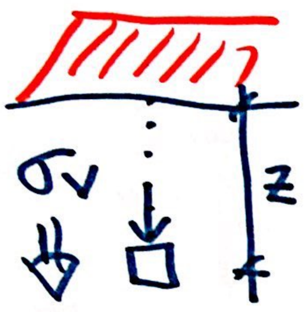
Resistência das Argilas

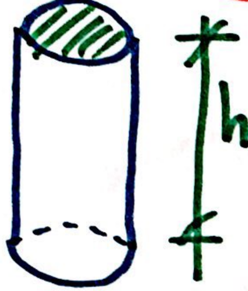
Propriedades de Engenharia

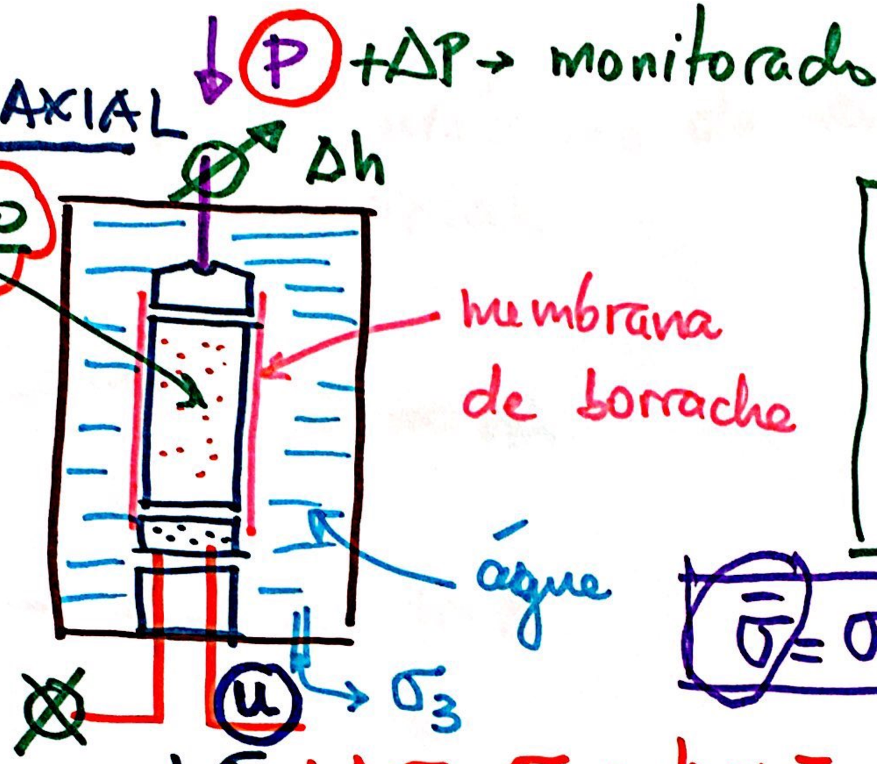
- RESISTÊNCIA – Triaxial / Cisalhamento Direto
- DEFORMABILIDADE – Triaxial / Compressão edométrica
- PERMEABILIDADE – Permeâmetro – carga constante
  - carga variável

ENSAIO TRIAXIAL



$\gamma \cdot z$

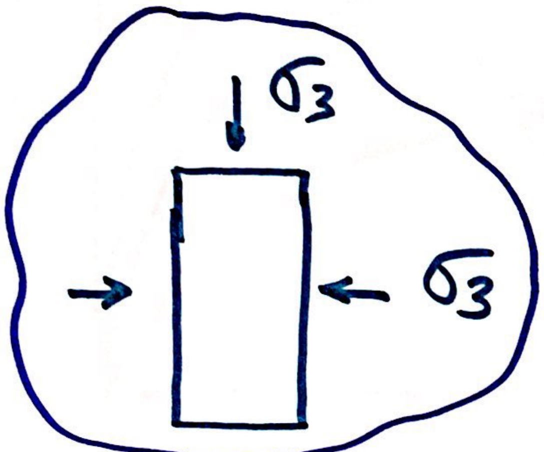




$$\varepsilon = \frac{\Delta h}{h_0}$$

$$\sigma_3 + \Delta\sigma = \sigma_1$$

$$\bar{\sigma} = \sigma - u$$



$\sigma_3 + \Delta\sigma = \sigma_1$ → tensão principal maior

σ_3 → tensão principal menor

1º CONFINAMENTO

SEM DRENAGEM - $\Delta V = 0$

ADENSADO - $\Delta V \neq 0$

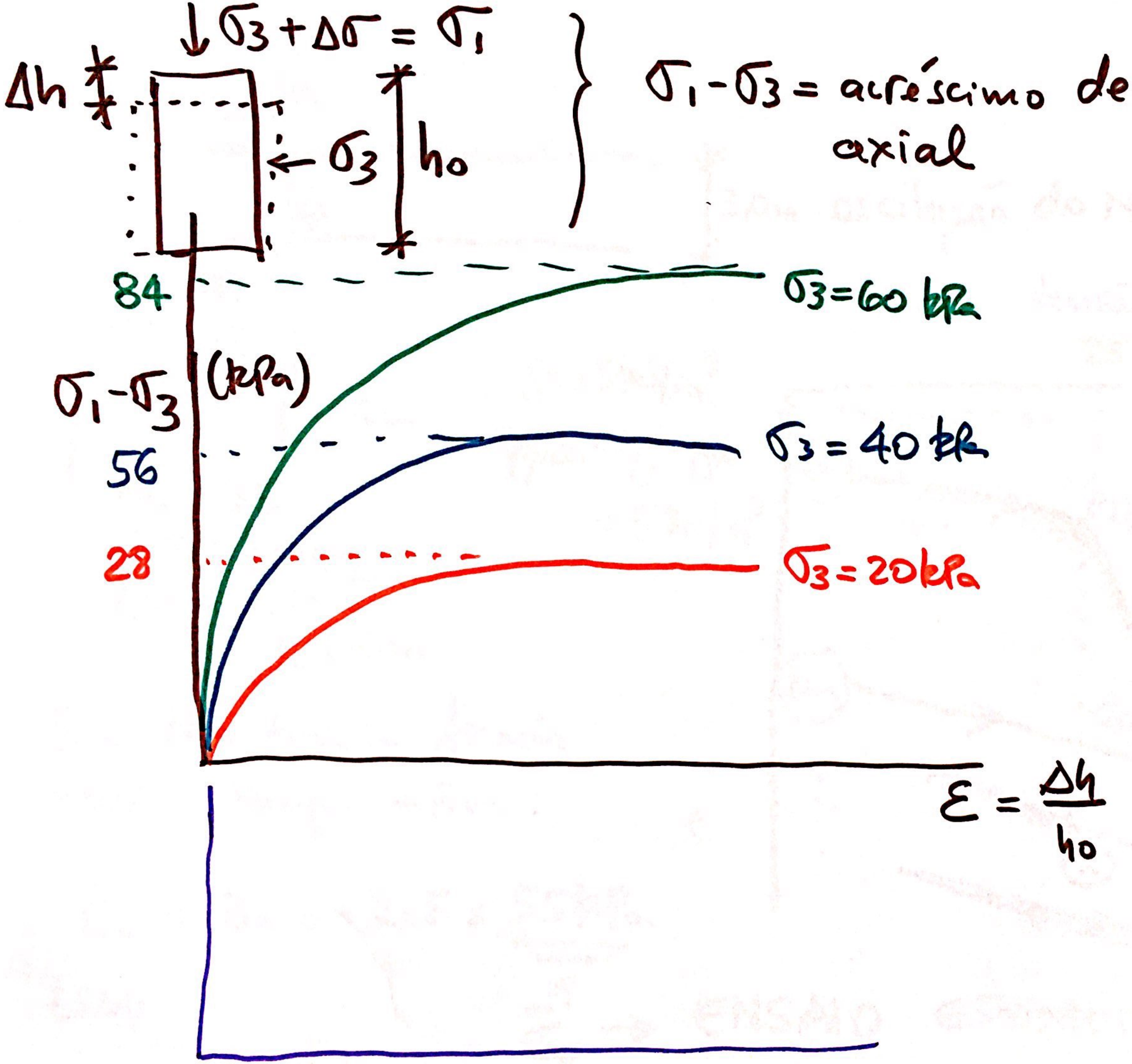
ADENSADO $\Delta V \neq 0$

2º CARREGAMENTO

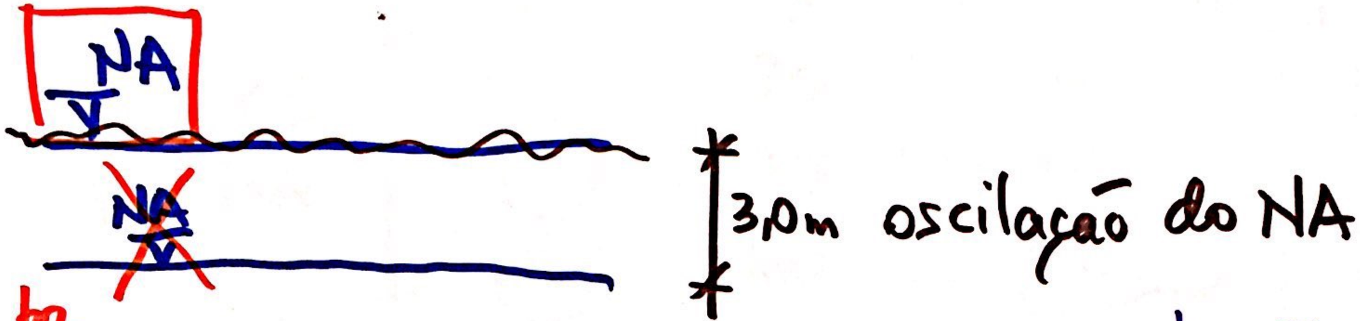
SEM DRENAGEM - UU (unconsolidated, undrained)

SEM DRENAGEM - CU (consolidated)

DRENADO - CD ← drained



$\sigma_1 - \sigma_3$ = acréscimo de tensão axial



kPa

$\bar{\sigma}_v = 25$

$u = 50$ □ 5m

$\sigma_v = 75$

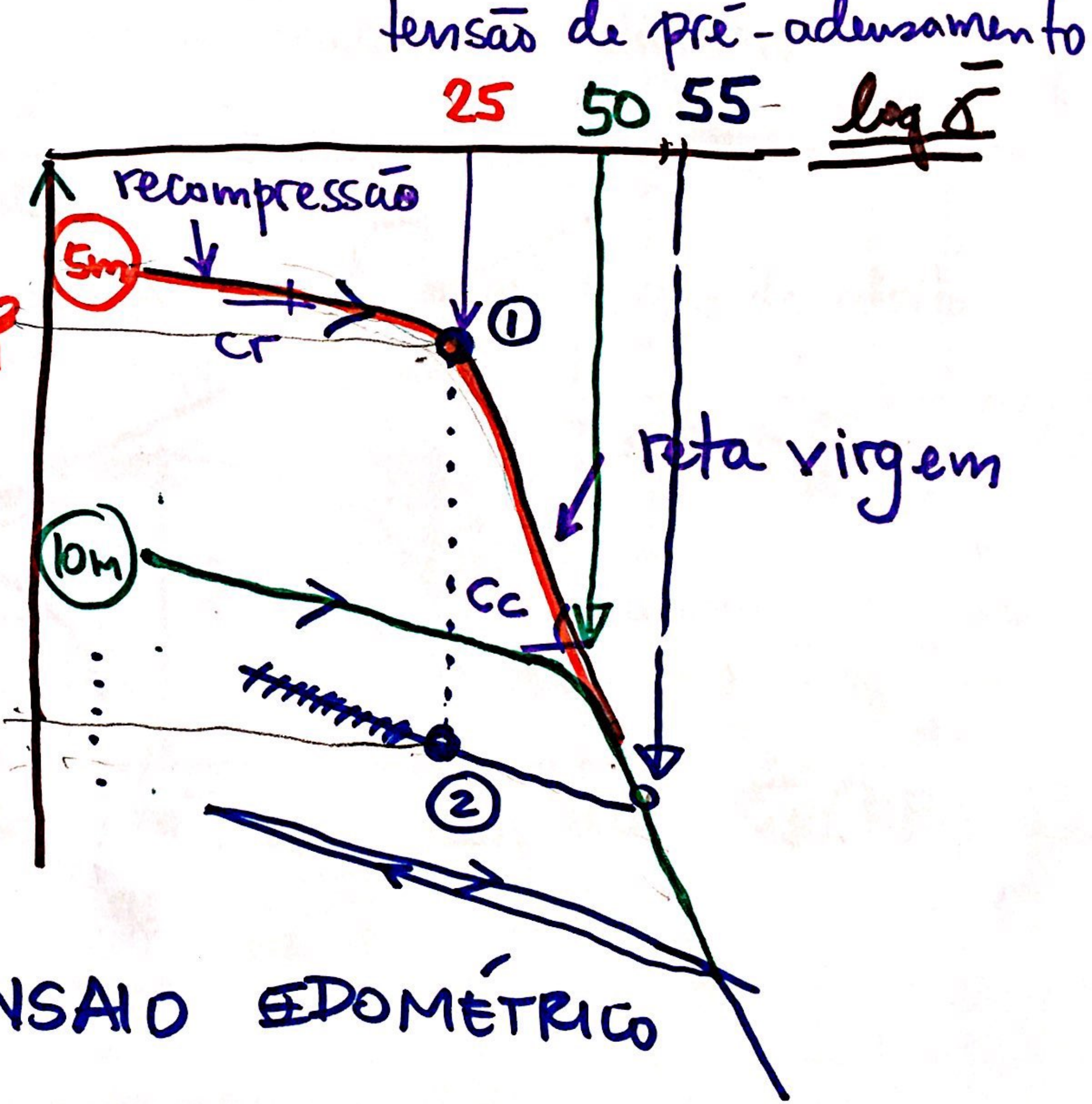
$\gamma = 15\,kN/m^3$

$\gamma_{sub} = \gamma - \gamma_w$

$= 5\,kN/m^3$

NORMALMENTE ADENSADA ∇

□ 10m



Se o NA tivesse ficado muito tempo -3m:

$\bar{\sigma}_v = 3 \times 15 + 2 \times 5 = \underline{\underline{55\,kPa}}$

(5m)

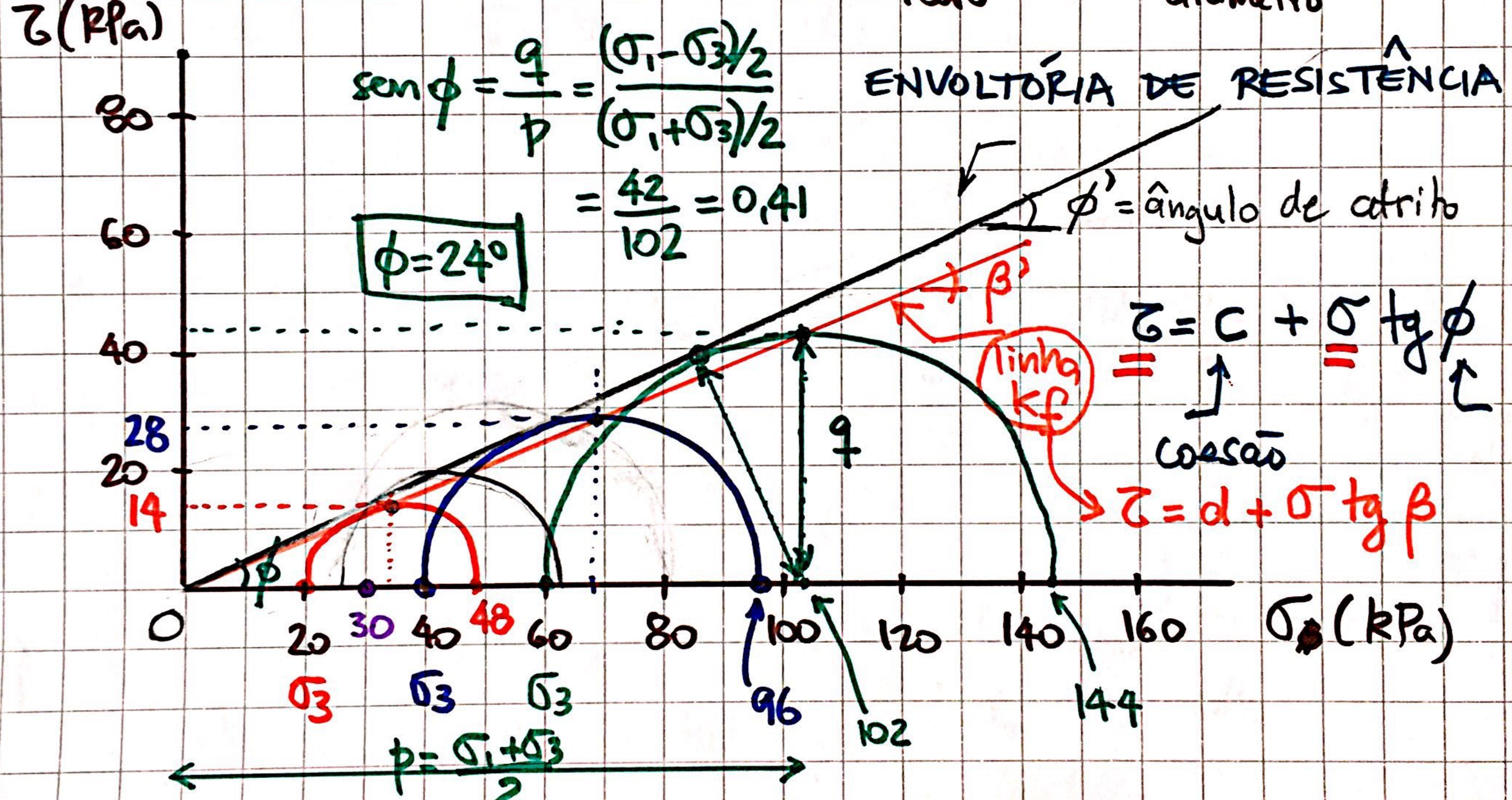
$\uparrow$

$\bar{\sigma}_p \rightarrow$ ENSAIO EDOMÉTRICO

(1.1)

argila NA (CD)

Ensaio	σ_3 (kPa)	$(\sigma_1-\sigma_3)/2 = q$	$(\sigma_1-\sigma_3)$	σ_1
7	20	14	28	48
8	40	28	56	96
9	60	42	84	144
		raio	diâmetro	



$$\text{sen}\,\phi = \frac{q}{p} = \frac{(\sigma_1-\sigma_3)/2}{(\sigma_1+\sigma_3)/2} = \frac{42}{102} = 0{,}41$$

$\phi = 24°$

$$\tau = c + \sigma \, tg\, \phi$$

$$\tau = d + \sigma \, tg\, \beta$$

$$p = \frac{\sigma_1+\sigma_3}{2}$$

1.2: Para o ensaio CU, corpos de prova NA, saturados

Vale também a proporcionalidade

1.3:

Ensaio	$\frac{\sigma_1+\sigma_3}{2} = p$	DRENADO $\bar{\sigma}_3$ (kPa)	σ_1	SEM DRENAGEM $(\sigma_1-\sigma_3)/2$ kPa $q = \frac{\sigma_1-\sigma_3}{2}$	
NA 4	26,5	20	33	6,5	~~26,5~~ ~~33~~
		30	49,5	9,75	~~39,75~~ ~~49,5~~
NA 5		40	66	13,0	53,0
NA 6		60		19,5	

$\rightarrow tg\beta = \frac{6,5}{26,5}$

RR = Razão de Resistência

$RR = \frac{S_u}{\bar{\sigma}_p} = \frac{6,5}{20} = \frac{13}{40} = \ldots$

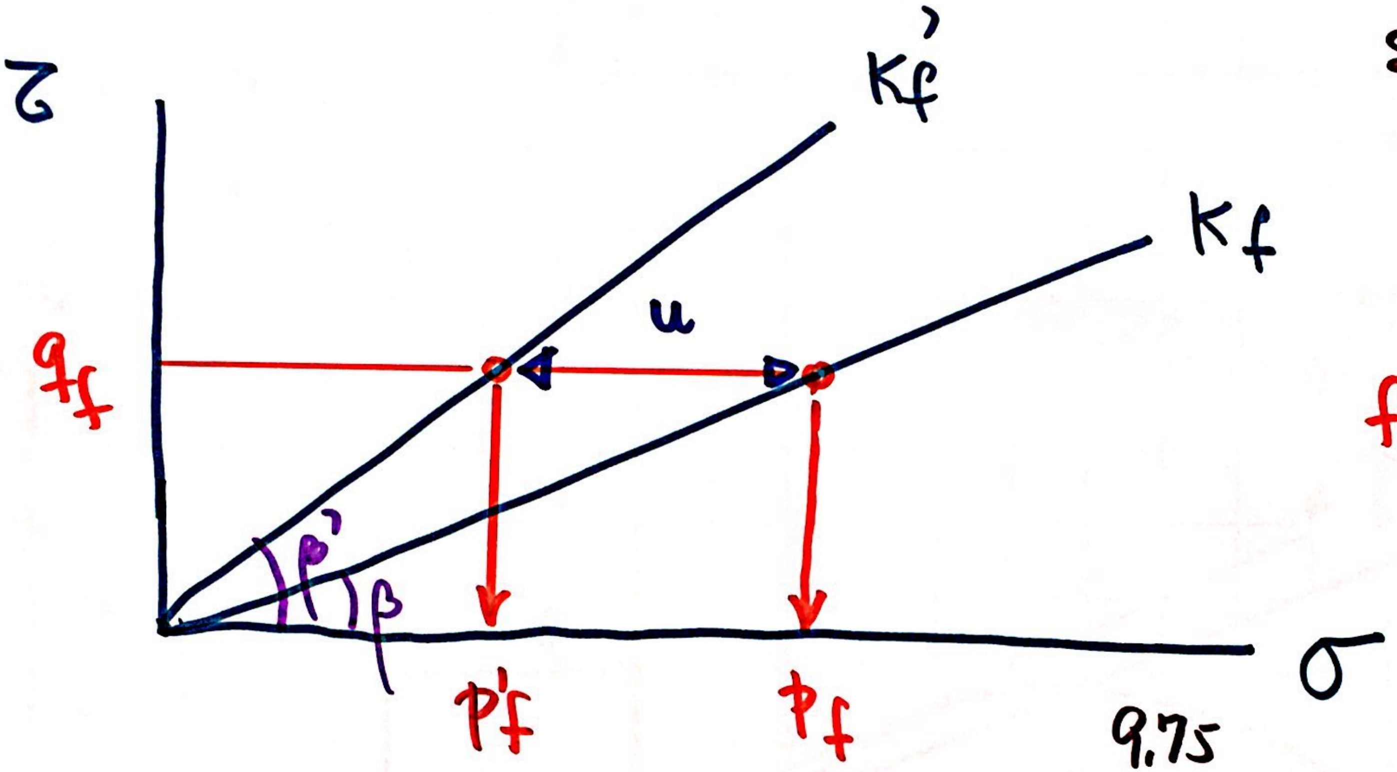
RR = 0,325

1.4: $\bar{\sigma}_3 = 30kPa$ drenado.

$\Delta\sigma_3 = 30kPa \rightarrow \sigma_3 = 60kPa$. ↓ sem drenagem

$\Delta V = 0 \quad e = cte$

$\operatorname{sen}\phi = \operatorname{tg}\beta$



f: failure (ruptura)

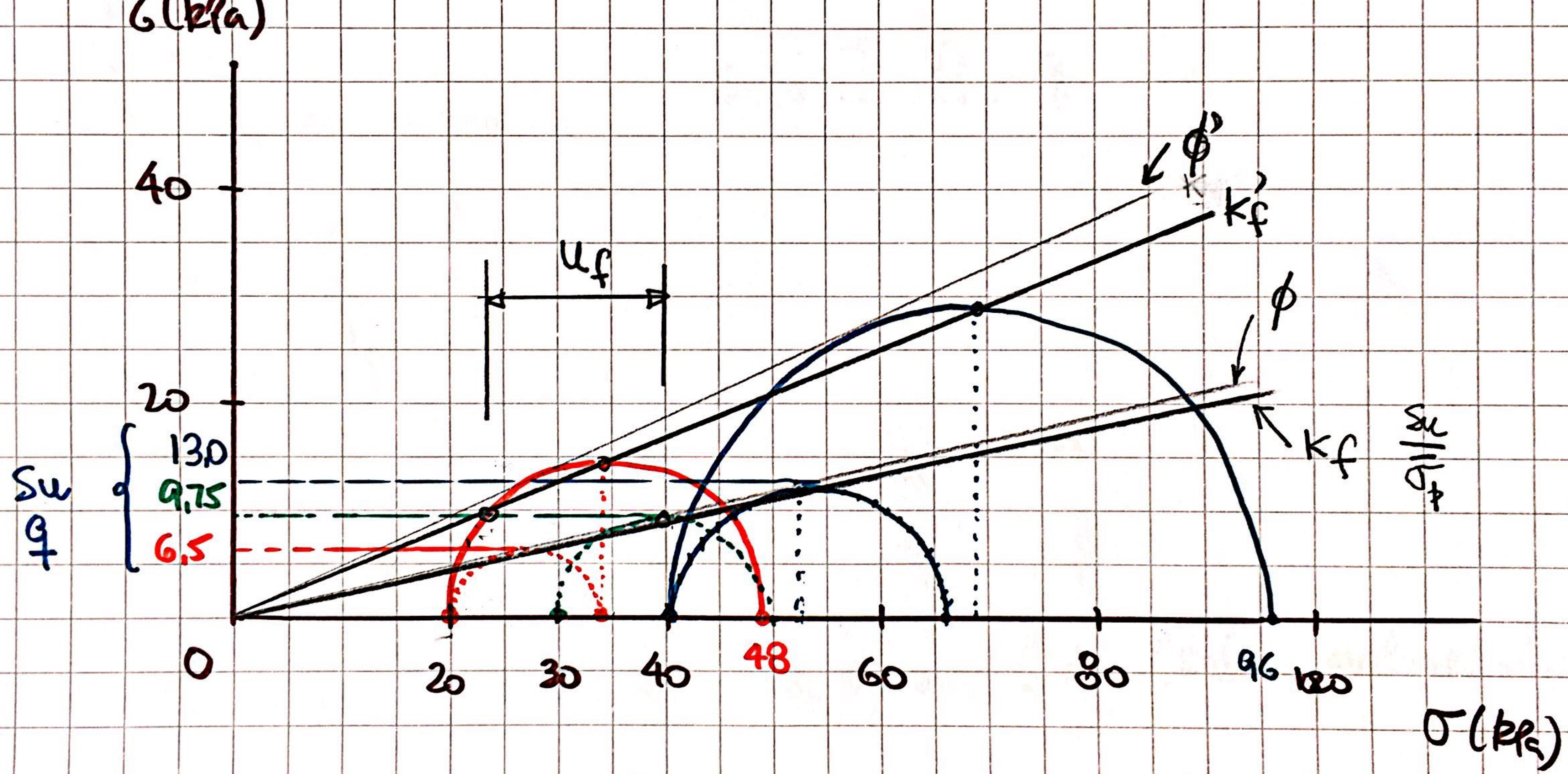
$$\left.\begin{aligned} u &= p_f - p'_f \\ \operatorname{tg}\beta &= \frac{q_f}{p_f} \\ \operatorname{tg}\beta' &= \frac{q_f}{p'_f} \end{aligned}\right\} \quad u = \frac{q_f}{\operatorname{tg}\beta} - \frac{q_f}{\operatorname{tg}\beta'} = q\left(\frac{1}{\operatorname{tg}\beta} - \frac{1}{\operatorname{tg}\beta'}\right)$$

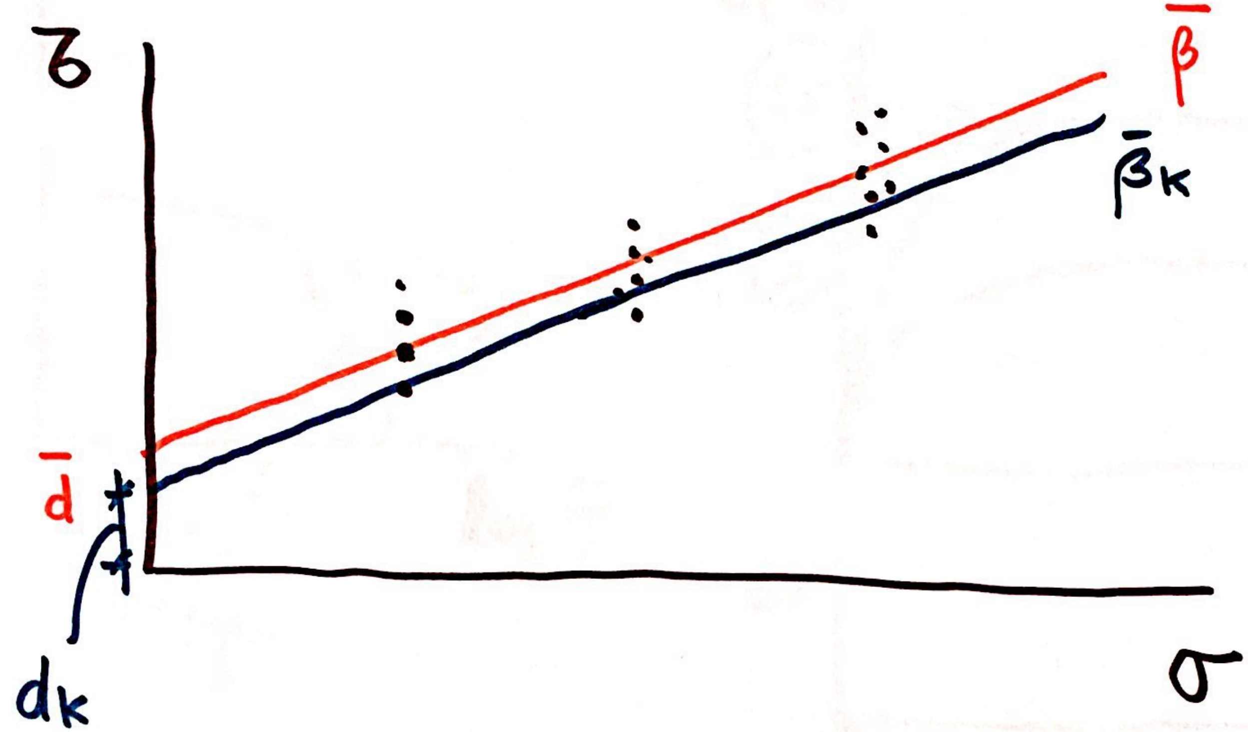
$q = 9{,}75$; $\beta = 13{,}8°$; $\beta' = 22°$

$\beta = 13{,}8°$

$\beta' = 22°$

$u = 45{,}5$ kPa


τ (kPa)
40
20
13,0
9,75
6,5
Su
q_f
u_f
φ'
k_f'
φ
k_f
Su / σ_p
0
20
30
40
48
60
80
96
100
σ (kPa)



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Estabilidade de Encostas

$$\text{sen}\,\phi = \text{tg}\,\beta$$

$$c = \frac{d}{\cos\phi}$$

S_u = S ⇒ strength
u ⇒ undrained } Resistência <u>Não Drenada</u>

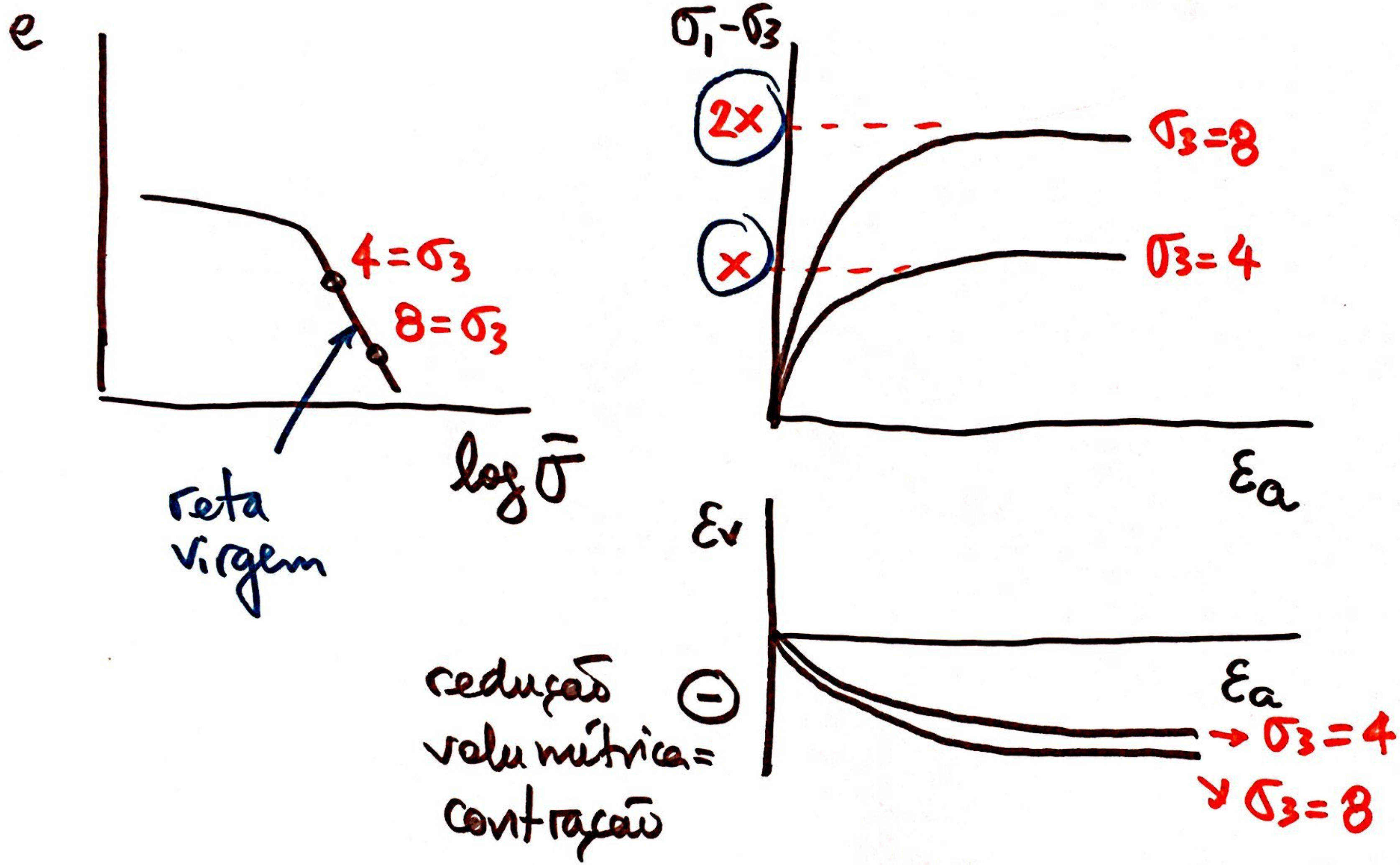
CU
↑ undrained

$$S_u = \frac{\sigma_1 - \sigma_3}{2} = q$$

$$RR = \frac{q}{\bar{\sigma}_p}$$

$\bar{\sigma}_3 > \bar{\sigma}_p$ (in situ) ⇒ corpo de prova N.A.

$\bar{\sigma}_3 < \bar{\sigma}_p$ (in situ) ⇒ corpo de prova S.A. (sobre adensado)


e
log σ̄
4 = σ3
8 = σ3
reta virgem
σ1 - σ3
2x
x
σ3 = 8
σ3 = 4
εa
εv
εa
→ σ3 = 4
→ σ3 = 8
⊖
redução volumétrica = contração