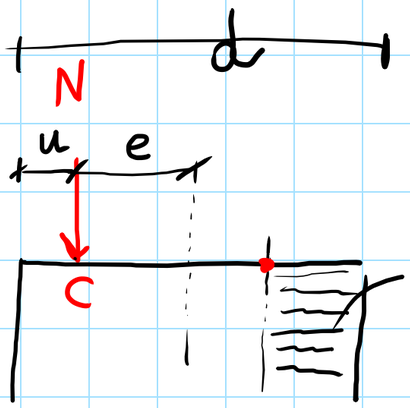
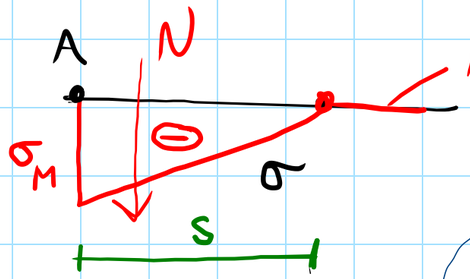
19/5/26

... COMPRESSED MASONRY PILLARS (NO-TENSION)



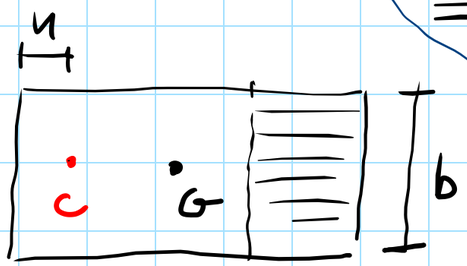
$e > \frac{d}{6}$

CRACKED / DAMAGED PART



BY IMPOSING EQUIVALENCE OF FORCES AND MOMENTS

$\Rightarrow \sigma_M, s$ (2 UNKNOWNS)



$$\int \sigma \, dA = N$$

$$\int_{\sigma} \text{MOMENT OF} = \text{MOM. OF } N$$

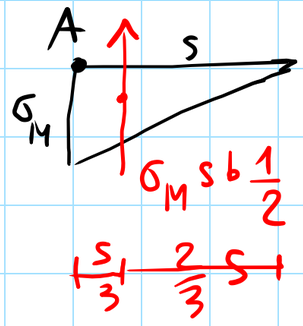
(N OUTSIDE THE KERNEL)

$$\begin{cases} \sigma_M s b \frac{1}{2} = N \\ \sigma_M s b \frac{1}{2} \cdot \frac{s}{3} = N u \end{cases}$$

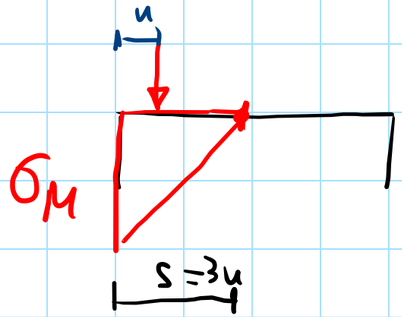
$\sigma_M 3ub\frac{1}{2} = N$

$u = \frac{s}{3}$

$s = 3u$



$$\sigma_M = \frac{2}{3}\frac{N}{ub}$$

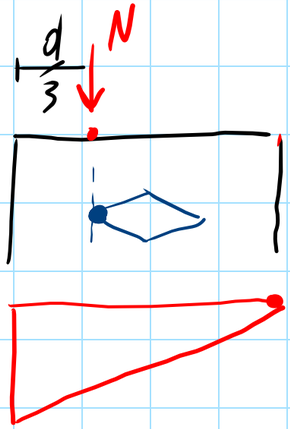


IMAGINE THAT THE MATERIAL HAS A LIMITED RESISTANCE IN COMPR.: f_K

$u \to u_{MIN}$,

$$u_{MIN} = \frac{2}{3}\frac{N}{b}\frac{1}{f_K}$$

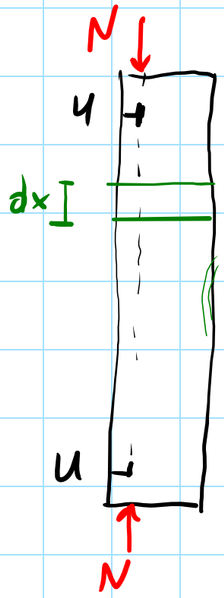
IMAGINE THAT $u = \frac{\phi}{3} \Rightarrow s = d$



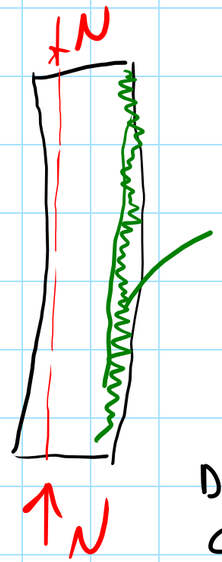
PROGRESSIVE INSTABILITY OF A NO-TENSION PILLAR AT "LARGE ECCENTRICITY"

$(u < \frac{d}{3})$

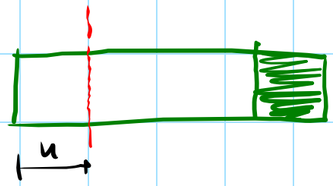
$(e > \frac{d}{6})$



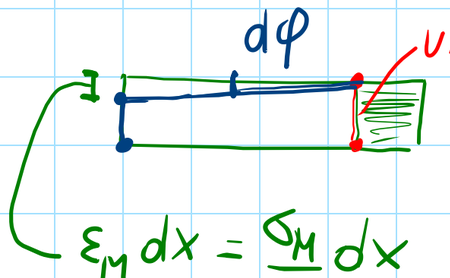
INITIAL CONFIG. $(N=0)$



DEFORMED CONFIG. AT INCR. N



$\sigma_M = \frac{2}{3}\frac{N}{bu}$



$\varepsilon_M dx = \frac{\sigma_M}{E} dx$

$d\varphi = \frac{\varepsilon_M dx}{3u} = \frac{\sigma_M}{E 3u} dx$

$d\varphi = \frac{2}{9}\frac{N}{Ebu^2} dx$

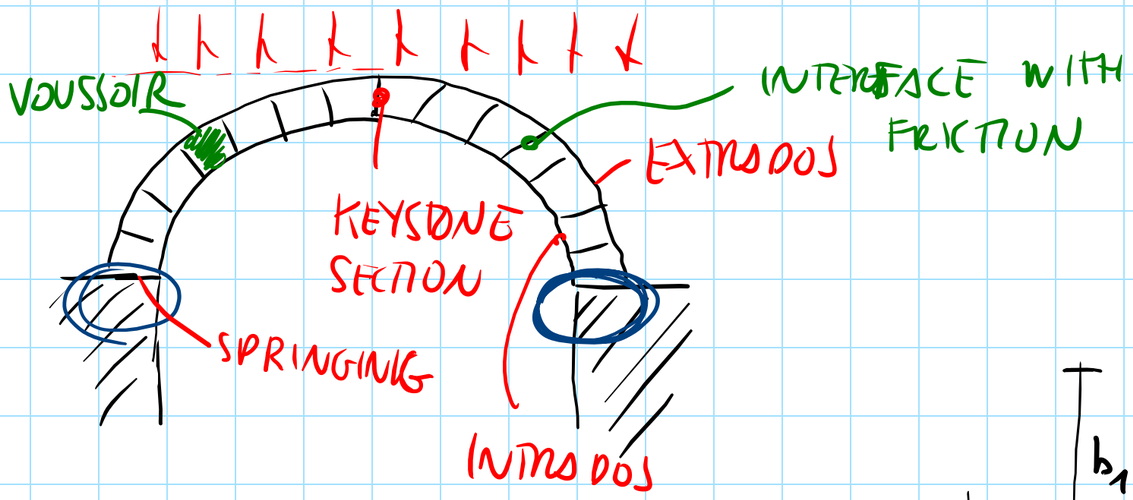
$\frac{d\varphi}{dx} = \frac{2}{9}\frac{N}{Ebu^2}$ (CURRENT CURVATURE OF THE GENERIC SLICE)

φ = function of $\frac{du}{dx}$

II ORDER ODE

$f(u''(x)) = \frac{2}{9}\frac{N}{Ebu(x)}$

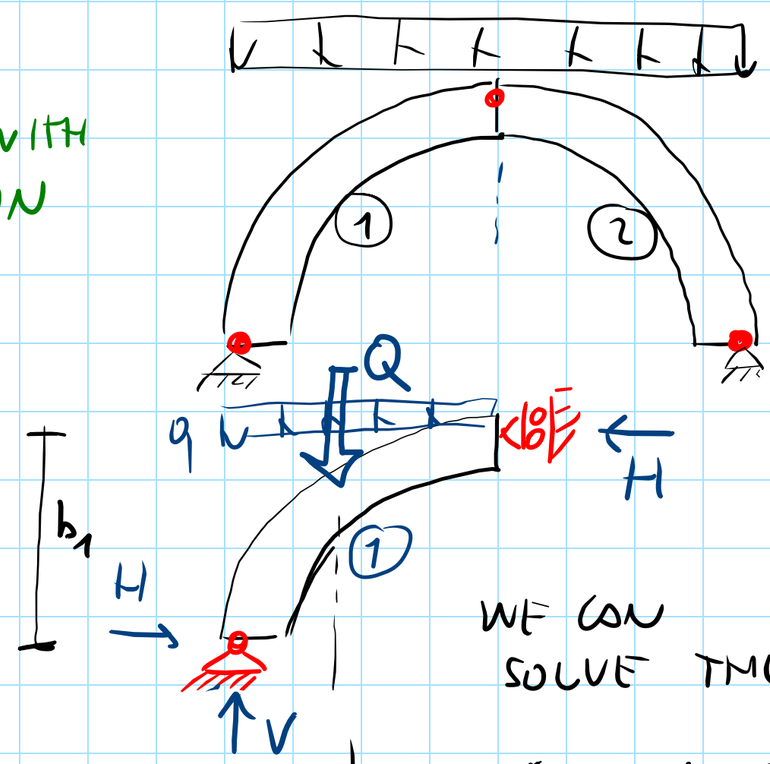
STATICS OF MASONRY ARCHES



SIMMETRIC ARCH WITH SIMMETRIC LOAD.

GOAL: EVALUATE THE "SAFETY" OF THE STRUCTURE

TO ASSESS "SAFETY" OF THE ARCH WE HAVE NOW TO DETERMINE THE "LINE OF THRUST" (LINEA DELLE PRESSIONI)



ISOSTATIC CONFIG: 3 HINGES

(SYMMETRIC STRUCT.

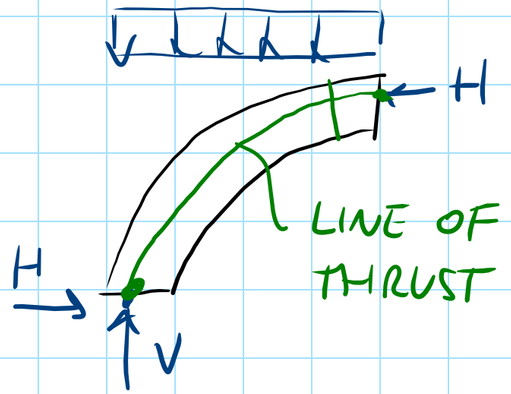
(THE HINGES ARE CLOSER TO THE EXTRADOS)

WE CAN SOLVE THE 2 "UNKNOWNS"

"THRUST" ↑

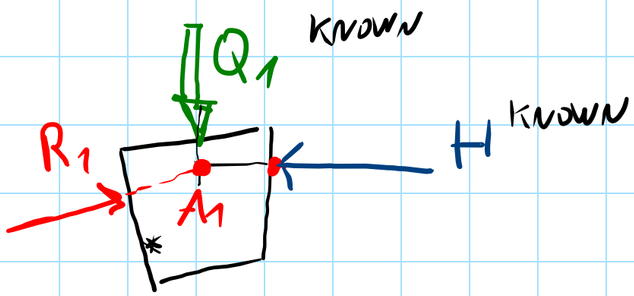
$+\uparrow: \quad V = Q$

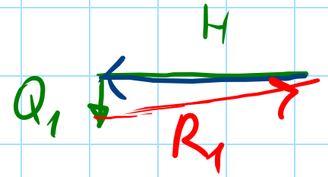
$+\circlearrowleft: \quad +H b_1 = Q b_2 \Rightarrow H = \frac{Q b_2}{b_1}$

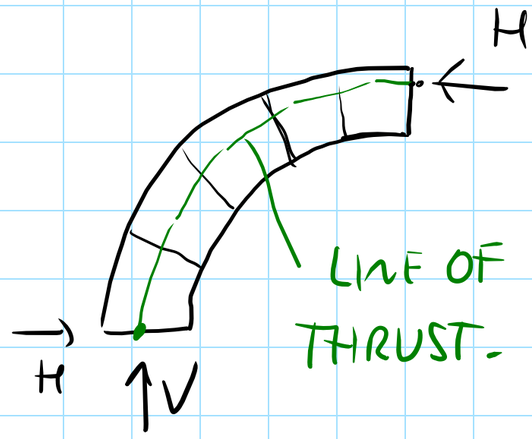


TO FIND THE L.OF.TH. CONSIDER EQUIL OF ALL VOUSSOIRS STARTING FROM THE KEY STONE

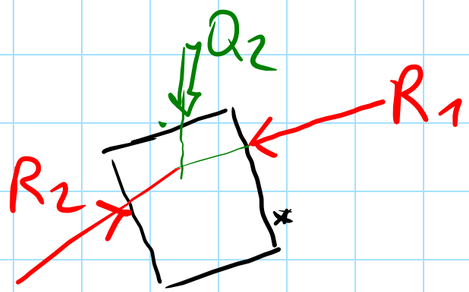
VOUSS NO. 1 GOAL: FIND R_1!

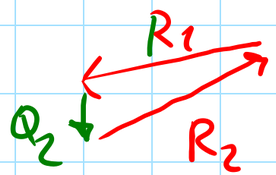






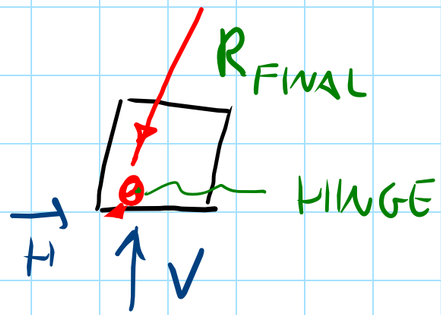
VOUSS NO. 2



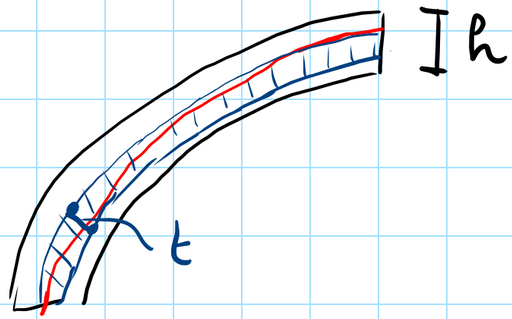


⋮

UP TO THE FINAL BLOCK.



R_{FINAL} MUST PASS THROUGH THE SELECTED HINGE.



h: THICKNESS OF THE ARCH

t: THICKNESS OF THE "INNER" ARCH THAT IS SPANNED BY THE L.O.T.

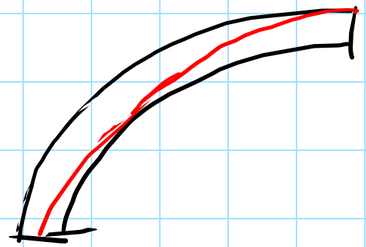
IN WEALTHY STRUCTURES

$$\frac{h}{t} \simeq 2$$

LIMITS:

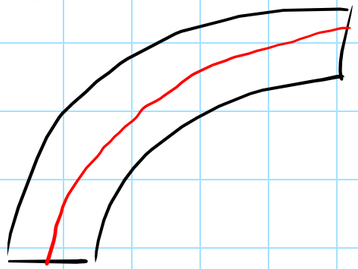
$$\frac{h}{t} \to 1$$

CLOSE TO FAILURE



$$\frac{h}{t} \gg 2$$

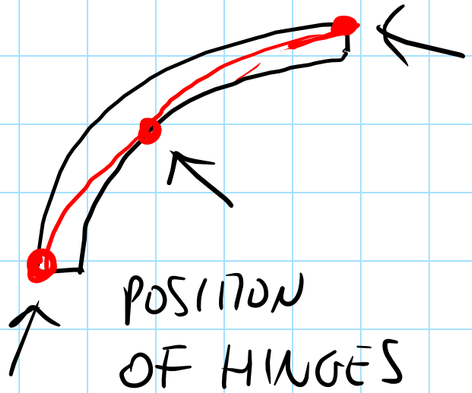
STRUCT. IS OVER-PERFORMING



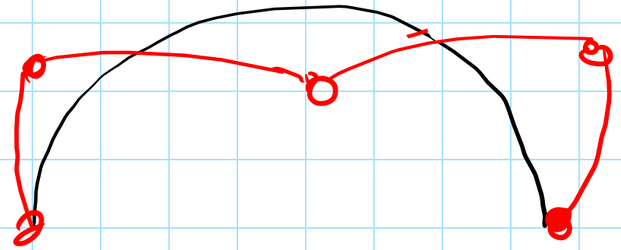
HEYMAN'S MASTER "SAFE" THEOREM.

THE ARCH IS IN EQUILIBRIUM IF AT LEAST ONE L.-OF. TH. IN EQUILIBRIUM WITH LOADS CAN BE FOUND WHICH LIES WITHIN ITS BOUNDARIES

$\frac{h}{t} = 1$

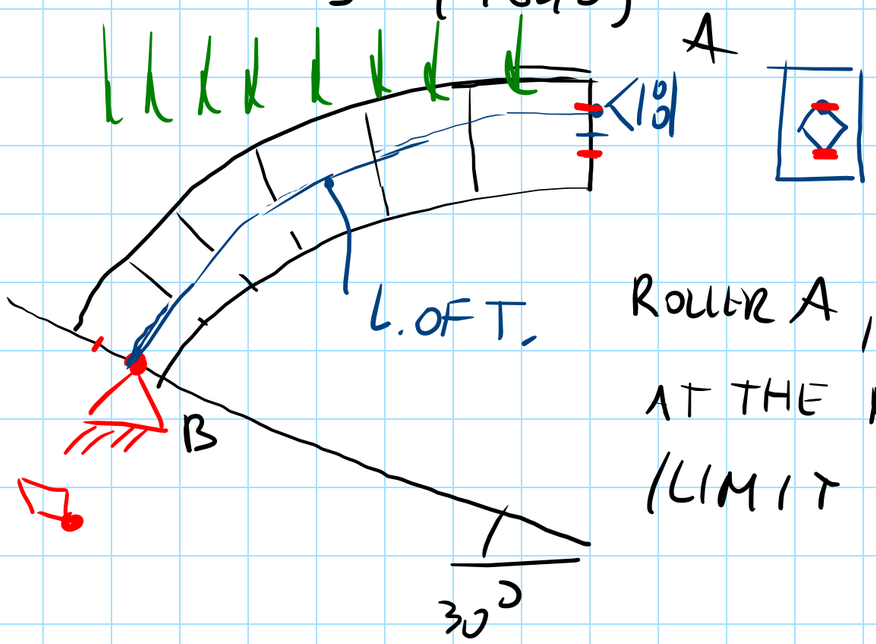


LEADING TO FAILURE MECHANISM

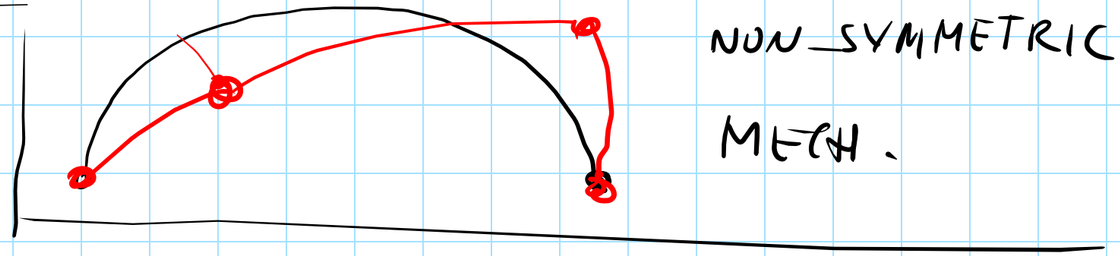


SYMMETRIC MECH.

MERY'S METHOD (1840)



ROLLER A, HINGE B AT THE MIDDLE-THIRD (LIMIT OF THE KERNEL)



NON-SYMMETRIC MECH.

FOR MERY, THE ARCH IS SAFE IF THE L. OF T. LIES WITHIN THE MIDDLE THIRD IN ALL INTERFACES.