

HSLU Hochschule Luzern

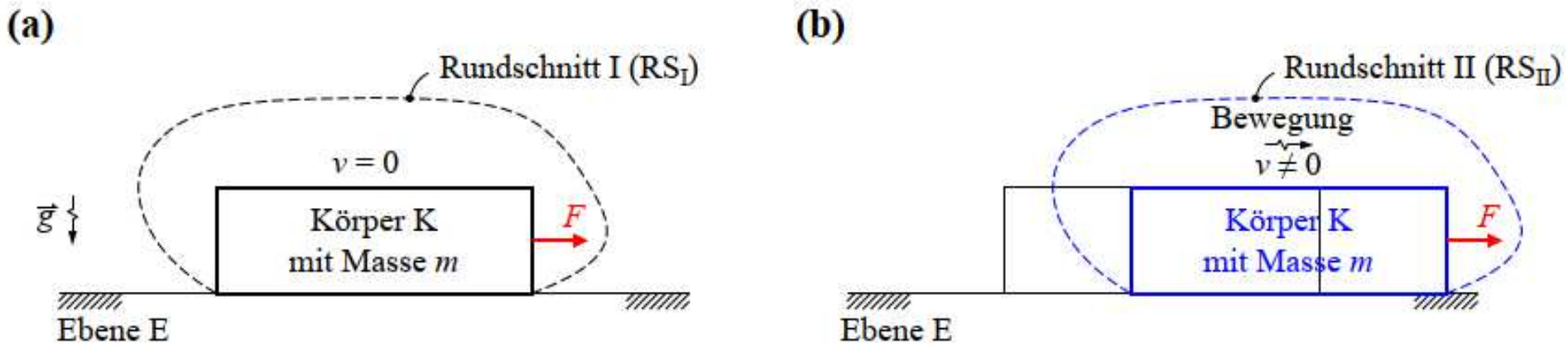
Herbstsemester 2026

Baustatik 1
Reibung

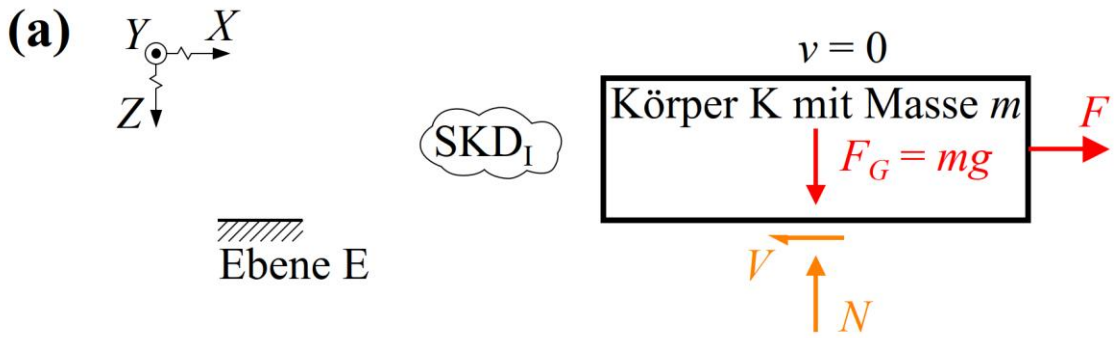
Dr. Stephan Gollob

$F \leq V_{max}$

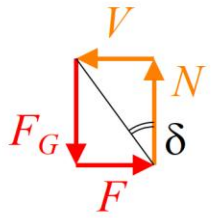
$F > V_{max}$



Haftung (Reibung der Ruhe)



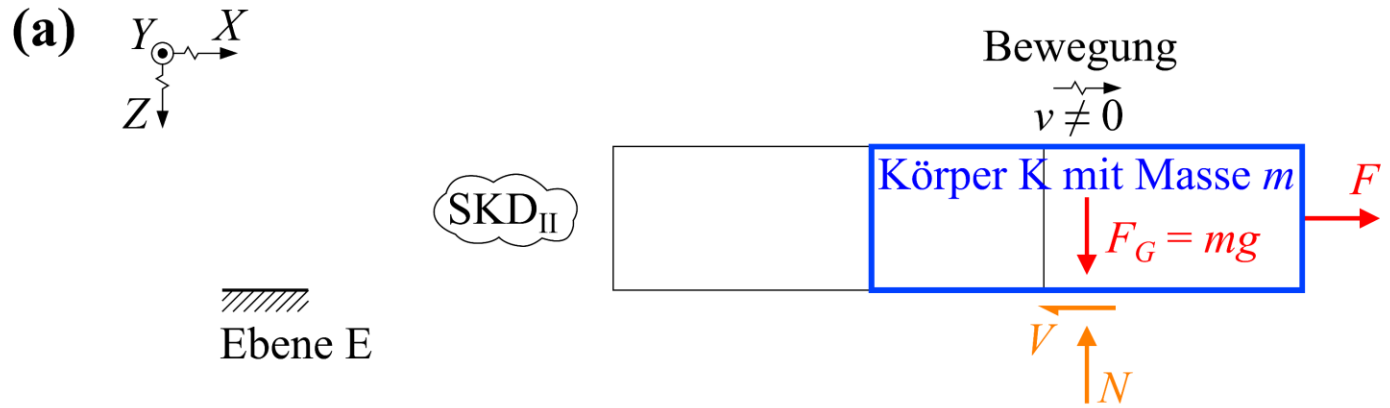
(b) $F = V_{max}$



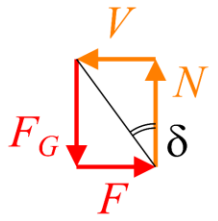
$$V_{H\,max} = \mu_H \cdot N = \tan(\delta) \cdot N$$

Materialien in Kontakt-fläche	Haftreibungs-koeffizient μ_H
Stahl - Stahl	0.15 . . . 0.20
Holz - Metall	0.50 . . . 0.65
Holz - Holz	0.40 . . . 0.65
Stahl - Eis	0.03
Stahl - Teflon	0.06
Lockergestein - Locker-gestein	
Lockergestein - glatte Betonoberfläche	
Fugen in Beton	
Mauerwerk Lagerfugen	

Haftung (Reibung der Bewegung)



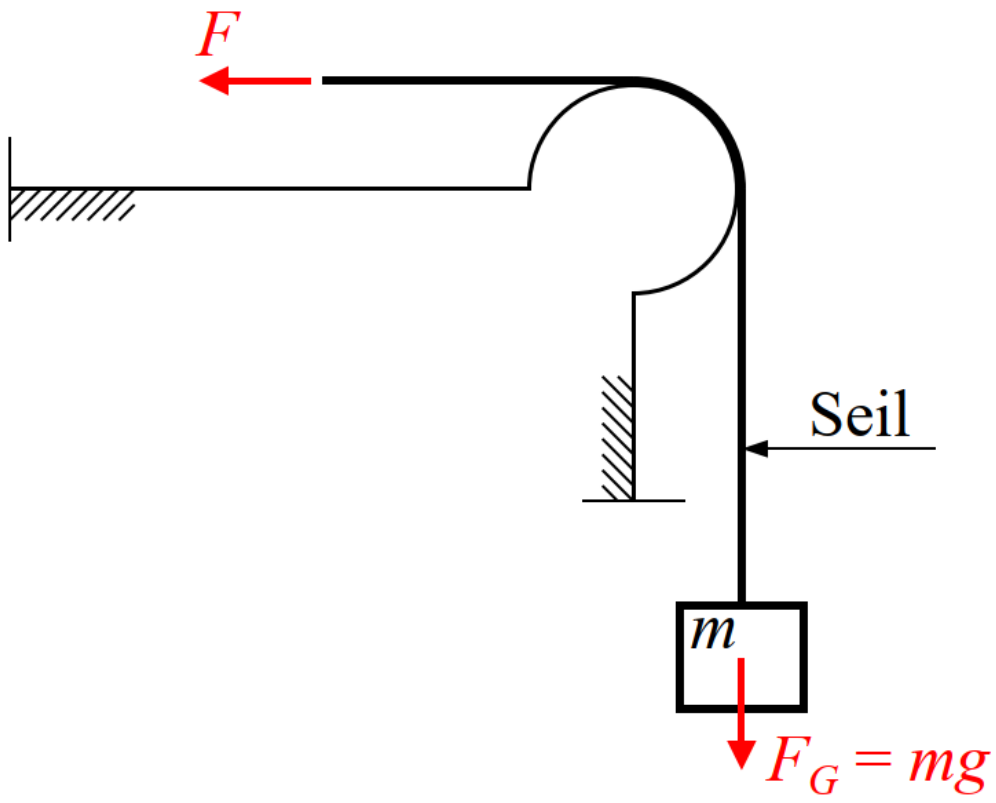
(b) $F > V_{max}$



$$F = V_{G\,max} = \mu_G \cdot N \leq V_{H\,max} = \mu_H \cdot N$$

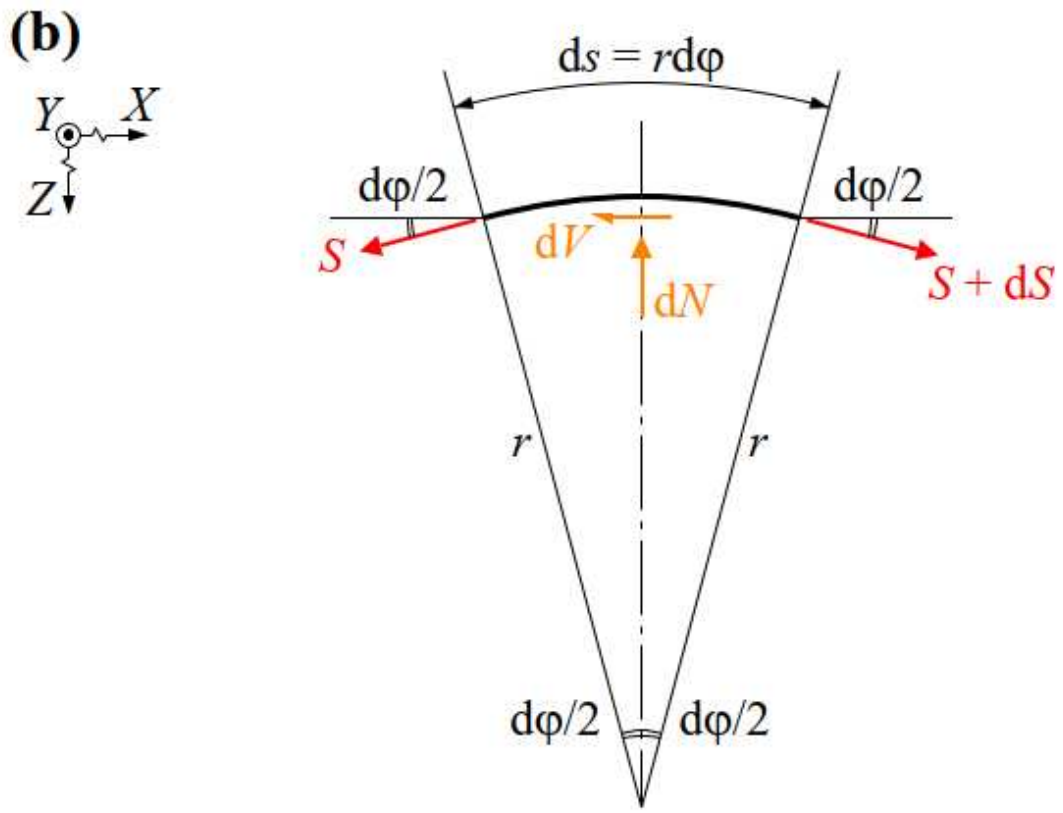
Materialien in Kontaktfläche	Haftreibungskoeffizient μ_H	Gleitreibungskoeffizient μ_G
Stahl - Stahl	0.15 ... 0.20	0.10 ... 0.15
Holz - Metall	0.50 ... 0.65	0.20 ... 0.50
Holz - Holz	0.40 ... 0.65	0.20 ... 0.40
Stahl - Eis	0.03	0.015
Stahl - Teflon	0.06	0.04
Lockergestein - Lockergestein		$\tan(\delta) = \tan(\varphi) \approx 0.58$
Lockergestein - glatte Betonoberfläche		$\tan(\delta) = \tan(1/2\varphi) \ldots \tan(2/3\varphi) \approx 0.26 \ldots 0.36$
Fugen in Beton		0.5 ... 0.9
Mauerwerk Lagerfugen		0.6

Seilreibung



$$F < F_G$$

Seilreibung



$$\sum_{SKD_I}^{\rightarrow +}$$

$$F_X = 0 = -\mathrm{d}V + (S + \mathrm{d}S) \cdot \cos\left(\frac{\mathrm{d}\varphi}{2}\right) - S \cdot \cos\left(\frac{\mathrm{d}\varphi}{2}\right)$$

$$\mathrm{d}V = \mathrm{d}S = \mu_H \mathrm{d}N$$

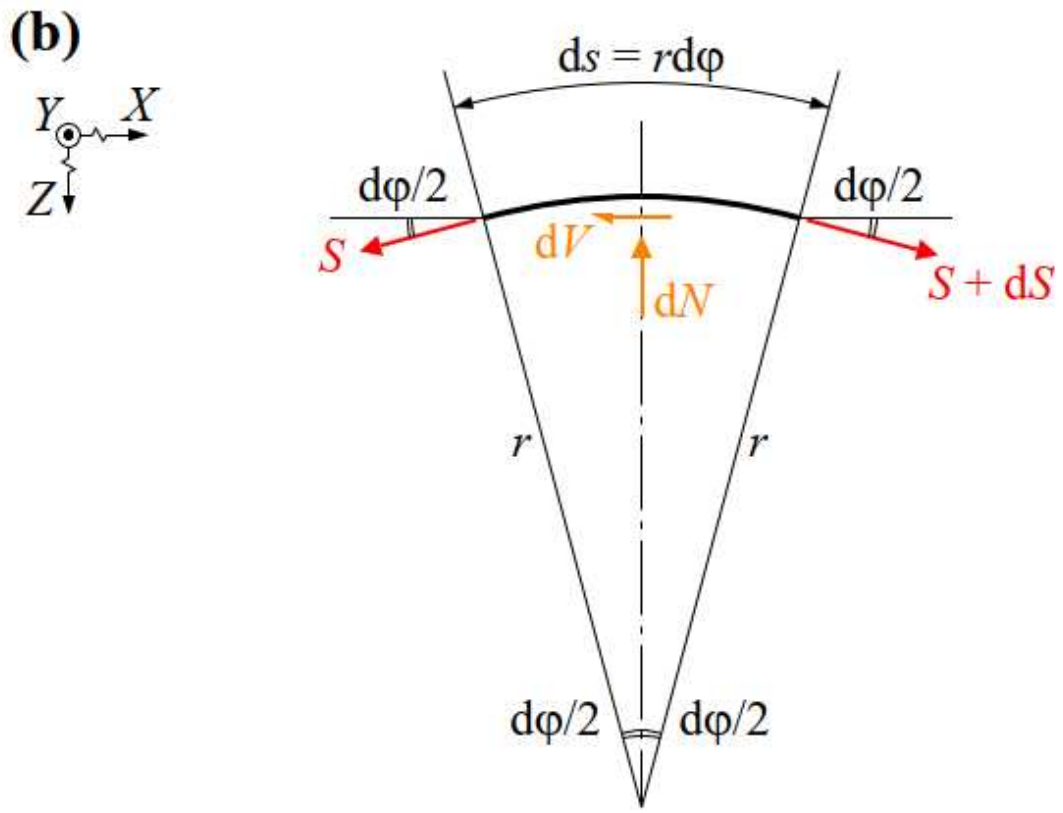
$$\sum_{SKD_I}^{\downarrow +}$$

$$F_Z = 0 = -\mathrm{d}N + (S + \mathrm{d}S) \cdot \sin\left(\frac{\mathrm{d}\varphi}{2}\right) + S \cdot \sin\left(\frac{\mathrm{d}\varphi}{2}\right)$$

$$0 = -\mathrm{d}N + 2S\frac{\mathrm{d}\varphi}{2} + dS\frac{\mathrm{d}\varphi}{2}$$

$$\mathrm{d}N = S\mathrm{d}\varphi = \frac{\mathrm{d}S}{\mu_H}$$

Seilreibung



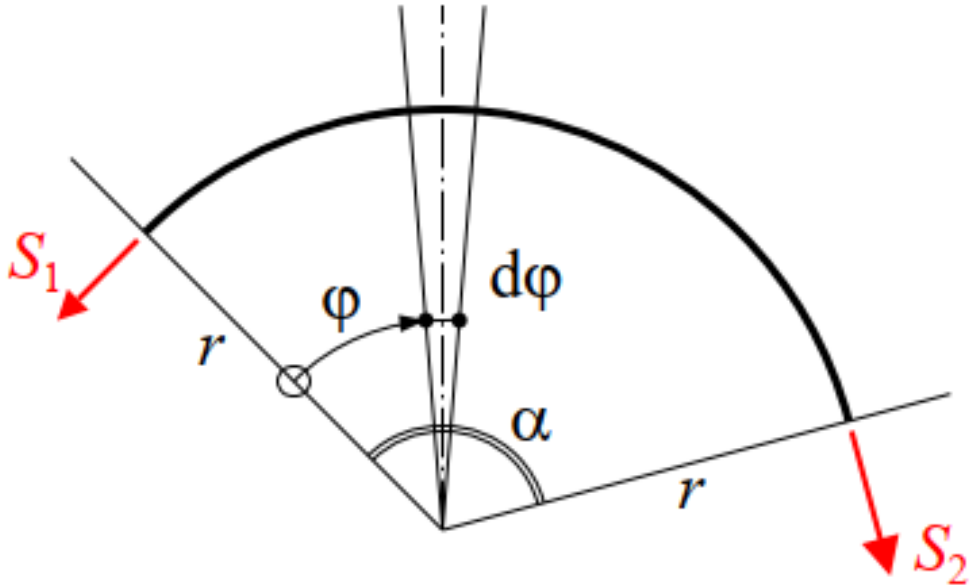
$$dV = dS = \mu_H dN$$

$$dN = S d\varphi = \frac{dS}{\mu_H}$$

$$\frac{dS}{S} = \frac{1}{S} dS = \mu_H d_\varphi$$

Seilreibung

$$S_2 = S_1 e^{\alpha \mu_H}$$



$$\mathrm{d}V = \mathrm{d}S = \mu_H \mathrm{d}N$$

$$\mathrm{d}N = S\mathrm{d}\varphi = \frac{\mathrm{d}S}{\mu_H}$$

$$\frac{\mathrm{d}S}{S} = \frac{1}{S}\mathrm{d}S = \mu_H \mathrm{d}_\varphi$$

$$\int_{S_1}^{S} \frac{1}{S}\mathrm{d}S = \mu_H \int_0^{\varphi} \mathrm{d}_\varphi$$

$$\ln\frac{S}{S_1} = \mu_H \varphi$$

$$S(\varphi) = S_1 e^{\varphi \mu_H}$$

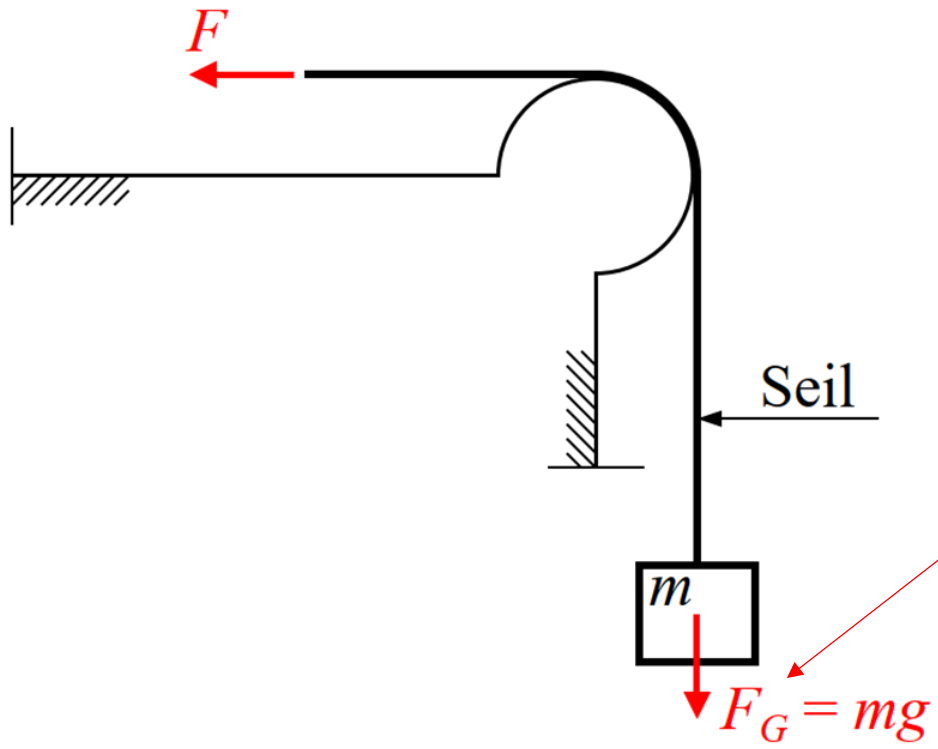
Seilreibung

$$F > F_G$$

$S_1 = S_2 e^{\alpha \mu_H}$

$S_2 = S_1 e^{-\alpha \mu_H}$

$S_1 e^{-\alpha \mu_H} \leq S_2 \leq S_1 e^{\alpha \mu_H}$



Kesselformel

$$\mathrm{d}N = q_n \,\mathrm{d}s = q_n r \,\mathrm{d}\varphi = S \,\mathrm{d}\varphi \qquad \mu_H \to 0$$

$$\int_0^{\pi} q_n r \,\mathrm{d}\varphi = \int_0^{\pi} S \,\mathrm{d}\varphi$$

$$S = r q_n$$

