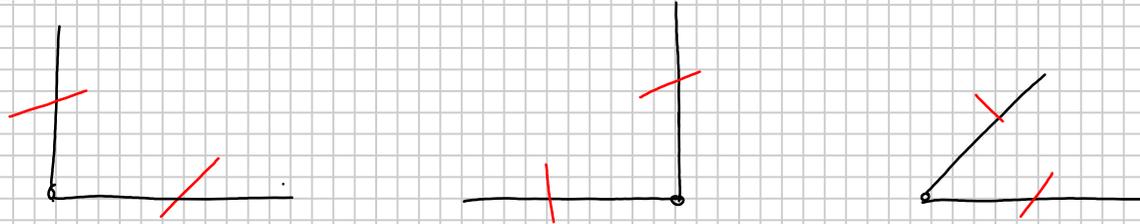


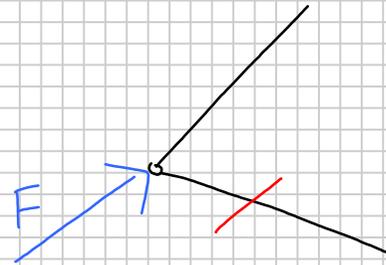
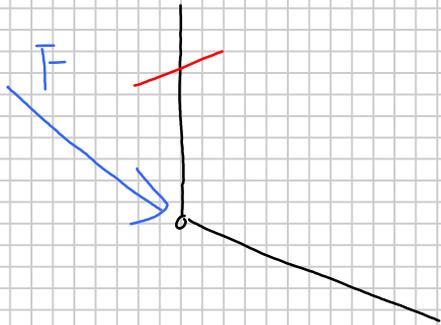
## Nullstäbe bestimmen

1. Regel:



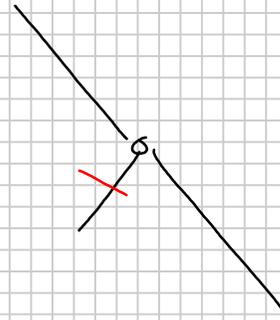
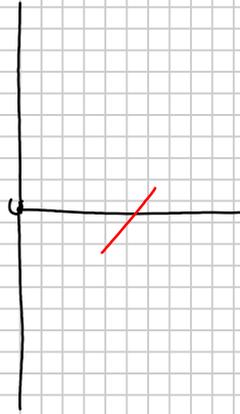
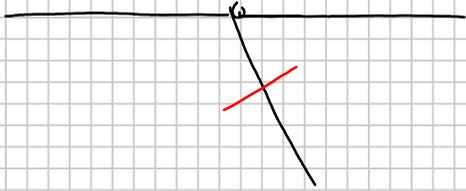
→ 2 Stäbe an unbelasteten Knoten zeigen in unterschiedliche Richtung: beides Nullstäbe

## 2. Regel:



→ 2 Stäbe am belasteten Knoten, Kraft  $F$  zeigt in Richtung des einen Stabes: der andere ist ein Nullstab

## 3. Regel



→ 3 Stäbe am unbelasteten Knoten, 2 in gleicher Richtung:  
Der andere ist ein Nullstab

Auflagerkräfte:

$$\rightarrow: -B_h - F \cdot \cos(45^\circ) = 0 \quad B_h = -14,14 \text{ kN}$$

$$\uparrow: A_v + B_v - F \cdot \sin(45^\circ) = 0$$

$$\odot(B): -A_v \cdot 3a + F \cdot \sin(45^\circ) \cdot a + F \cdot \cos(45^\circ) \cdot a = 0$$

$$A_v = \frac{F \cdot \sin(45^\circ) \cdot a + F \cdot \cos(45^\circ) \cdot a}{3a}$$

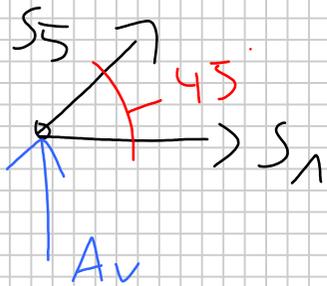
$$A_v = 9,42 \text{ kN}$$

$$B_v = -A_v + F \cdot \sin(45^\circ)$$

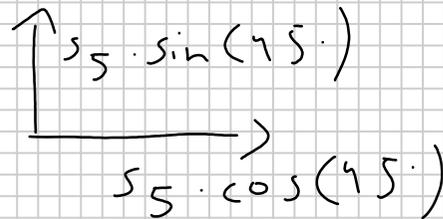
$$B_v = 4,72 \text{ kN}$$

## Knotenpunktverfahren:

I)



Kräftezerlegung:



$$\rightarrow: S_1 + S_5 \cdot \cos(45^\circ) = 0$$

$$\uparrow: A_v + S_5 \cdot \sin(45^\circ) = 0$$

$$S_5 = \frac{-A_v}{\sin(45^\circ)} = -13,32 \text{ kN}$$

$$\rightarrow: S_1 = -S_5 \cdot \cos(45^\circ) = 9,42 \text{ kN}$$

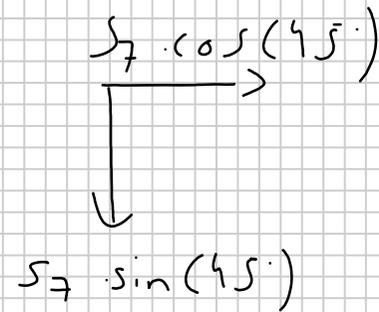
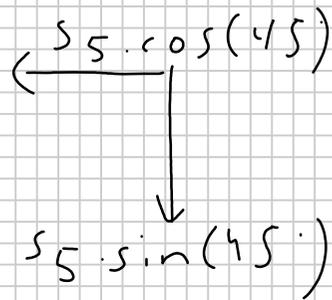
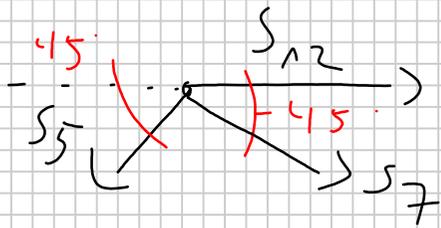
III)



$$\rightarrow: -S_1 + S_2 = 0$$

$$S_2 = S_1 = 9,42 \text{ kN}$$

VI)



$$\rightarrow: S_{12} - S_5 \cdot \cos(45^\circ) + S_7 \cdot \cos(45^\circ) = 0$$

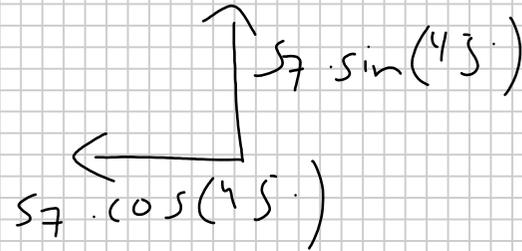
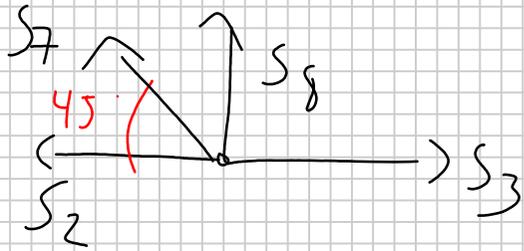
$$\uparrow: -S_5 \cdot \sin(45^\circ) - S_7 \cdot \sin(45^\circ) = 0$$

$$S_7 = \frac{-S_5 \cdot \sin(45^\circ)}{\sin(45^\circ)} = \underline{\underline{13,32 \text{ kN}}}$$

$$\rightarrow: S_{12} = S_5 \cdot \cos(45^\circ) - S_7 \cdot \cos(45^\circ)$$

$$\boxed{S_{12} = -18,84 \text{ kN}}$$

III)



$$\rightarrow: S_3 - S_2 - S_7 \cdot \cos(45^\circ) = 0$$

$$S_3 = +S_2 + S_7 \cdot \cos(45^\circ)$$

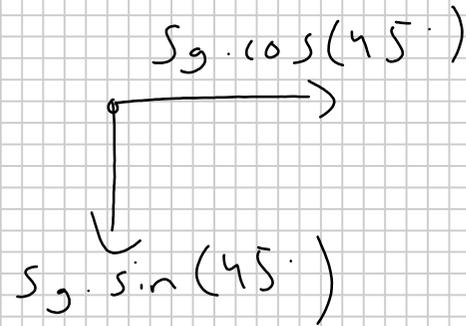
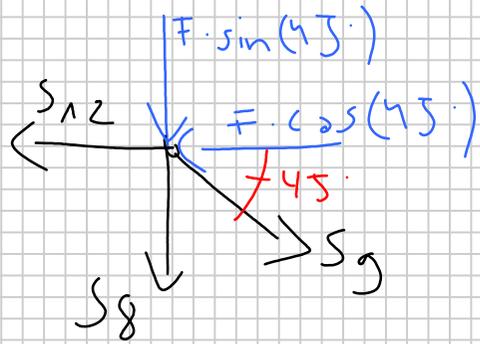
$$S_3 = 18,87 \text{ kN}$$

$$\uparrow: S_8 + S_7 \cdot \sin(45^\circ) = 0$$

$$S_8 = -S_7 \cdot \sin(45^\circ)$$

$$S_8 = -9,42 \text{ kN}$$

V)



$$\rightarrow: -S_{12} - F \cdot \cos(45^\circ) + S_g \cdot \cos(45^\circ) = 0$$

$$S_g = \frac{S_{12} + F \cdot \cos(45^\circ)}{\cos(45^\circ)}$$

$$S_g = -6,64 \text{ kN}$$

Stäbe	1	2	3	4	5	6	7	8	10	11	12	13
Kraft (kN)	9,42	9,42	18,84	0	-13,32	0	13,32	-9,42	0	0	-18,84	0

→ negativer Wert = Druckstäbe