Webinar: Elastostatik
Thema: Stabzweischlag

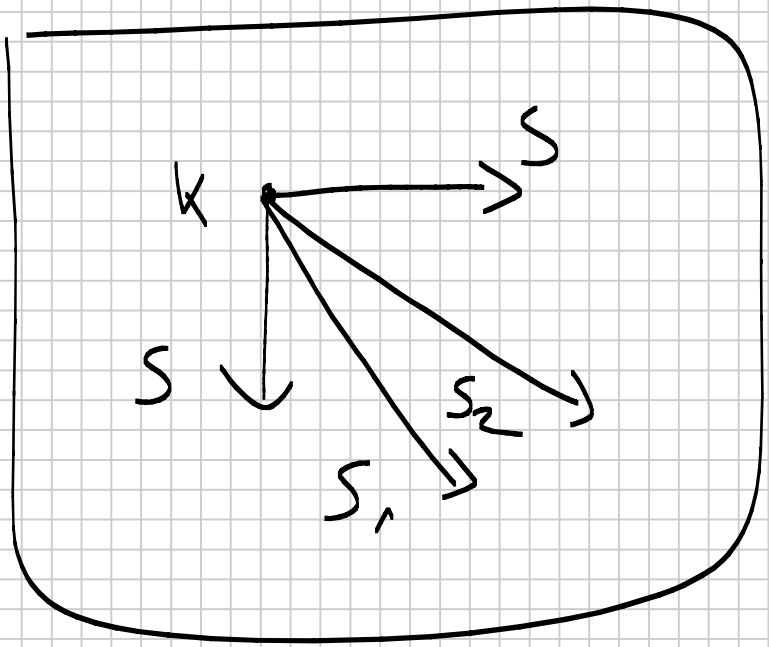
Notiztitel 14.06.2016

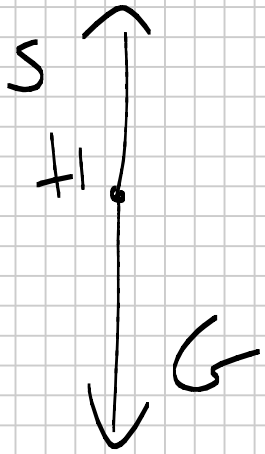
Vorgehensweise:

1. Stabkräfte ermitteln: Aus den Gleichgewichtsbedingungen am unverformten System werden die Stabkräfte ermittelt.

2. Längenänderung der Stäbe bestimmen

3. Bestimmung der Vertikal- und Horizontalverschiebung: Die Verschiebungen werden grafisch skizziert und dann berechnet (z.B. durch Trigonometrie)





$$\sum F_{iy} = 0$$

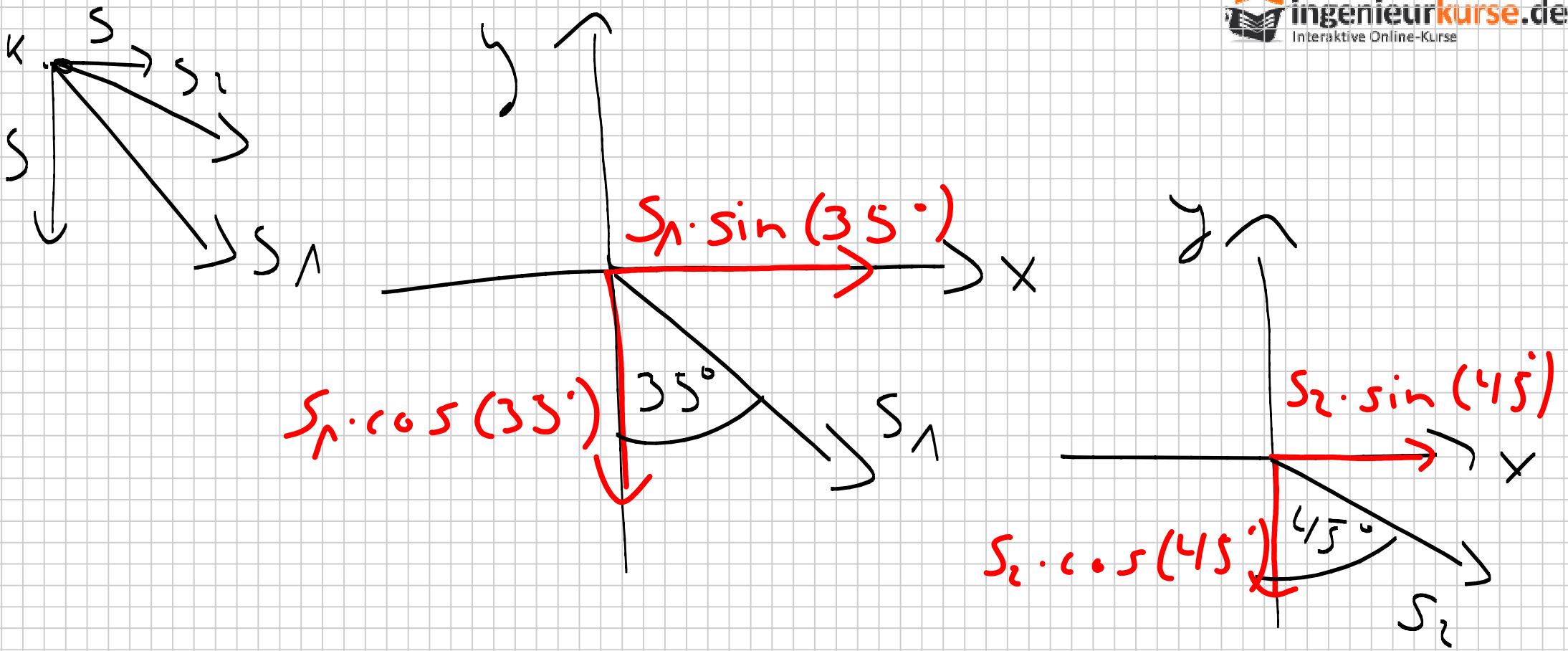
$$\uparrow: -G + S = 0$$

$$\boxed{S = G}$$

$$G = 150\,kg \cdot 9{,}81\,\frac{m}{s^2}$$

$$G = 1471{,}5\,N$$

$$S = 1471{,}5\,N$$



$$\rightarrow \sum F_{ix} = 0$$

$$\rightarrow: \; S + S_1 \cdot \sin(35°) + S_2 \cdot \sin(45°) = 0$$

$$S_1 = \frac{-S - S_2 \cdot \sin(45°)}{\sin(35°)}$$

$$\uparrow: -S - S_1 \cdot \cos(35°) - S_2 \cdot \cos(45°) = 0$$

$$S_1 = \frac{-S}{\cos(35°)} - \frac{S_2 \cdot \cos(45°)}{\cos(35°)}$$

$$\frac{-S}{\cos(35°)} - \left(\frac{S_2 \cdot \cos(45°)}{\cos(35°)}\right) = \left(\frac{-S}{\sin(35°)}\right) - \frac{S_2 \cdot \sin(45°)}{\sin(35°)}$$

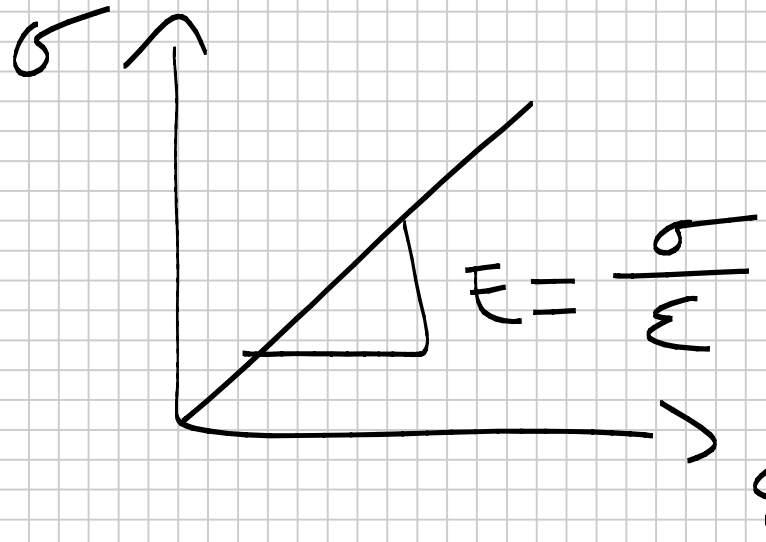
$$S_2 = \frac{\frac{-S}{\cos(35°)} + \frac{S}{\sin(35°)}}{\frac{\cos(45°)}{\cos(35°)} - \frac{\sin(45°)}{\sin(35°)}} \qquad S = 1.417{,}5\,N$$

$$\boxed{S_2 = -2.081{,}02\,N}$$

$$S_1 = \frac{-1.417{,}5\,N}{\sin(35°)} + \frac{2.081{,}02\,N \cdot \sin(45°)}{\sin(35°)}$$

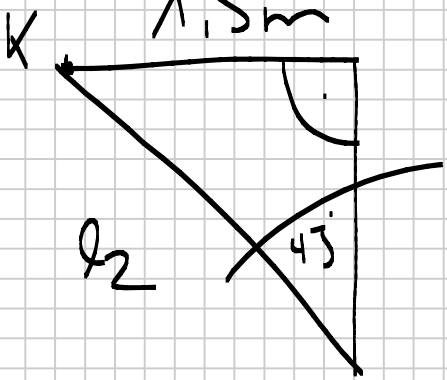
$$\boxed{S_1 = 0}$$

2)



$$\sigma = E \cdot \varepsilon \qquad \frac{F}{A} = E \cdot \frac{\Delta l}{l}$$

$$\Delta l = \frac{F \cdot l}{E A} \qquad \Delta l_2 = \frac{S_2 \cdot l_2}{E A}$$



$$\sin(45°) = \frac{1{,}5\,m}{l_2}$$

$$l_2 = \frac{1{,}5\,m}{\sin(45°)} = 2{,}12\,m$$

$$d = 5\,cm\,,\ r = 2{,}5\,cm\,,\ r = 0{,}025\,m$$

$$A = \pi \cdot r^2 = \pi \cdot (0{,}025\,m)^2 = 0{,}001963\,m^2$$

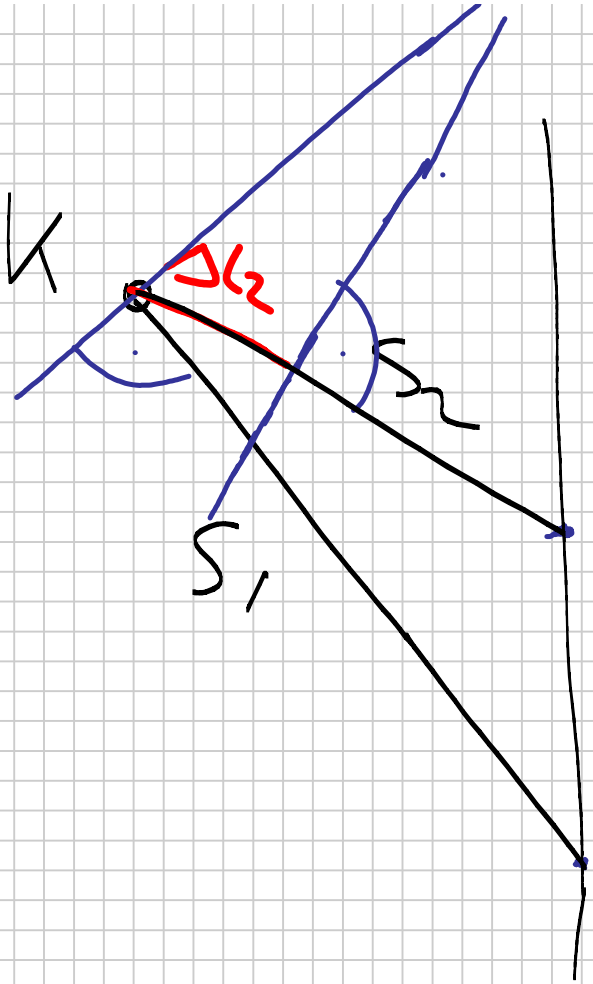
$$\frac{1\,kN}{mm^2} = \frac{1000\,N}{1 \cdot 10^{-6}\,m^2}$$

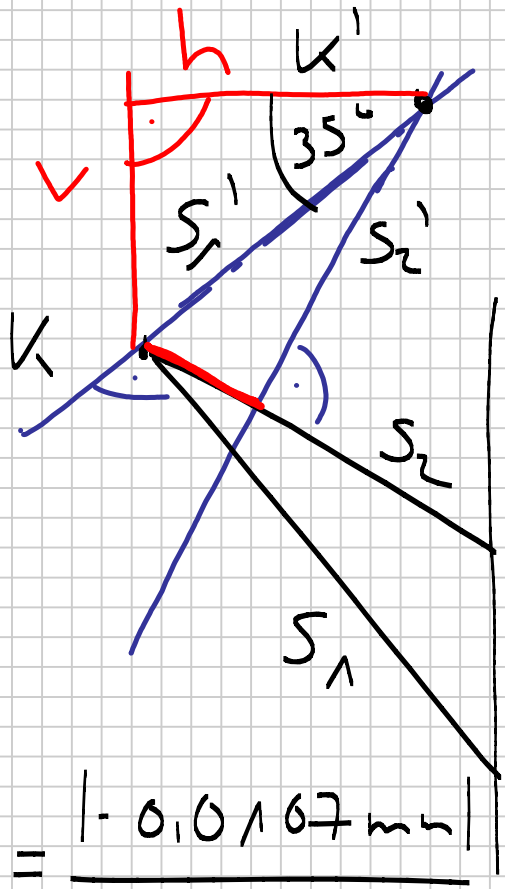
$$E = 210\,\frac{kN}{mm^2} \cdot \frac{1000\,N}{1 \cdot 10^{-6}\,m^2} = 2{,}1 \cdot 10^{11}\,\frac{N}{m^2}$$

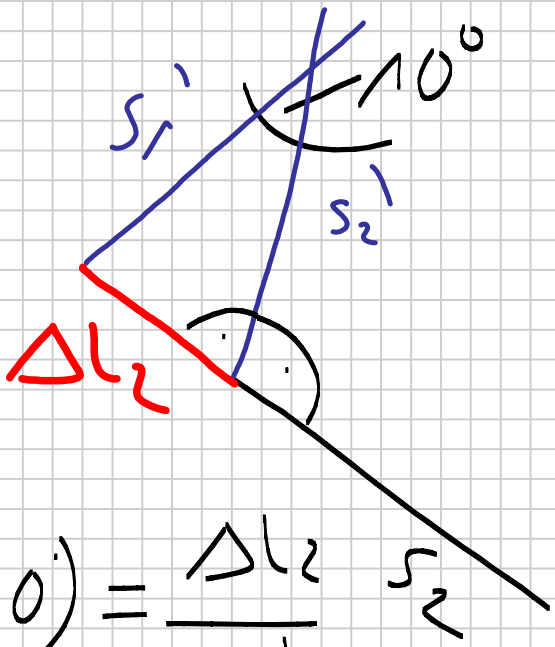
$$\Delta l_2 = \frac{S_2 \cdot l_2}{E \cdot A} = \frac{-2.058{,}102\,N \cdot 2{,}12\,m}{2{,}1 \cdot 10^{11}\,\frac{N}{m^2} \cdot 0{,}0061963\,m^2}$$

$$\Delta l_2 = -0{,}0107\,mm \qquad = -1{,}07 \cdot 10^{-5}\,m$$

3.

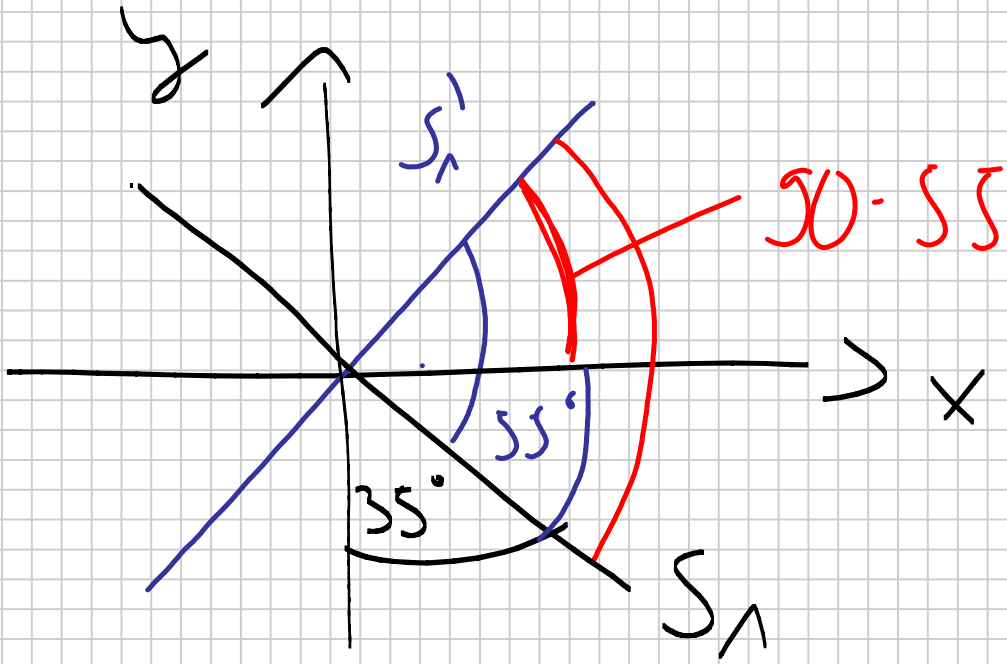




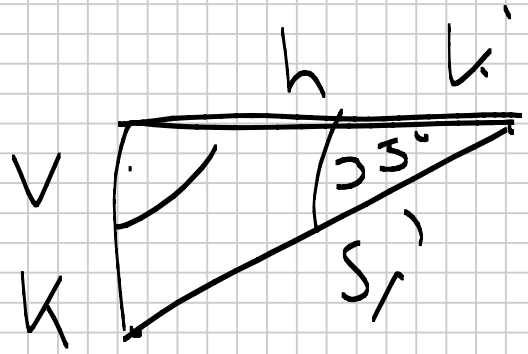


$$S_1' = \frac{\Delta L_2}{\sin(10^\circ)} = \frac{|-0{,}01807\,\text{mm}|}{\sin(10^\circ)} = 0{,}0616\,\text{mm}$$

$$\sin(10^\circ) = \frac{\Delta L_2}{S_1'}$$



$90° - 55° = 35°$



$$\sin(35°) = \frac{V}{s_1'}$$

$$V = s_1' \cdot \sin(35°) = 0{,}06616\,mm \cdot \sin(35°)$$

$$= 0{,}03793\,mm$$

$$\cos(35°) = \frac{u}{s_1'}$$

$$u = s_1' \cdot \cos(35°) = 0{,}0616\,mm \cdot \cos(35°)$$

$$u = 0{,}0505\,mm$$