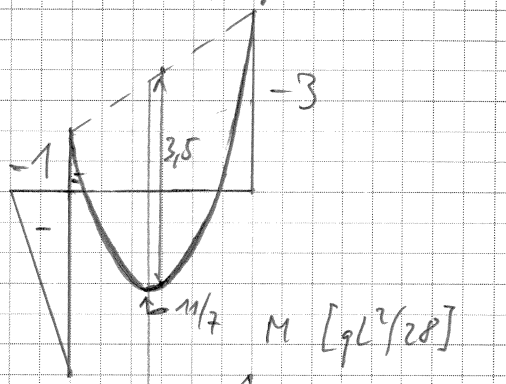
M [qL²/48]



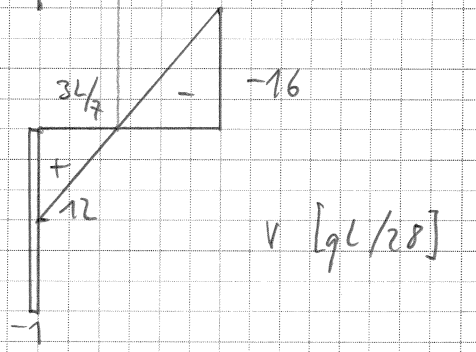
V [qL/48]



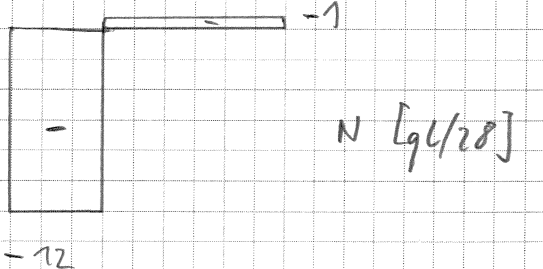
N [qL/48]



M [qL²/28]



V [qL/28]

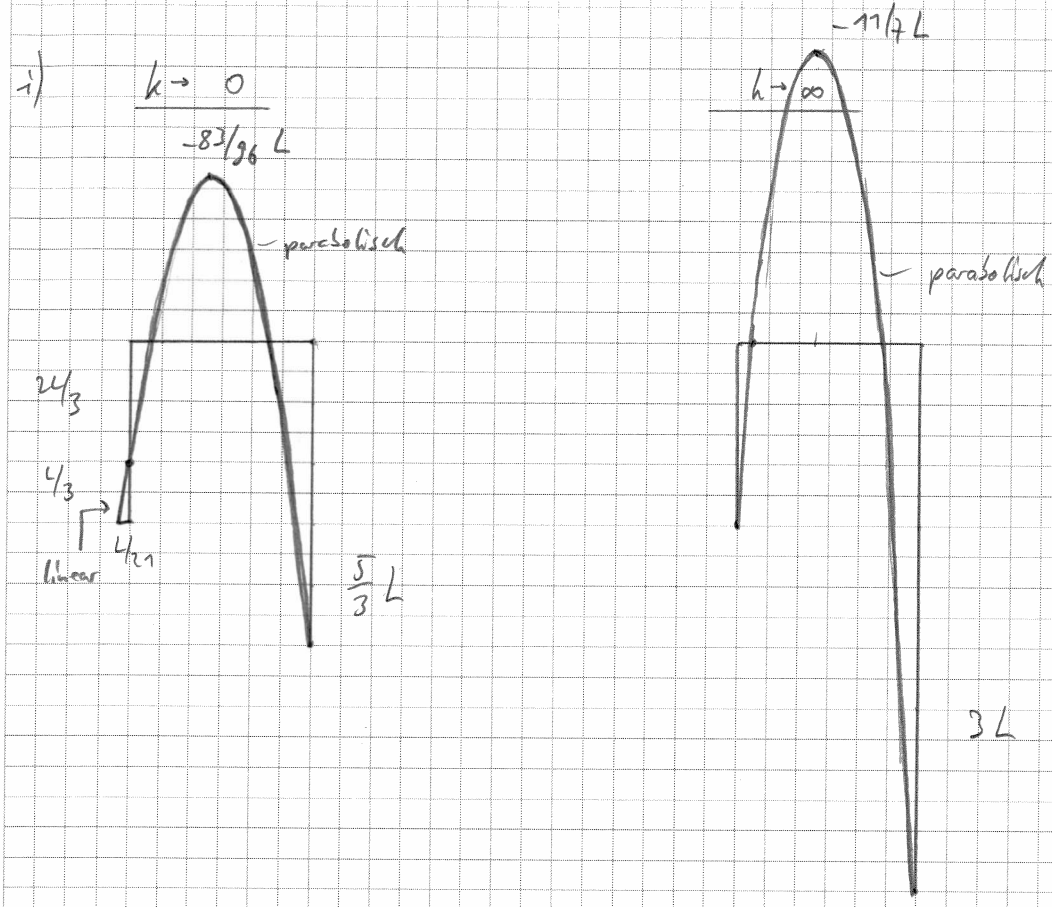


N [qL/28]

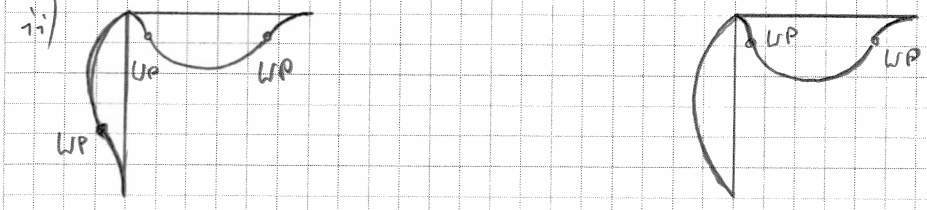
c) i) Stützlinie: $e = \frac{M}{N}$

ii) Stegeffekt: Wendepunkte bei Momentennullpunkten

i)



ii)



Aufgabe 6

a) Methode Mohr: $f_h = \frac{18\,EI_R}{43\,L^2} \approx 0{,}42\,\frac{EI_R}{L^2}$

b) $EI_S = \frac{81\,EI_R}{86\,\pi^2} \approx 0{,}095\,EI_R$