

### Kräftebilanzen

$$\rightarrow F_{NA} - F_{RB} = 0 \qquad \uparrow F_{RA} - F + F_{NB} = 0$$

### Momentenbilanz (bzgl. B)

$$\frac{h}{\tan \alpha} F - F_{NA} L \sin \alpha - F_{RA} L \cos \alpha = 0$$

### Coulomb-Reibung

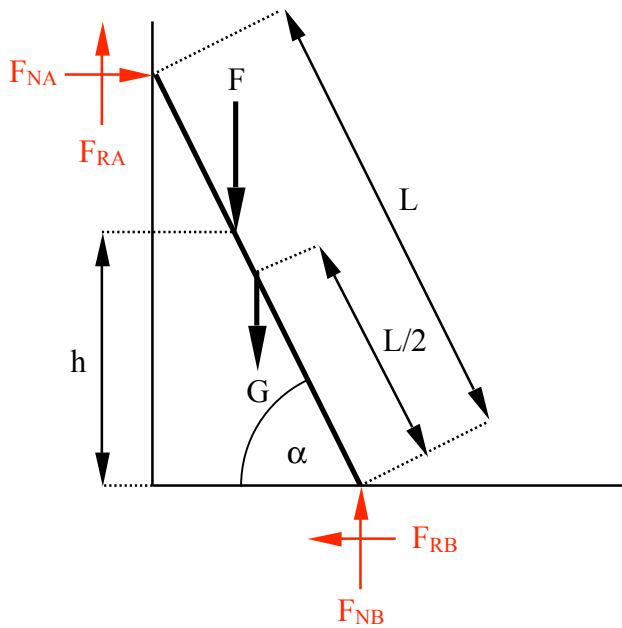
$$F_{RA} = \mu_A F_{NA} \qquad F_{RB} = \mu_B F_{NB}$$

### Zusammenfassung der Bilanzen in einem linearen Gleichungssystem

$$\begin{pmatrix} 1 & 0 & 0 & -1 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ -\sin \alpha & -\cos \alpha & 0 & 0 & \frac{F}{L \tan \alpha} \\ \mu_A & -1 & 0 & 0 & 0 \\ 0 & 0 & \mu_B & -1 & 0 \end{pmatrix} \begin{pmatrix} F_{NA} \\ F_{RA} \\ F_{NB} \\ F_{RB} \\ h \end{pmatrix} = \begin{pmatrix} 0 \\ F \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} F_{NA} \\ F_{RA} \\ F_{NB} \\ F_{RB} \\ \frac{h}{L \sin \alpha} \end{pmatrix} = \frac{\mu_B F}{\mu_A \mu_B + 1} \begin{pmatrix} 1 \\ \mu_A \\ 1 / \mu_B \\ 1 \\ \frac{\tan \alpha + \mu_A}{F} \end{pmatrix}$$

## Berücksichtigung des Eigengewichts der Leiter



$$\begin{pmatrix} 1 & 0 & 0 & -1 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ -\sin \alpha & -\cos \alpha & 0 & 0 & \frac{F}{L \tan \alpha} \\ \mu_A & -1 & 0 & 0 & 0 \\ 0 & 0 & \mu_B & -1 & 0 \end{pmatrix} \begin{pmatrix} F_{NA} \\ F_{RA} \\ F_{NB} \\ F_{RB} \\ h \end{pmatrix} = \begin{pmatrix} 0 \\ F+G \\ -\frac{G}{2} \cos \alpha \\ 0 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} F_{NA} \\ F_{RA} \\ F_{NB} \\ F_{RB} \\ \frac{h}{L \sin \alpha} \end{pmatrix} = \frac{\mu_B (F+G)}{\mu_A \mu_B + 1} \begin{pmatrix} 1 \\ \mu_A \\ 1/\mu_B \\ 1 \\ \frac{\tan \alpha + \mu_A}{F} \end{pmatrix} - \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ \frac{G}{2F} \end{pmatrix}$$