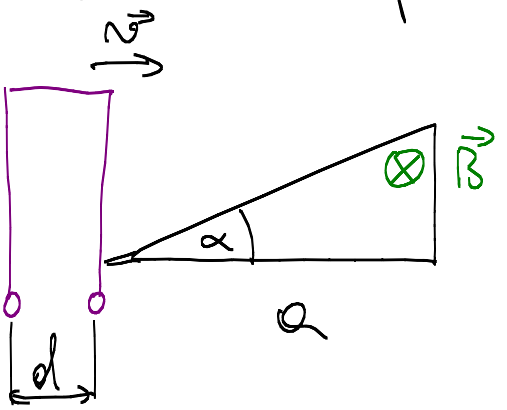
Gel Ru 09012007

Notiztitel 09.01.2007

Induzierte Spannung:

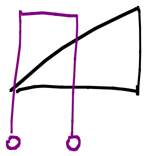


ges.: Induzierte Spannung U_{ind} in der mech. bewegten Leiterschleife → Verlauf

geg.: $a, d, \alpha, \vec{B}, \vec{v}$

1. Bereich:

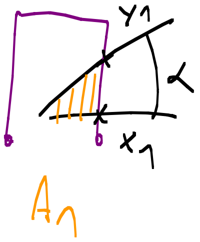
t_A



$$v = \frac{s}{t}$$

$$t_A = \frac{d}{v}$$

$0 \le t \le t_A$



$$x_1 = v \cdot t$$

$$y_1 = x_1 \cdot \tan\alpha = v \cdot t \cdot \tan\alpha$$

$$A_1(t) = \frac{x_1 \cdot y_1}{2} = \frac{(v \cdot t)^2 \cdot \tan\alpha}{2}$$

Inprodukt nicht notwendig da 90° zwischen $\vec{B}$ und Schleife

$$U_{ind} = \frac{d\varphi}{dt} = B \frac{dA_1(t)}{dt}$$

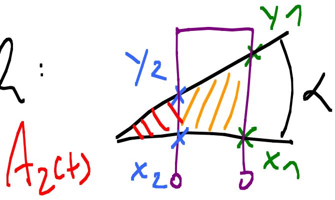
$$= B \cdot \frac{d}{dt}\left[\frac{(vt)^2 \cdot \tan\alpha}{2}\right]$$

$$= B \frac{2(vt)v}{2} \tan\alpha$$

$$= B \cdot v^2 \tan\alpha \cdot t$$

linear mit t

2. Bereich:



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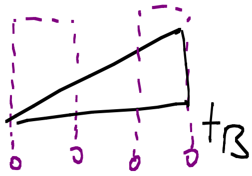


$$t_B = \frac{a}{v} \qquad t_A \leq t \leq t_B$$

$$A_1(t) = \frac{(v t)^2}{2} \tan\alpha$$

$$x_2 = x_1 - d = v \cdot t - d$$

$$y_2 = x_2 \cdot \tan\alpha = (v \cdot t - d) \cdot \tan\alpha$$

$$A_{2(t)} = \frac{x_2 \, y_2}{2} = \frac{(v t - d)^2}{2} \tan\alpha$$

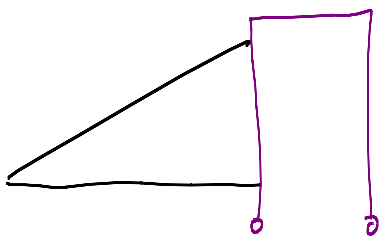
$$u_{ind} = B \frac{d}{dt} \left(A_{1(t)} - A_{2(t)} \right)$$

$$= B \frac{d}{dt} \left[(v t)^2 - (v t - d)^2 \right] \cdot \frac{\tan\alpha}{2}$$

$$= B \tan\alpha \left[v^2 t - (v t - d) v \right]$$

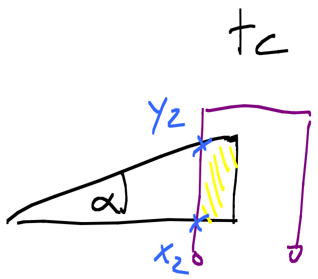
const. Funkt. $= B \tan\alpha \left[d \cdot v \right]$

3. Bereich:



$$t_C = \frac{a + d}{v}$$

$$t_B \leq t \leq t_C$$



$$A_{1(t)} = \frac{a \cdot a \tan\alpha}{2} \quad \text{const.}$$

$$A_{2(t)} = \frac{(v t - d)^2}{2} \tan\alpha$$

$$u_{ind} = B \frac{d}{dt}[A_1 - A_2(t)]$$

$$= B \cdot \frac{\tan\alpha}{2} \frac{d}{dt}[a^2 - (vt - d)^2]$$

$$= -B \tan\alpha [(vt - d)v]$$

$$= -B \tan\alpha \, v^2 t + B \tan\alpha \, d \cdot v$$

Angaben:

$B = 1\,T$

$v = 2\,m/s$

$\alpha = 45°$

$a = 1\,m$

$d = 0{,}1\,m$

Berechnung: $t_A = \frac{d}{v} = 50\,ms$

$t_B = \frac{a}{v} = 500\,ms$

$t_C = \frac{a+d}{v} = 550\,ms$

$u_{ind_1} = B \tan\alpha \, v^2 t = 1 \cdot \tan 45 \cdot 1^2 = 4 \cdot t$

$t = 0 \rightarrow 0V$

$t = t_A \rightarrow 0{,}2V$

$u_{ind_2} = B \tan\alpha \, v \, d = 1 \cdot \tan 45 \cdot 2 \cdot 0{,}1 = 0{,}2V$

$$u_{ind_3} = \underbrace{B \tan\alpha \, v \, d}_{0{,}2\,V} - \underbrace{B \tan\alpha \, v^2 t}_{4t}$$

$t = 500ms \rightarrow -1,8V$

$t = 550ms \rightarrow -2V$