

Baustatik I

Musterlösung Probeklausur 1

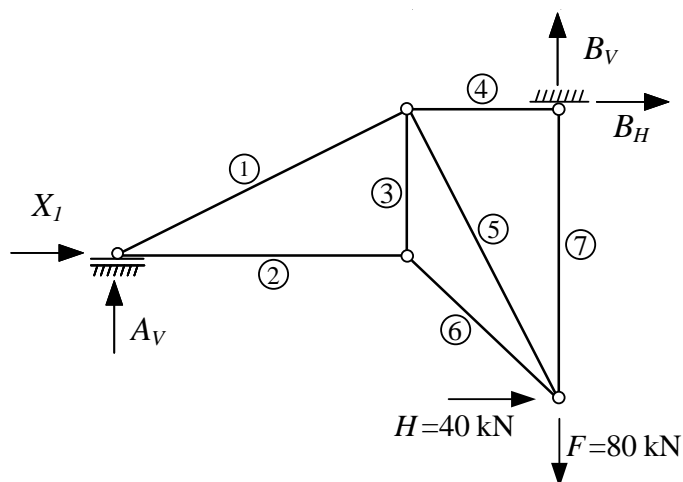
Aufgabe 1: Fachwerk

- a) Bestimmung des Grads der innerlichen und äußerlichen statischen Unbestimmtheit

$$a_a = 4 - 3 = 1$$

$$a_i = 18 - 3 \cdot (7 - 1) = 0$$

- b) Bestimmung der Stabkräfte Statisch bestimmtes Hauptsystem:



Nullzustand ($X_1 = 0$):

$$A_V = 26\frac{2}{3} \text{ kN}$$

$$B_H = -40 \text{ kN}$$

$$B_V = 53\frac{1}{3} \text{ kN}$$

Einheitszustand ($X_1 = 1$):

$$A_V = \frac{1}{3}$$

$$B_H = -1$$

$$B_V = -\frac{1}{3}$$

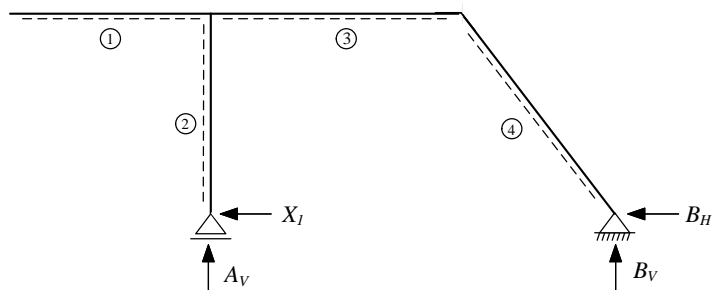
| | S_1 | S_2 | S_3 | S_4 | S_5 | S_6 | S_7 |
|-------------------------|--------|--------|--------|--------|--------|---------|--------|
| N_0 | -59,63 | 53,33 | 53,33 | -40,00 | -29,81 | 75,43 | 53,33 |
| N_1 | -0,745 | -0,333 | -0,333 | -1,000 | 0,745 | -0,471 | -0,333 |
| N_0 | 4,47 | 4,00 | 2,00 | 2,00 | 4,47 | 2,83 | 4,00 |
| $N_0 \cdot N_1 \cdot l$ | 198,57 | -70,4 | -35,55 | 80,00 | -99,27 | -100,47 | -71,11 |
| $N_1 \cdot N_1 \cdot l$ | 2,48 | 0,44 | 0,22 | 2 | 2,48 | 0,627 | 0,44 |
| N_{end} | -26,11 | 45,95 | 46,03 | -62,12 | -13,33 | 65,01 | 46,03 |

Aufgabe 2: Ebener Spannungszustand

a) Schnittgrößenverläufe

1) $a_{ges} = 4 - 3 = 1$

2) Statisch bestimmtes Hauptsystem:



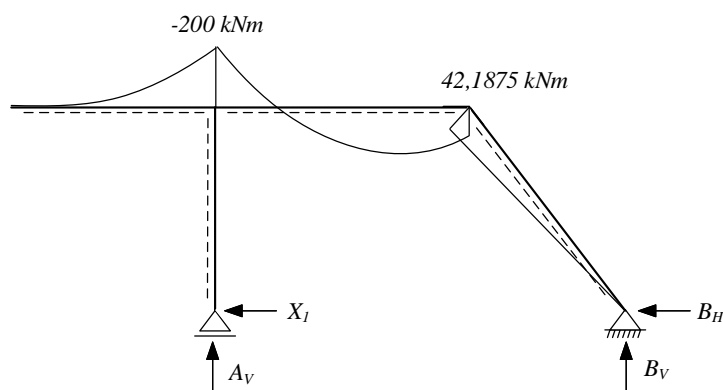
3) Nullzustand ($X_1 = 0$):

$$A_V = 210,9375 \text{ kN}$$

$$B_H = 0$$

$$B_V = 14,0625 \text{ kN}$$

M_0 [kNm]



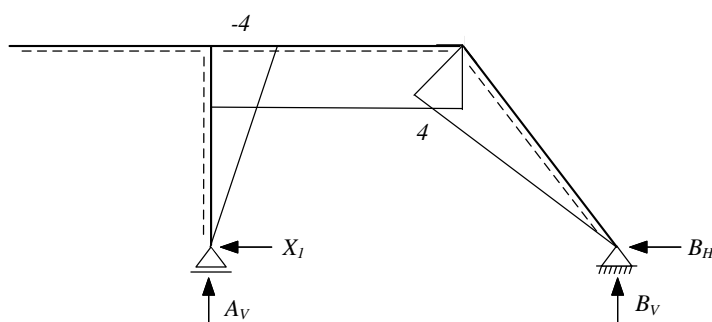
4) Einheitszustand ($X_1 = 1$):

$$A_V = 0$$

$$B_H = -1$$

$$B_V = 0$$

M_1



5) Flexibilitätszahlen

$$EI_c \cdot \delta_{10} = -822,28$$

$$EI_c \cdot \delta_{11} = 140,92$$

$$\Rightarrow X_1 = 5,835$$

6) Endzustand

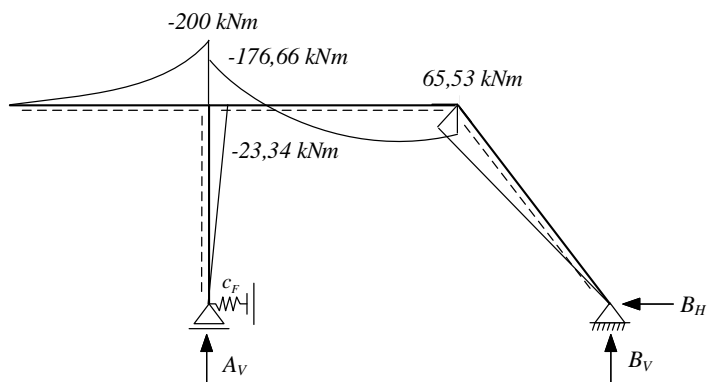
$$A_H = 5,835 \text{ kN}$$

$$A_V = 210,9375 \text{ kN}$$

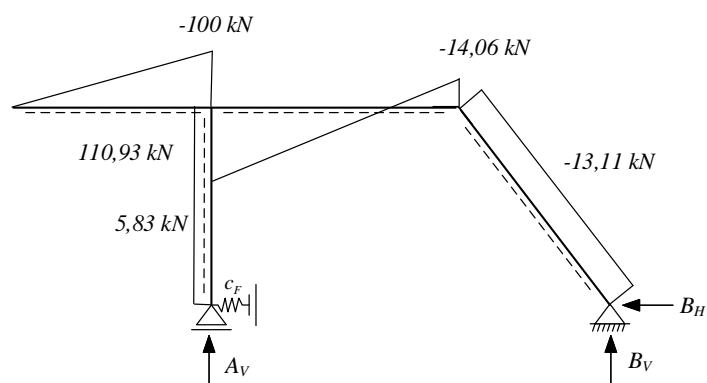
$$B_H = -5,835$$

$$B_V = 14,0625 \text{ kN}$$

$M_{end} [kNm]$

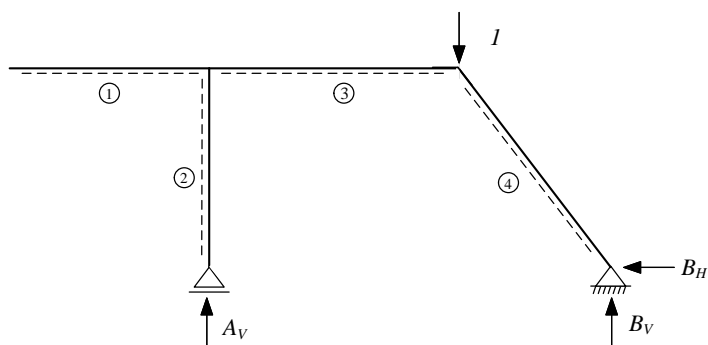


$Q_{end} [kN]$



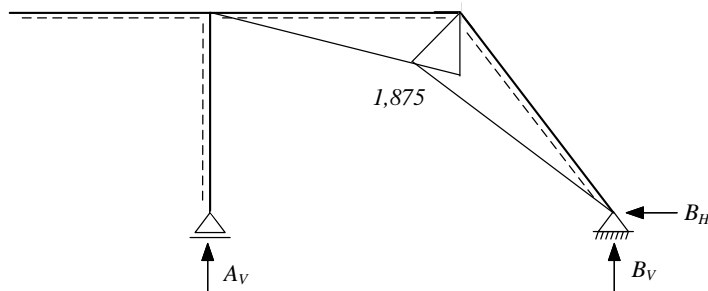
b) Absenkung w_m

1) Hauptsystem und Belastung



2) Schnittgrößenverlauf infolge $\bar{1}$ -Last

\bar{M}_0



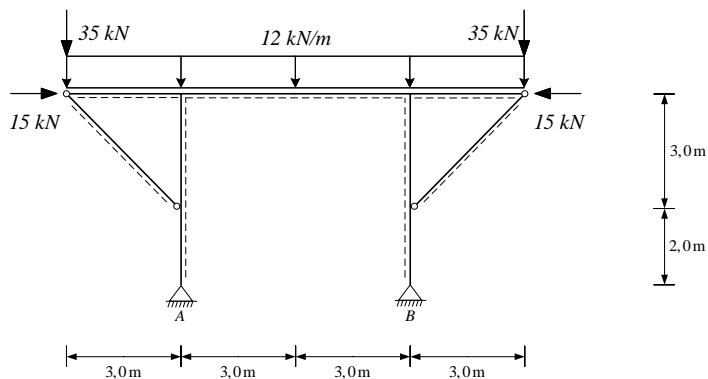
3) Lösung

$$\delta_v = 8,39 \text{ mm}$$

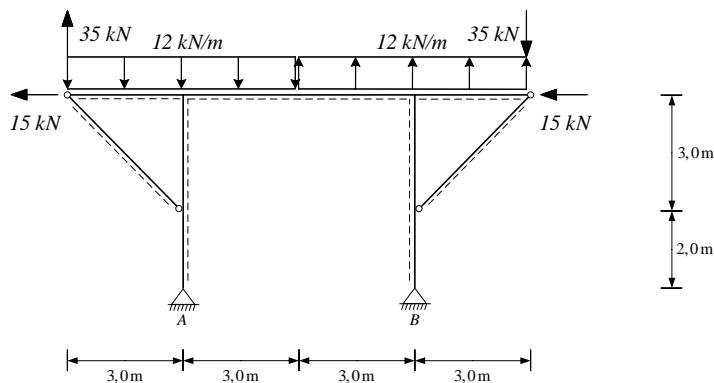
Aufgabe 3: Symmetrie / Antimetrie

a) Aufteilung in symmetrisches und antimetrisches System

1) Symmetrischer Lastfall

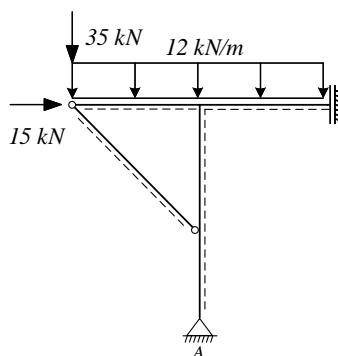


2) Antimetrischer Lastfall

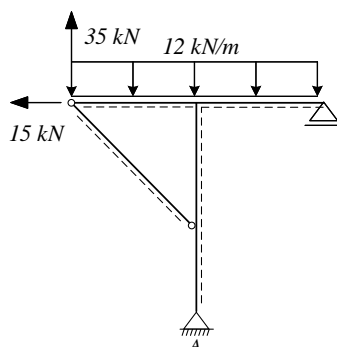


b) Ersatzsysteme

1) Symmetrisches Ersatzsystem



2) Antimetrisches Ersatzsystem



c) Statische Unbestimmtheit

$$a_{sym} = 4 + 4 - 2 \cdot 3 = 2$$

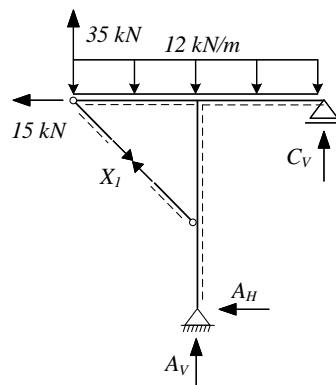
$$a_{anti} = 3 + 4 - 2 \cdot 3 = 1$$

$$a_{ges} = 4 + 8 - 3 \cdot 3 = 3$$

d) Antimetrischer Lastfall

$$1) a_{anti} = 1$$

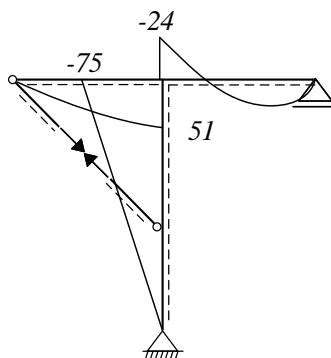
2) Statisch bestimmtes Hauptsystem

3) Nullzustand ($X_1 = 0$):

$$A_H = -15 \text{ kN}$$

$$A_V = 27 \text{ kN}$$

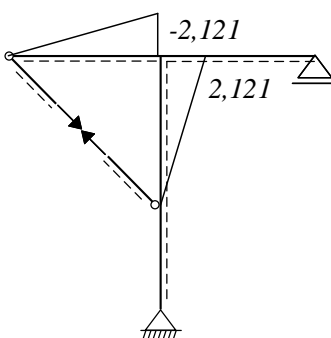
$$C_V = 10 \text{ kN}$$

M_0 [kNm]4) Einheitszustand ($X_1 = 1$):

$$A_H = 0$$

$$A_V = 0$$

$$C_V = 0$$

 M_1 

5) Flexibilitätszahlen

$$EI_c \cdot \delta_{10} = -327,695$$

$$EI_c \cdot \delta_{11} = 8,997$$

$$\Rightarrow X_1 = 36,423$$

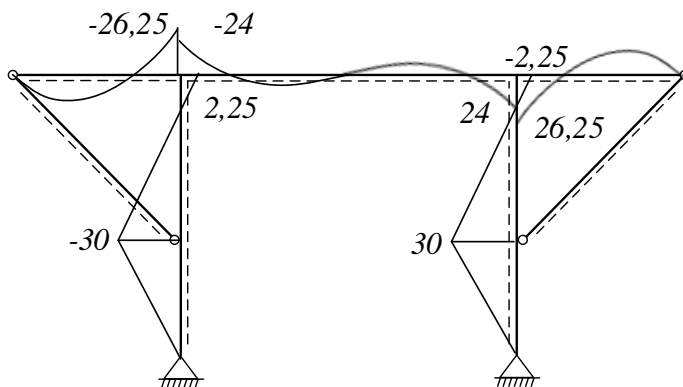
6) Endzustand

$$A_H = -15 \text{ kN}$$

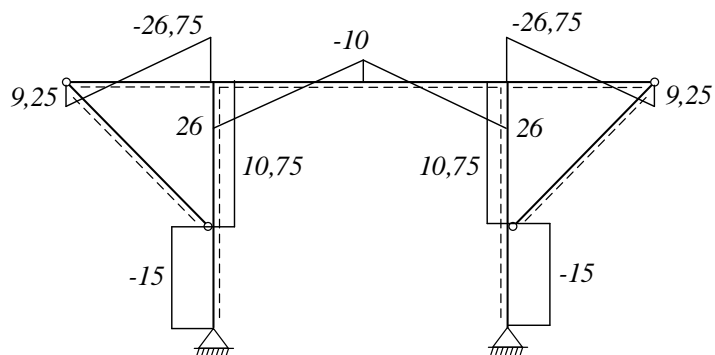
$$A_V = 27 \text{ kN}$$

$$C_V = 10 \text{ kN}$$

M_{end} [kNm]



Q_{end} [kN]

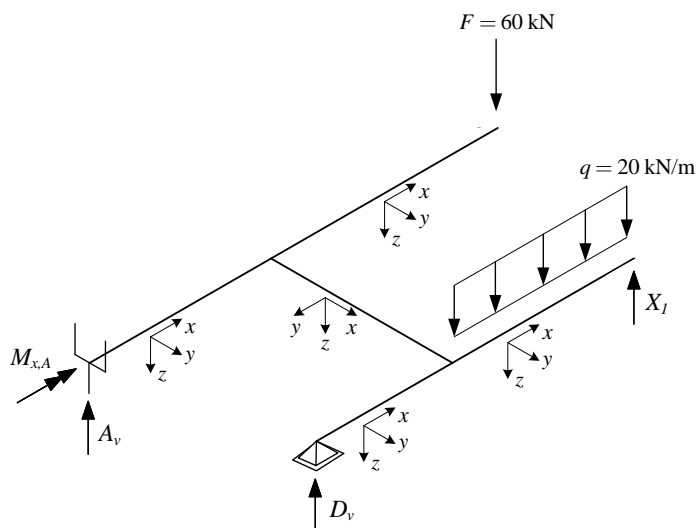


Aufgabe 4: Trägerrost

a) $a_{TR} = 2 + 2 - 1 \cdot 3 = 1$

b) Kraftgrößenverfahren

1) Statisch bestimmtes Hauptsystem



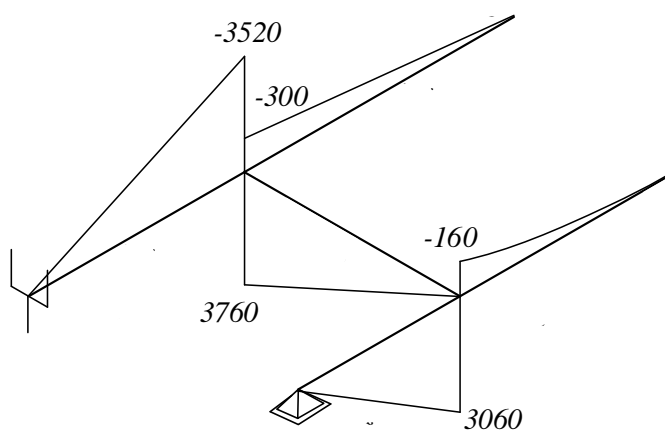
2) Nullzustand ($X_1 = 0$):

$$A_V = -880 \text{ kN}$$

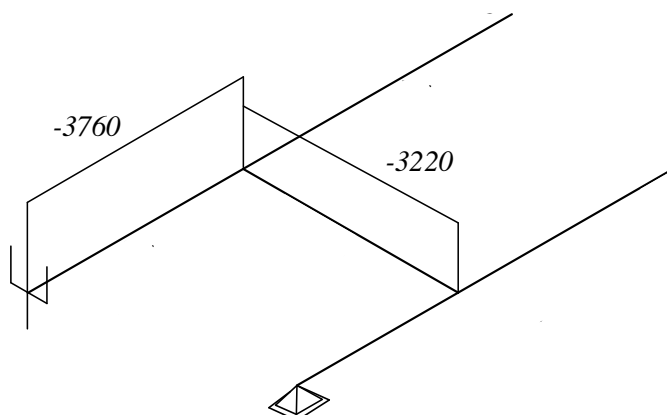
$$M_{x,A} = 3760 \text{ kNm}$$

$$D_V = 1020 \text{ kN}$$

$M_{y,0} \text{ [kNm]}$



$$M_{x,0} [kNm]$$



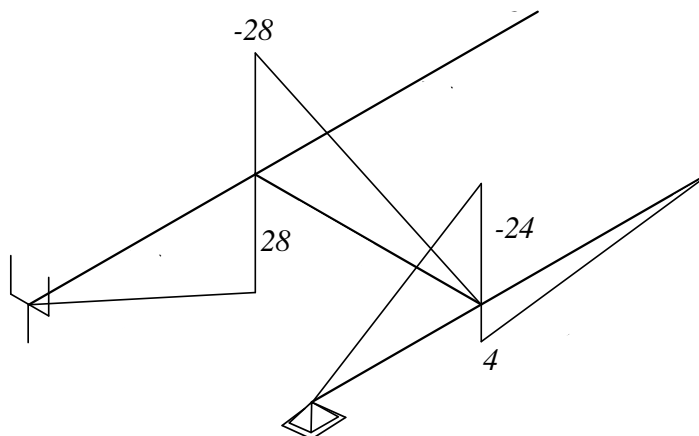
3) Einheitszustand ($X_1 = 1$):

$$A_V = 7$$

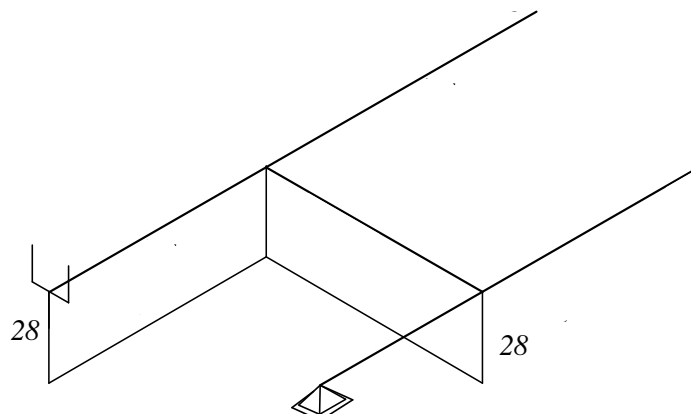
$$M_{x,A} = -28$$

$$D_V = -8$$

$$M_{y,1} [kNm]$$



$$M_{x,1} [kNm]$$



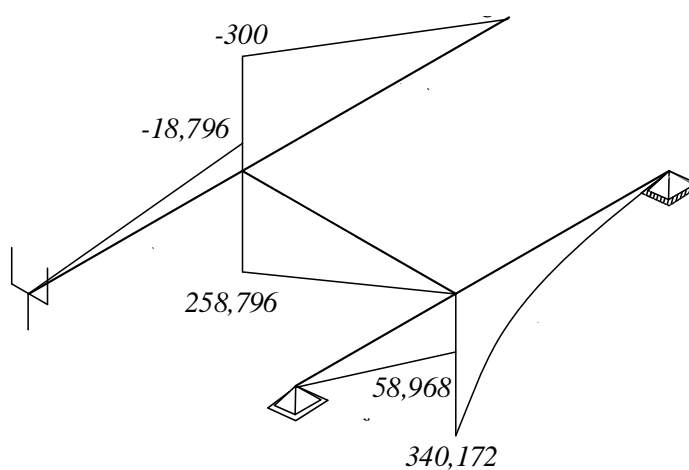
4) Flexibilitätszahlen

$$EI_c \cdot \delta_{10} = -3386913,067$$

$$EI_c \cdot \delta_{11} = 27086,08$$

$$\Rightarrow X_1 = 125,043$$

5) Endzustand

 $M_{y,end} [kNm]$  $M_{x,end} [kNm]$ 