Berechnung Kräfte Dreirad

Montag, 28. Dezember 2020   16:17

1. Lastfall : voller Pedaltritt
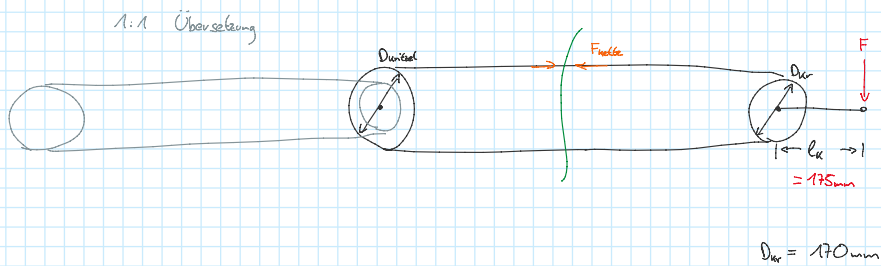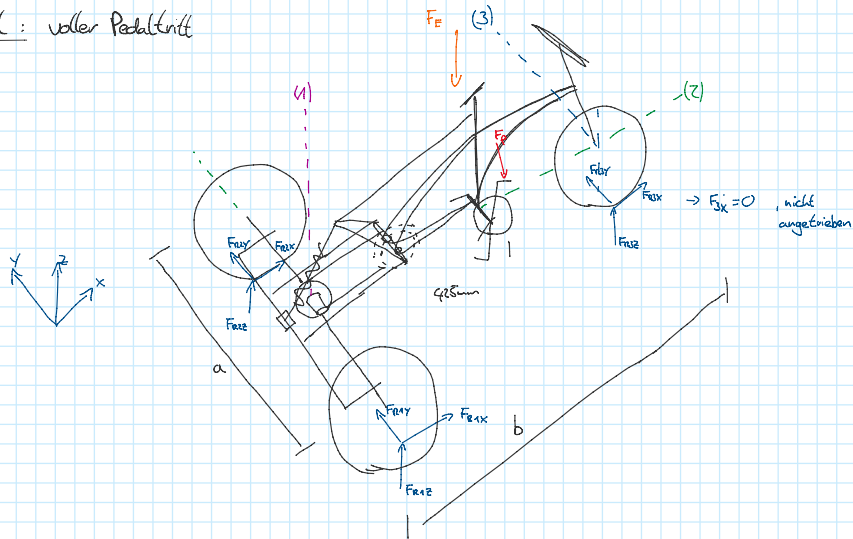
F_E (3)

(1)

(2)

F_{R3Y}

F_E

F_{R3X} → $F_{3X} = 0$, nicht angetrieben

F_{R3Z}

F_{R2Y} F_{R2X}

F_{R2Z}

625 mm

F_{R1Y} → F_{R1X}

a   b

F_{R1Z}

1:1 Übersetzung

$D_{kritzel}$ F_{kette} D_{kr} F

l_K →|

= 175 mm

$D_{kr} = 170\,mm$

$$F_{kette} \cdot \frac{D_{KR}}{2} = F \cdot l_K$$

$$F_{kette} = F \cdot \frac{2\,l_K}{D_{kr}}$$

Gleichgewicht an Hinterrädern

$$F_{kette} \cdot \frac{D_{kritzel}}{2} = \left(F_{R1X} + F_{R2X}\right) \cdot \frac{D_{rad}}{2}$$

$$F_{R1X} + F_{R2X} = F_{kette} \cdot \frac{D_{kritzel}}{D_{rad}}$$

$$= F \cdot \frac{2\,l_K}{D_{kr}} \cdot \frac{D_{kritzel}}{D_{rad}} \qquad \text{mit} \quad \frac{D_{kritzel}}{D_{kr}} = \frac{1}{3}$$

da $F_{R1X} = F_{R2X}$:

$D_{rad} = 20''$ $F_{R2X} = 2 \cdot F \cdot \frac{l_K}{D_{rad}} \cdot \frac{1}{3}$

$= 508\,mm$

$= 275,6 \quad N \qquad \Rightarrow$

$F_{R1X} = 137,8\,N$

$F_{R2X} = 137,8\,N$

(1)

F_{R2Z}

$e_1 = \dfrac{174 + 100}{2} = 137 \text{ mm}$

$b_4 = b_1 + b_2 + \ell_k$

$= 750 \text{ mm}$

Eigengewicht: 150N

Pedalkraft: 1050N

$Q = 174$

$\sum F_z:$ $\quad F_{R1z} + F_{R2z} + F_{R3z} - F_p - F_E = 0$ $\qquad \Rightarrow F_{R3z} = F_E + F_p - F_{R1z} - F_{R2z}$

$$= 633{,}3 \, N$$

$\sum M_{(1)}$ $\quad F_{R3y} \cdot b + F_{R1x} \cdot \dfrac{a}{2} - F_{R2x} \cdot \dfrac{a}{2} = 0$

$\qquad$ für $\quad F_{R1x} = F_{R2x}$

$\qquad\qquad \Rightarrow \quad F_{R3y} = 0$

$\sum F_y:$ $\quad F_{R1y} + F_{R2y} + F_{R3y} = 0$

$\qquad\qquad\qquad = 0$

$\sum M_{(2)}:$ $\quad F_{R1z} \cdot \dfrac{a}{2} - F_{R2z} \cdot \dfrac{a}{2} - F_p \cdot e_1 = 0$ $\qquad\qquad \Rightarrow F_{R2z} = F_{R1z} - 2F_p \dfrac{e_1}{a}$

$$= 81{,}7 \, N$$

$\sum M_{(3)}:$ $\quad F_E \cdot b_3 + F_p(b_3 - \ell_k) - F_{R1z} \cdot b - F_{R2z} \cdot b + F_{R1x} \cdot \dfrac{D_{Rad}}{2} + F_{R2x} \cdot \dfrac{D_{Rad}}{2} = 0$

$\Rightarrow \quad F_{R1z} \cdot b + F_{R1z} \cdot b - 2F \cdot \dfrac{e_1 \cdot b}{a} = F_p(b_3 - \ell_k) + F_{R1x} \cdot \dfrac{D_{Rad}}{2} + F_{R2x} \cdot \dfrac{D_{Rad}}{2} + F_E \cdot b_3$

$F_{R1z} = \dfrac{1}{2b} \left[2F_p \cdot \dfrac{e_1 \cdot b}{a} + F_p(b_3 - \ell_k) + F_{R1x} \cdot \dfrac{D_{Rad}}{2} + F_{R2x} \cdot \dfrac{D_{Rad}}{2} + F_E \cdot b_3 \right]$

$= \dfrac{1}{2400} \left[507.705{,}88 + 540.000 + 35001{,}2 + 35.001{,}2 + 93750 \right]$

$\dfrac{1}{2400} \cdot 1211458{,}3$

$= 504{,}8 \, N$

2. Lastfall:

Belastung durch Fahrer und Eigengewicht
mit m ≈ 120 kg

F (3)

→ $F_{3X} = 0$, nicht angetrieben

F_{R3Y} F_{R3X} F_{R3Z}

F_{R2Y} F_{R2X} F_{R2Z}

F_{R1Y} F_{R1X} F_{R1Z}

625mm

a   b

(1)   (2)

Y Z X
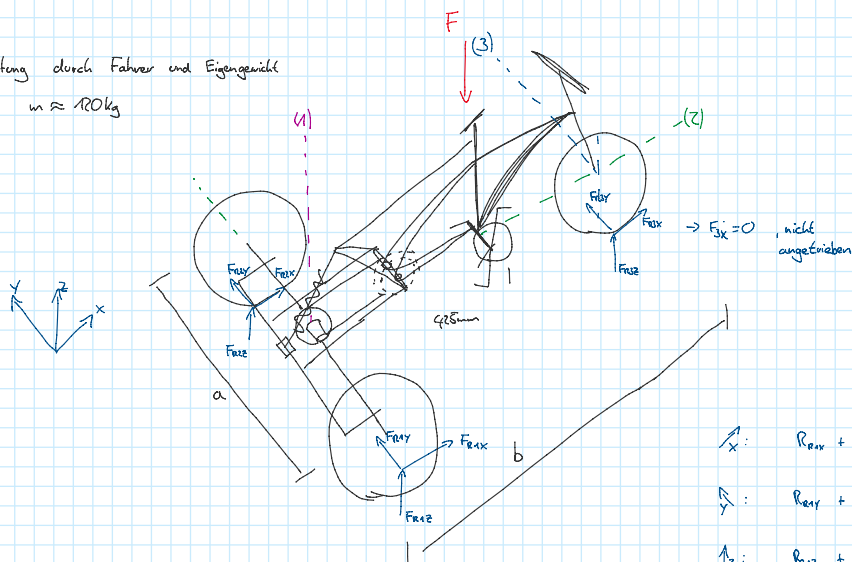
$\nearrow_X$: $F_{R1X} + F_{R2X} + F_{R3X} = 0$ → nicht angetrieben ≙ = 0

$\nwarrow_Y$: $F_{R1Y} + F_{R2Y} + F_{R3Y} = 0$ → gerade ausfahrt ≙ = 0.

$\uparrow_Z$: $\underline{F_{R1Z} + F_{R2Z} + F_{R3Z}} - F_m = 0$

wg. Belastung in Mitte

$F_{R1Z} = F_{R2Z}$?

→ $2 \cdot F_{R bindenz} = F_m - F_{R3Z}$

$F_{R1Z} = F_{R2Z} = 312,5\ N$

(1)
F_{R2Z}
a
F_m
F_{R3Z}
C_3
F_{R1Z} b_1 b_2 b_3
b
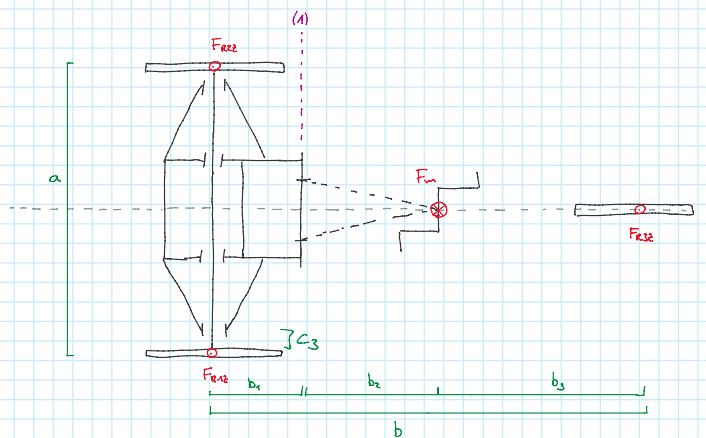
$b_1 = 150$ mm
$b_2 = 625$
$b_3 = 625$
$b =$
$a = 680$ mm
$C_3 = 86$ mm

$M_{(1)}^Y$: $F_{R1Z} \cdot b_1 + F_{R2Z} \cdot b_1 + F_m \cdot b_2 - F_{R3Z} \cdot (b_2 + b_1) = 0$

wg. Belastung in Mitte

$F_{R1Z} = F_{R2Z}$?

→ $(F_m - F_{R3Z}) \cdot b_1 + F_m\, b_2 - F_{R3Z}\, (b_2 + b_3) = 0$

⇔ $F_m \cdot b_1 - F_{R3Z} \cdot b_1 + F_m \cdot b_2 - F_{R3Z} \cdot (b_2 + b_3) = 0$

$F_{R3Z} = \dfrac{F_m \cdot (b_1 + b_2)}{b_1 + b_2 + b_3}$

$= 575\ N$