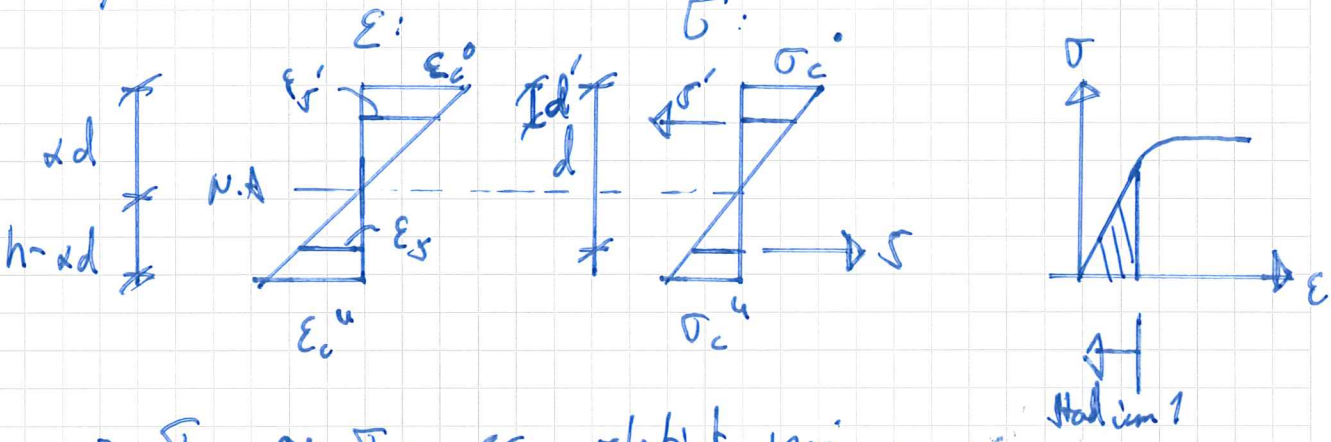
# LF Bruksgrense

a) Matematisk modell Stadium 1




- $\sigma_c$ og $\sigma_s$ er relativt små
- Elastisk oppførsel
- Betong tar strekk spenninger

b)

$$\kappa = \frac{M}{(EI)_1} = \frac{\varepsilon_s'}{\alpha_1 d - d'} \Rightarrow \varepsilon_s' = \frac{M}{(EI)_1} \cdot (\alpha_1 d - d')$$

$$\sigma_s' = E_s \cdot \varepsilon_s' = \underline{E_s \frac{M}{(EI)_1} \cdot (\alpha_1 d - d')} \quad \text{q.e.d}$$

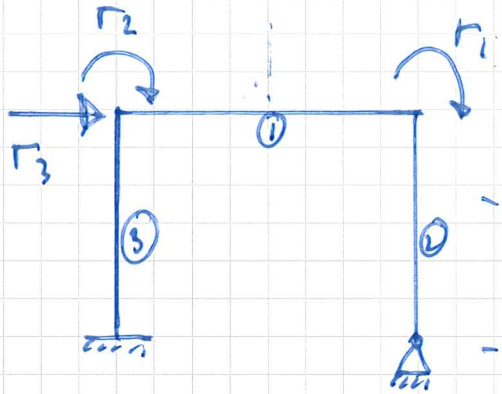
c)

- $\alpha_1$ er kun avhengig av $E_s$, $E_c$ og tverrsnittets geometri.
- $I_{c1}$ er kun avhengig av $b, h$ og $\alpha_1$
- $E$ er tidsavhengig, men det ser vi bort fra her

$\Rightarrow$ Ikke lastavhengig

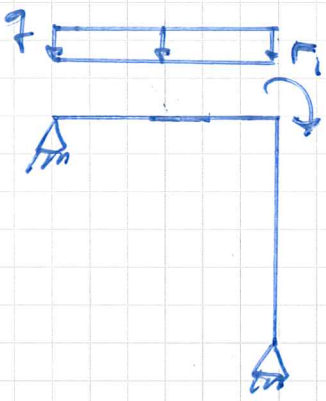
# LF Matrisestatikk

a)

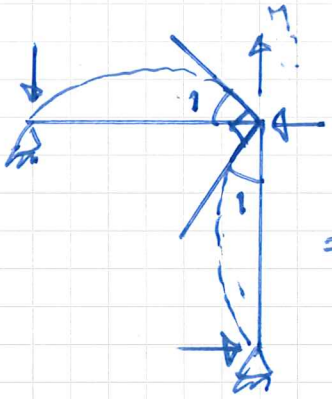



- Min. 3 frihetsgrader er nødvendig
- Ikke fasthodt mot horisontalberegelse stav (1)

b)



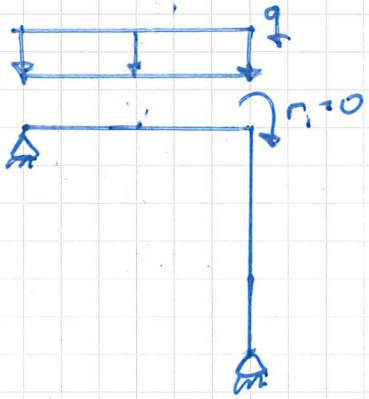

Stivhet ($r_1 = 1$)

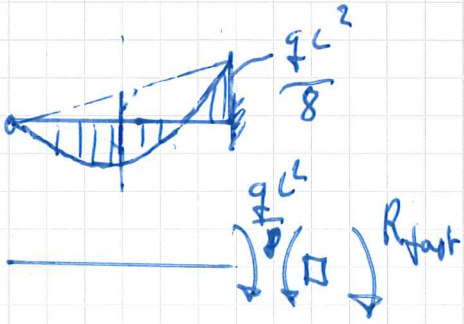



$$k_{11} = 2 \cdot \frac{3EI}{L}$$

$$\Rightarrow k_{11} = 6\frac{EI}{L}$$

Last



$$R = R_{fri} = -R_{fast} = -\frac{qL^2}{8}$$

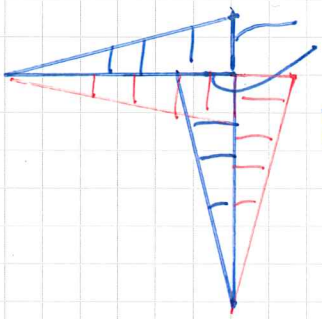
$$\Rightarrow Kr = R \Rightarrow r = \frac{R}{K} = \frac{-\frac{qL^2}{8}}{6\frac{EI}{L}} = -\frac{qL^3}{48EI}$$

c) Moment diagram

kun 1 bjelke !!

$$M_{tot} = M_{fri} + M_{fast}$$

$M_{fri}$:



$$M_{fri} = k \cdot r = \left(3\frac{EI}{L}\right) \cdot \left(-\frac{qL^3}{48EI}\right)$$

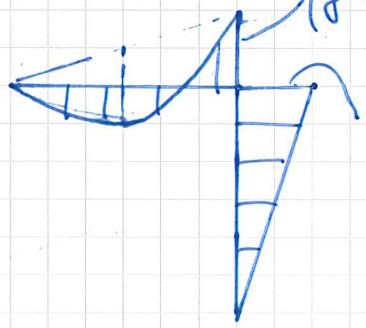
$$M_{fri} = -\frac{1}{16} qL^2$$

↑ negativt fortegn !!

$M_{fast}$:

$$M_{fast} = \frac{1}{8} qL^2$$

$M_{tot}$:



$$\left(\frac{1}{8} - \frac{1}{16}\right) qL^2 = \frac{1}{16} qL^2$$

$$\frac{1}{16} qL^2$$