Introdução a Teoria do Adensamento

Recalques por Adensamento

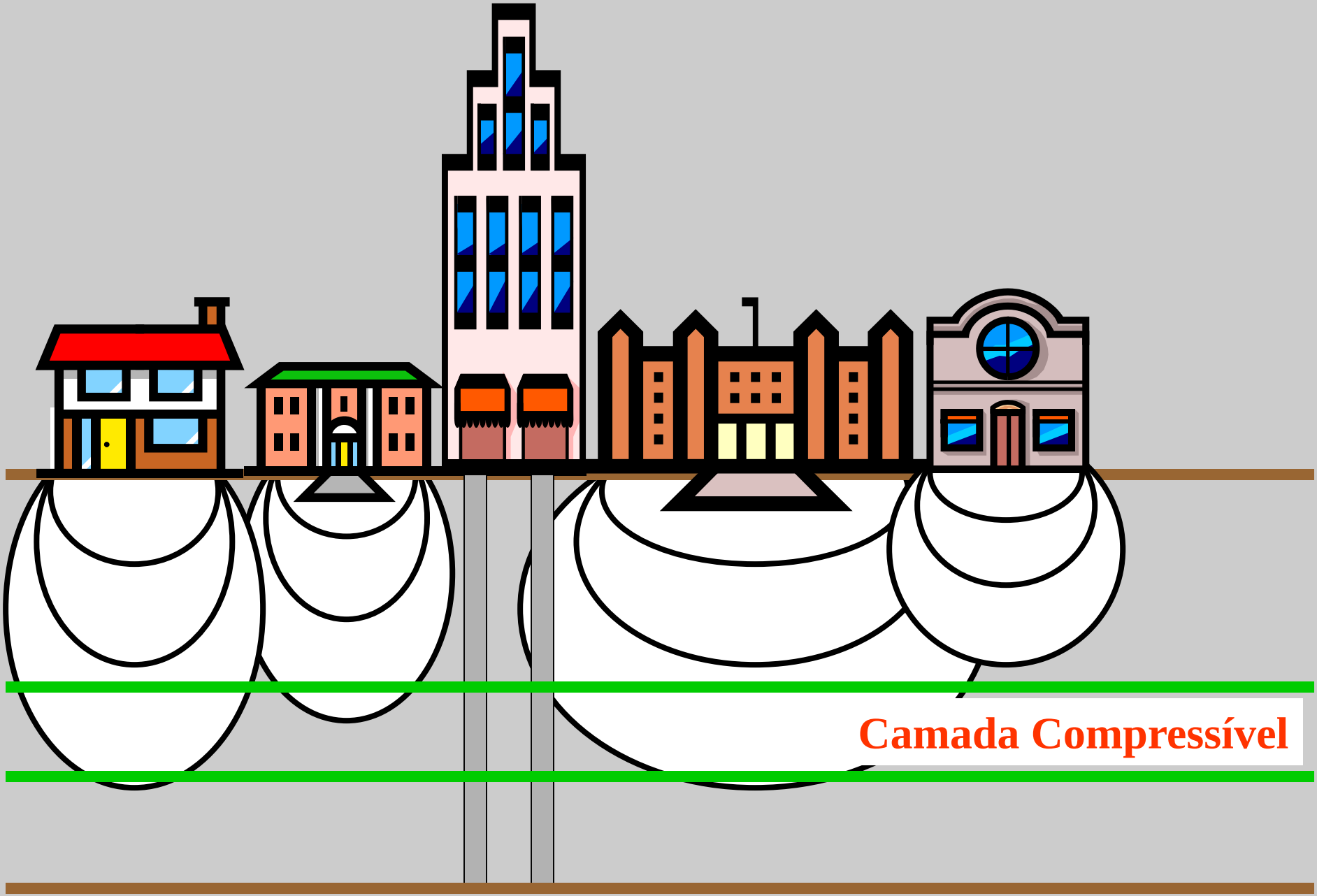
Prof. Fernando A. M. Marinho

Recalques e as construções

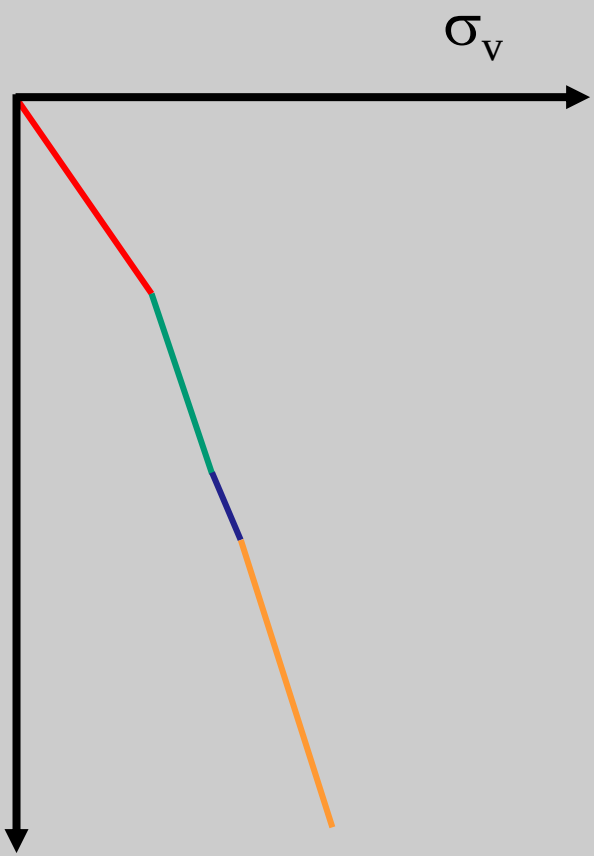
Castelo de Ussé, em que Charles Perrault se inspirou para escrever a "Bela Adormecida".

Recalques e as construções

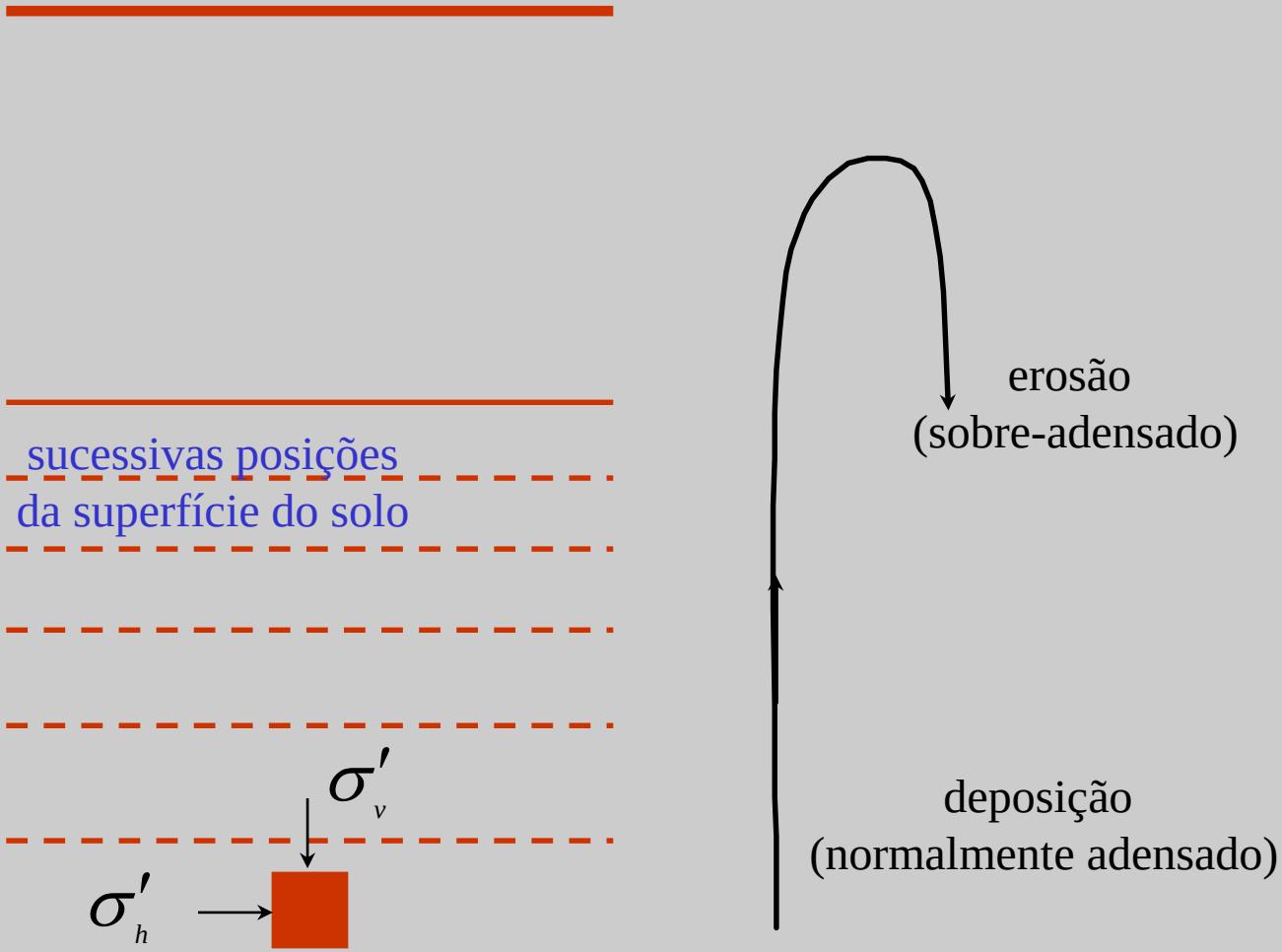
Santos
26 10 2001


Camada Compressível

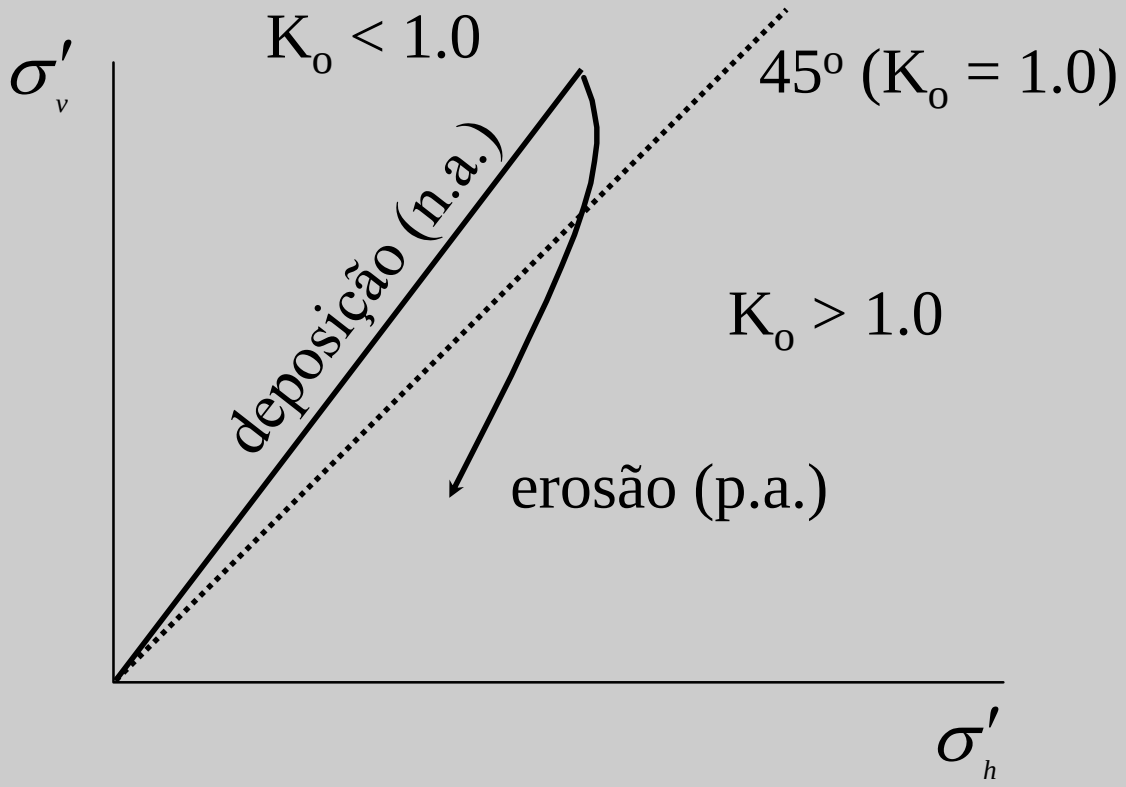
Tensão vertical no solo



Trajetória de Tensões
Deposição e Erosão

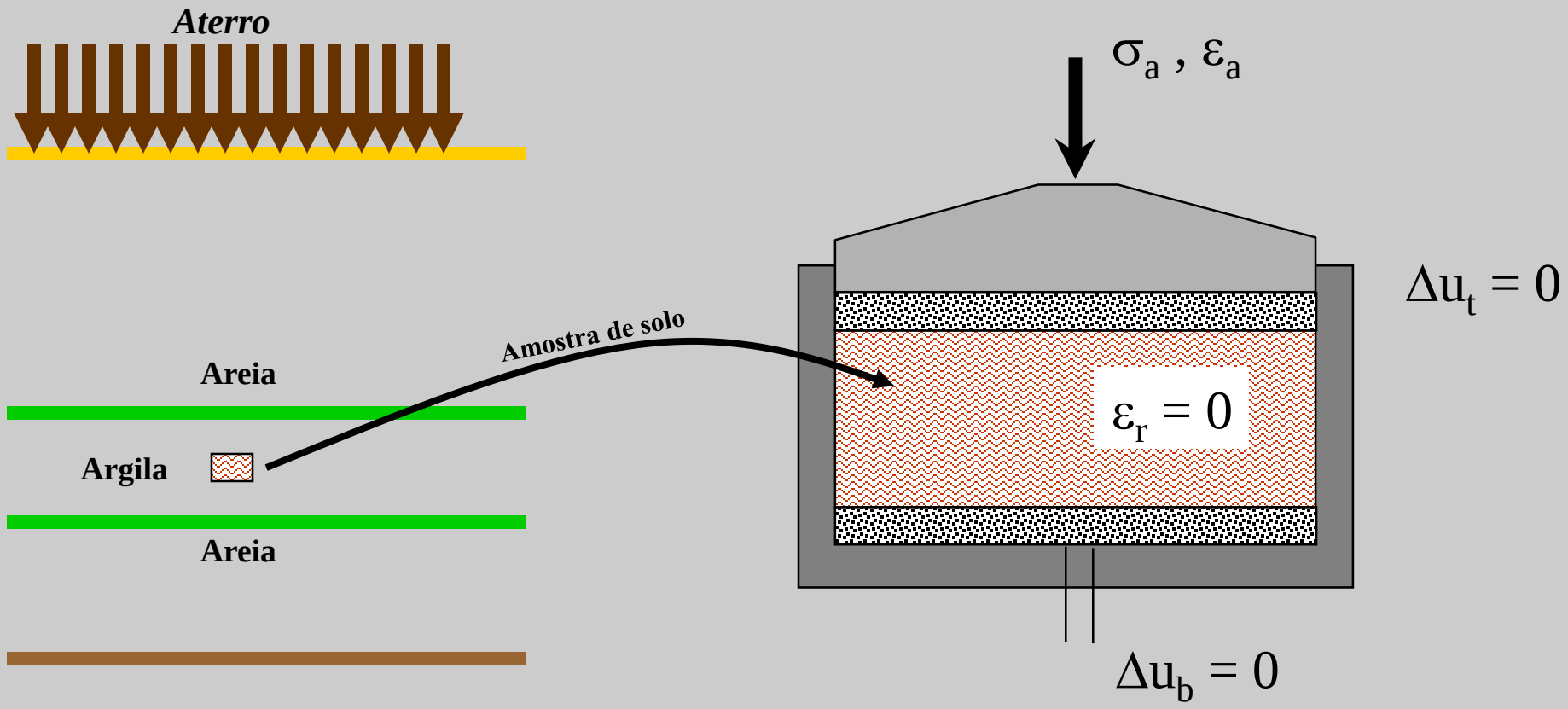


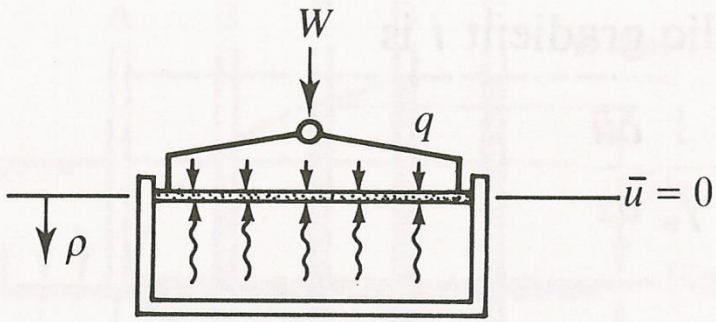
Trajetória de tensões



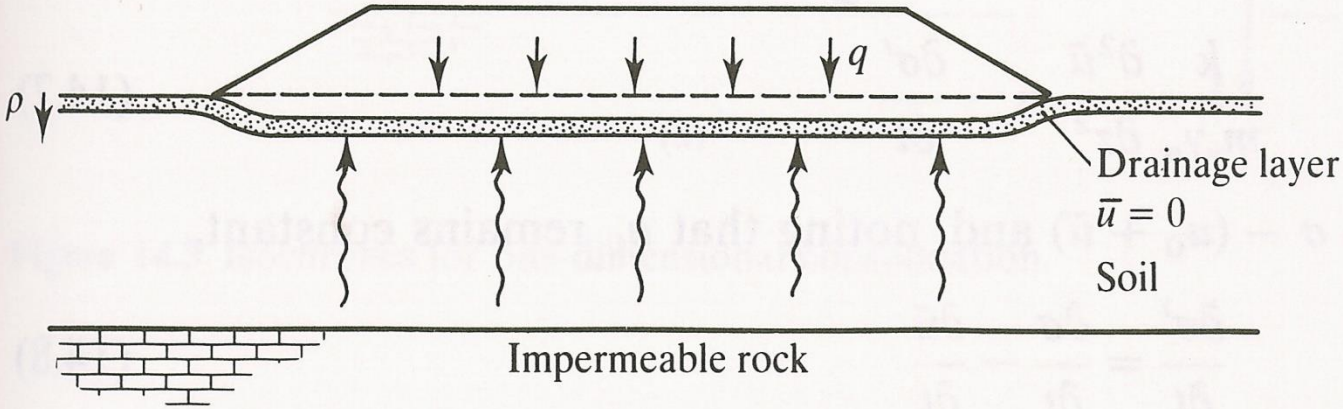
Compressão Uni-Dimesional - <u>Ensaio de Adensamento</u>

- **Condição K_o - Deformação lateral nula.**
- **Fluxo de água - vertical (uni-dimensional)**



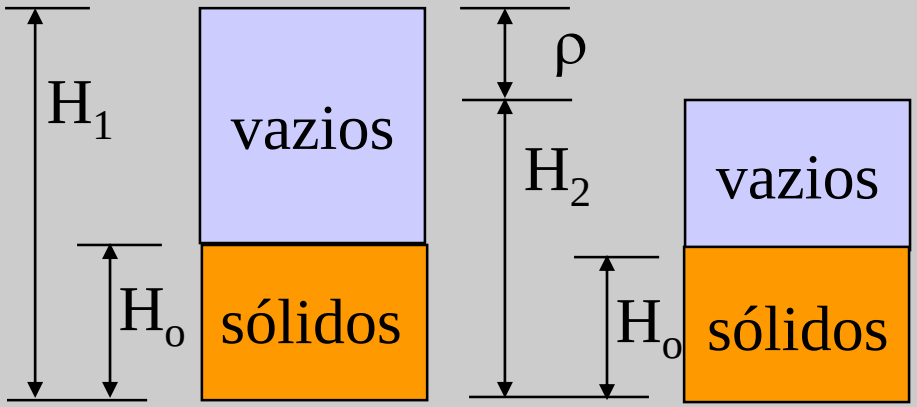


(a) Oedometer test

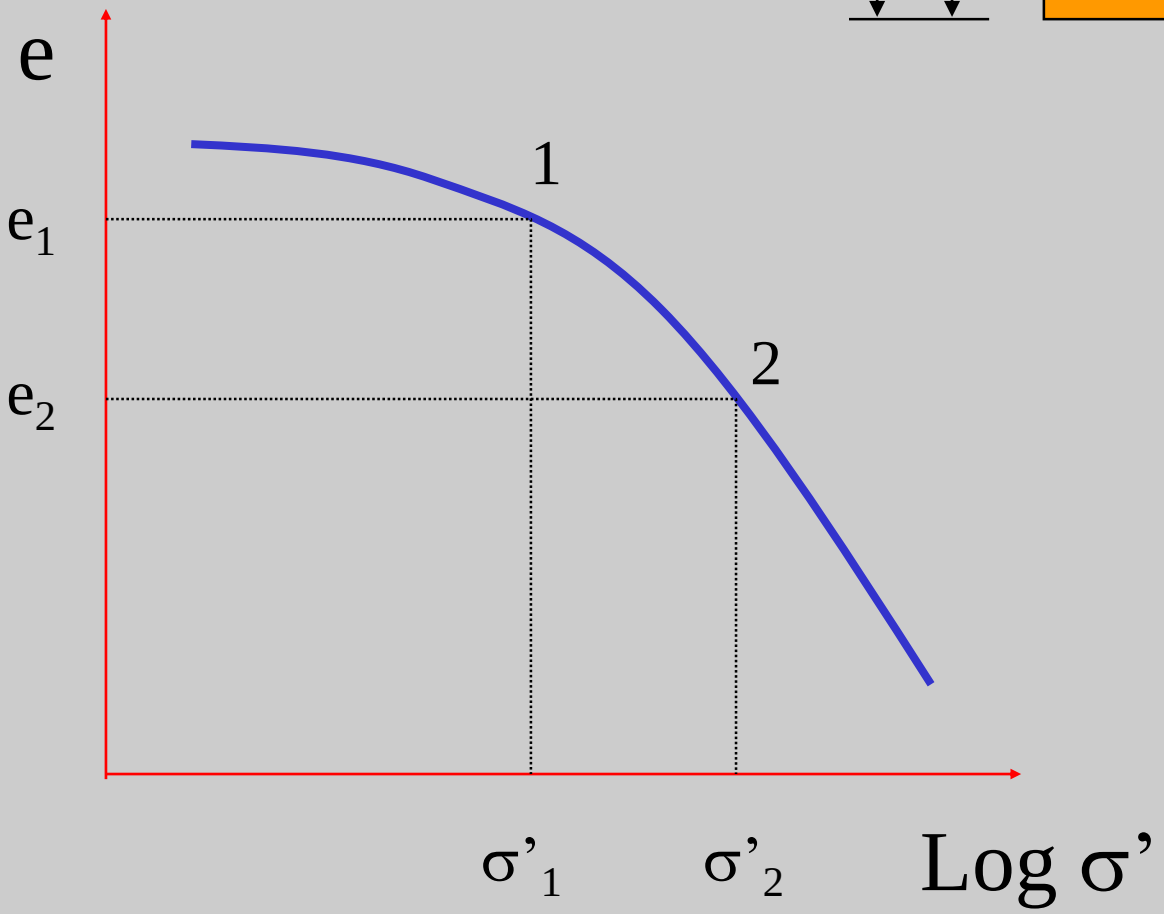


(b) Wide foundation

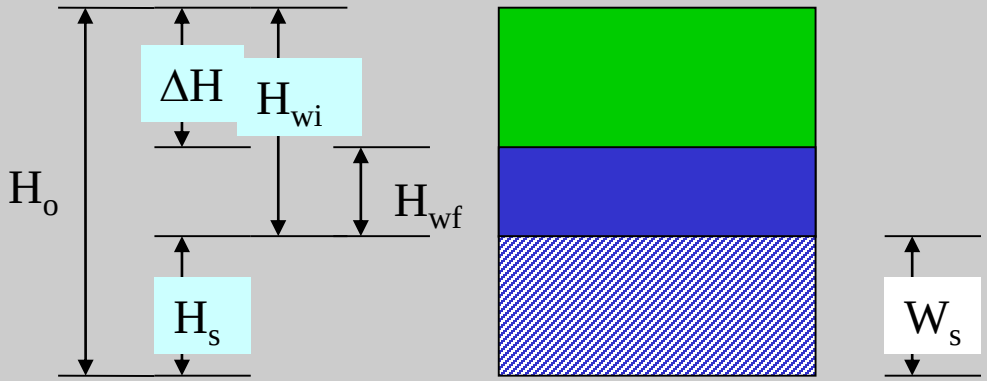
Atkinson (1993)



Após o recalque



Cálculos do ensaio



H_f - Altura final da amostra - (ensaio)
H_{wi} - Altura inicial de água = $w_i H_s G$
H_{wf} - Altura final de água = $w_f H_s G$
w - teor de umidade

$$\rho_s = \frac{M_s}{V_s} \Rightarrow V_s = \frac{M_s}{\rho_s}$$

$$H_s A = \frac{M_s}{\rho_s}$$

$$H_s = \frac{M_s}{A\rho_s} = \frac{M_s}{AG\gamma_w}$$

$$\rho_W = \frac{M_W}{V_W} \Rightarrow V_W = \frac{M_W}{\rho_W}$$

$$H_W A = \frac{M_W}{\rho_W} \Rightarrow H_W = \frac{M_W}{A\rho_W}$$

$$H_W = \frac{M_W}{A\rho_W}\frac{M_S}{M_S} \Rightarrow H_W = w\frac{M_S}{A\rho_W}$$

$$H_W = w\frac{M_S}{A}\frac{G}{\rho_S} \Rightarrow H_W = wH_S G$$

$$e = \frac{V_V}{V_S} = \frac{HA - H_S A}{H_S A} = \frac{H - H_S}{H_S}$$

Cálculos no ensaio

1 Altura de sólidos

$$H_s = \frac{M_s}{A\rho_s} = \frac{M_s}{AG\gamma_w}$$

2 Altura inicial de vazios

$$H_v = H_o - H_s$$

3 Índice de vazios inicial

$$e_o = \frac{V_v}{V_s} = \frac{H_v A}{H_s A} = \frac{H_v}{H_s}$$

4 Variação do índice de vazios para o primeiro incremento de carga

$$\Delta e_1 = \frac{\Delta H_1}{H_s}$$

5 Novo índice de vazios

$$e_1 = e_o - \Delta e_1$$

6 Demais carregamentos

$$e_2 = e_1 - \frac{\Delta H_2}{H_s}$$

Cálculos do recalque

$$e = \frac{V_v}{V_s} \qquad H_1 = H_s + H_v$$

$$H_v = V_v \qquad H_v = eV_s$$

$$H_1 = H_s + e_1 H_o$$

$$H_1 = H_s(1 + e_1)$$

$$H_2 = H_s(1 + e_2)$$

$$\rho = H_1 - H_2$$

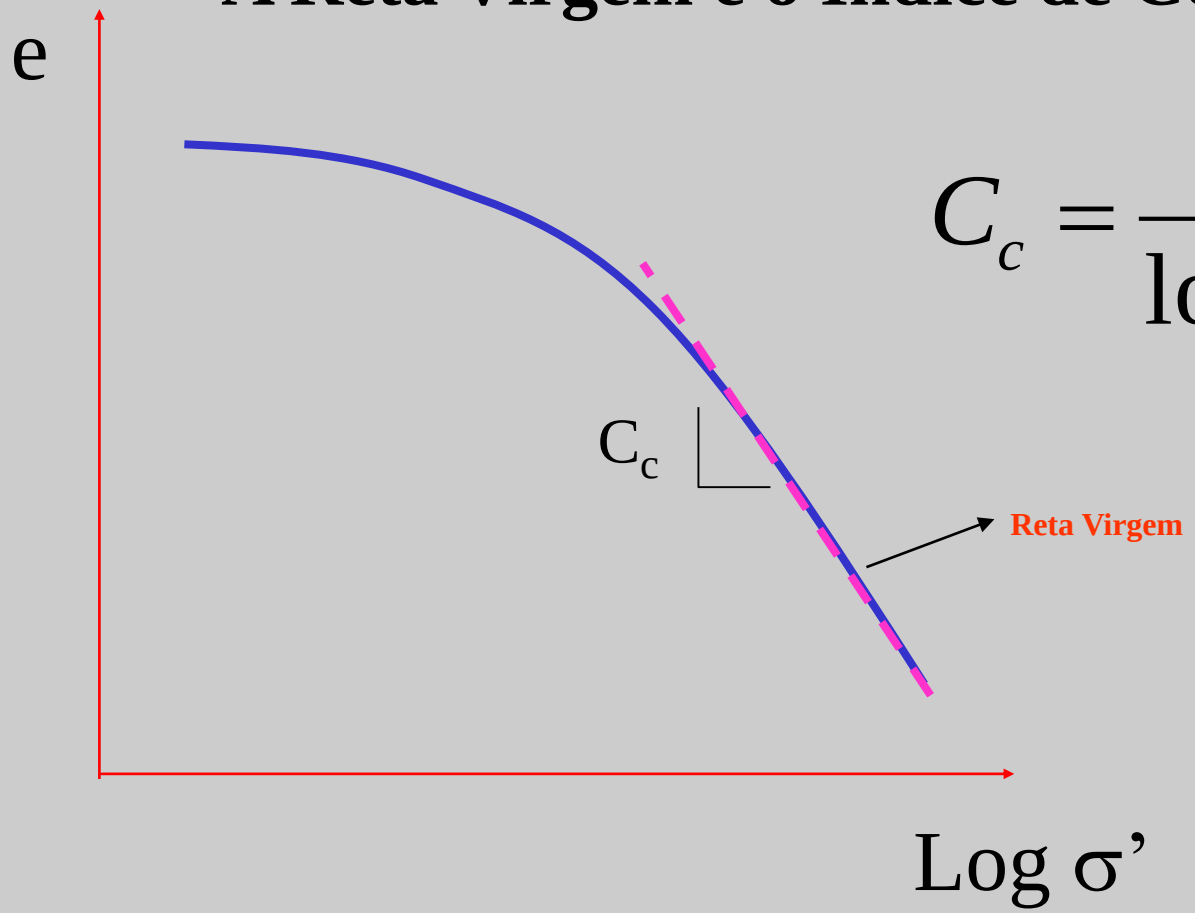
$$\rho = H_s(1 + e_1 - 1 - e_2)$$

$$\rho = H_s(e_1 - e_2)$$

$$H_s = \frac{H_1}{1 + e_1}$$

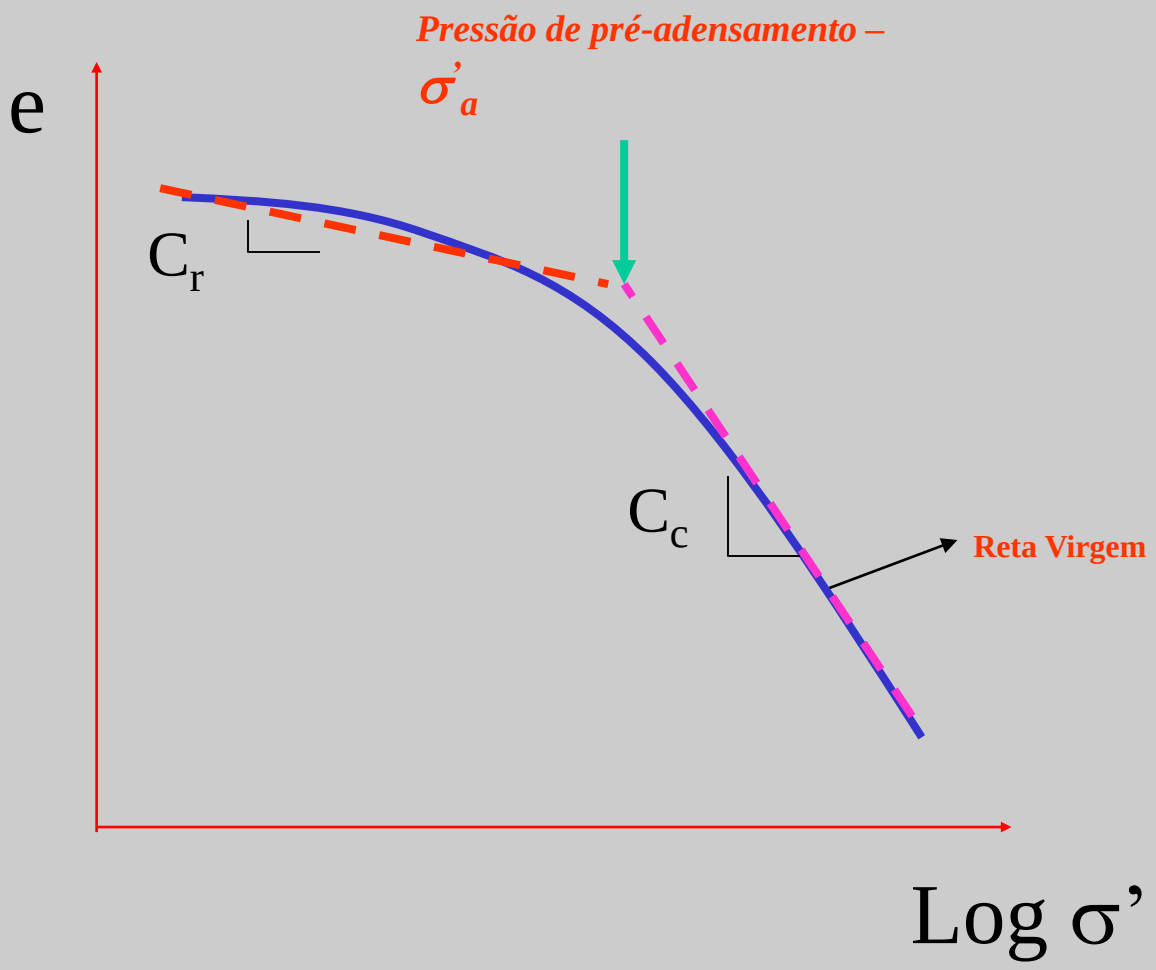
$$\boxed{\rho = \frac{H_1}{1 + e_1}(\Delta e)}$$

A Reta Virgem e o Índice de Compressão

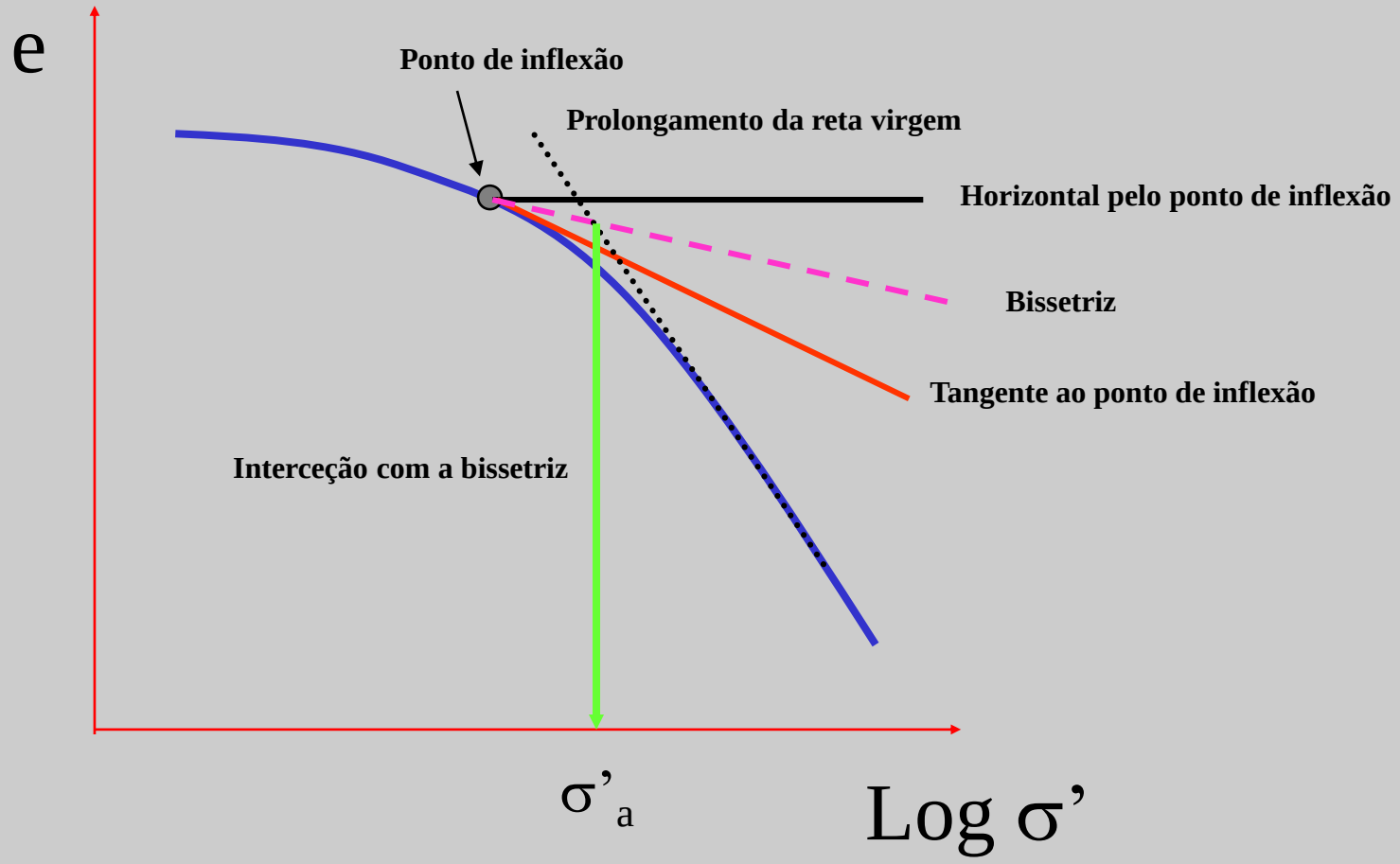


$$C_c = \frac{e_1 - e_2}{\log \sigma'_2 - \log \sigma'_1}$$

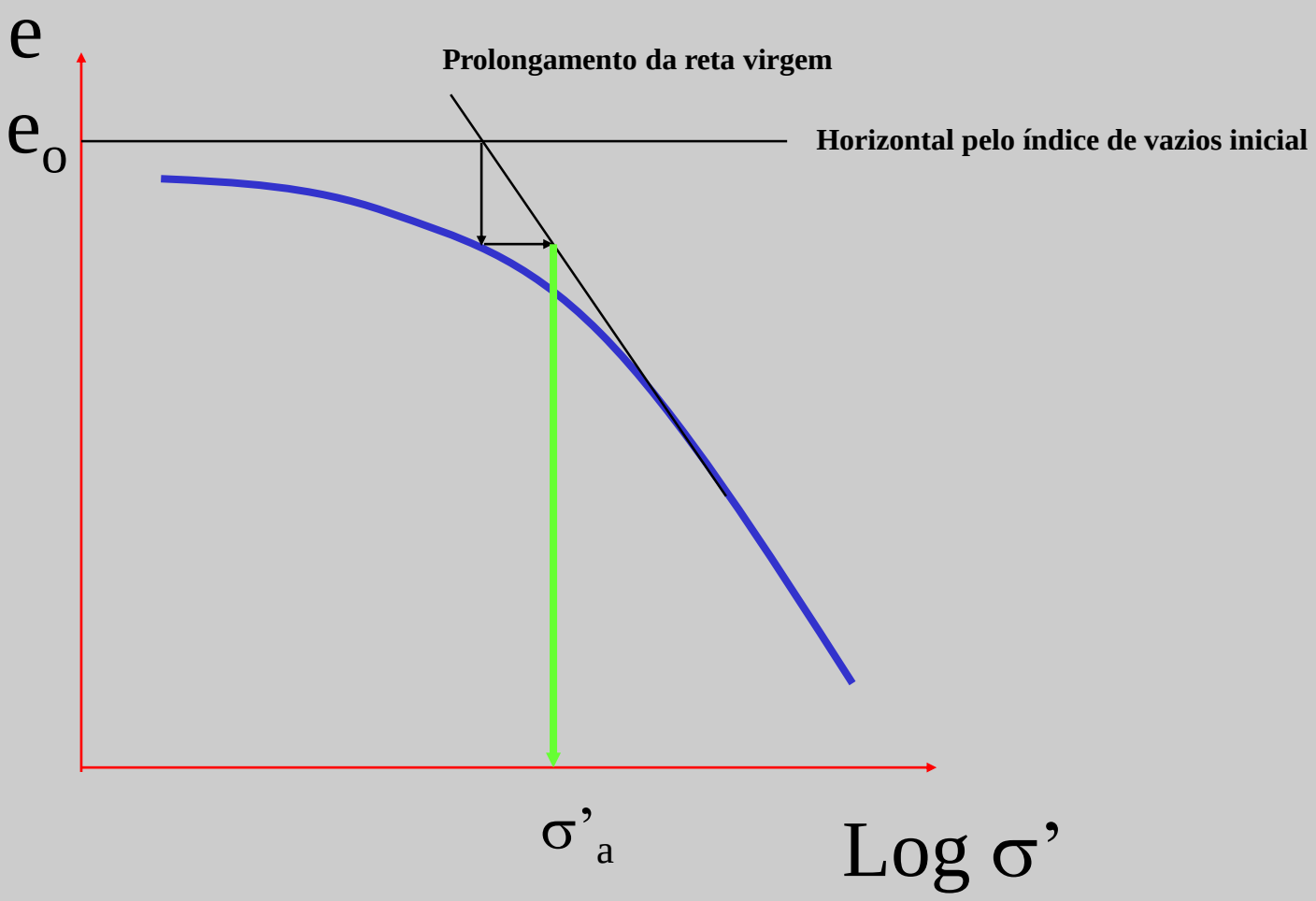
$$\rho = C_c \frac{H_1}{1 + e_1} \log\left(\frac{\sigma'_2}{\sigma'_1}\right)$$


Pressão de pré-adensamento –
σ'a
e
Cr
Cc
Reta Virgem
Log σ'

Método de Casagrande



Método de Pacheco Silva



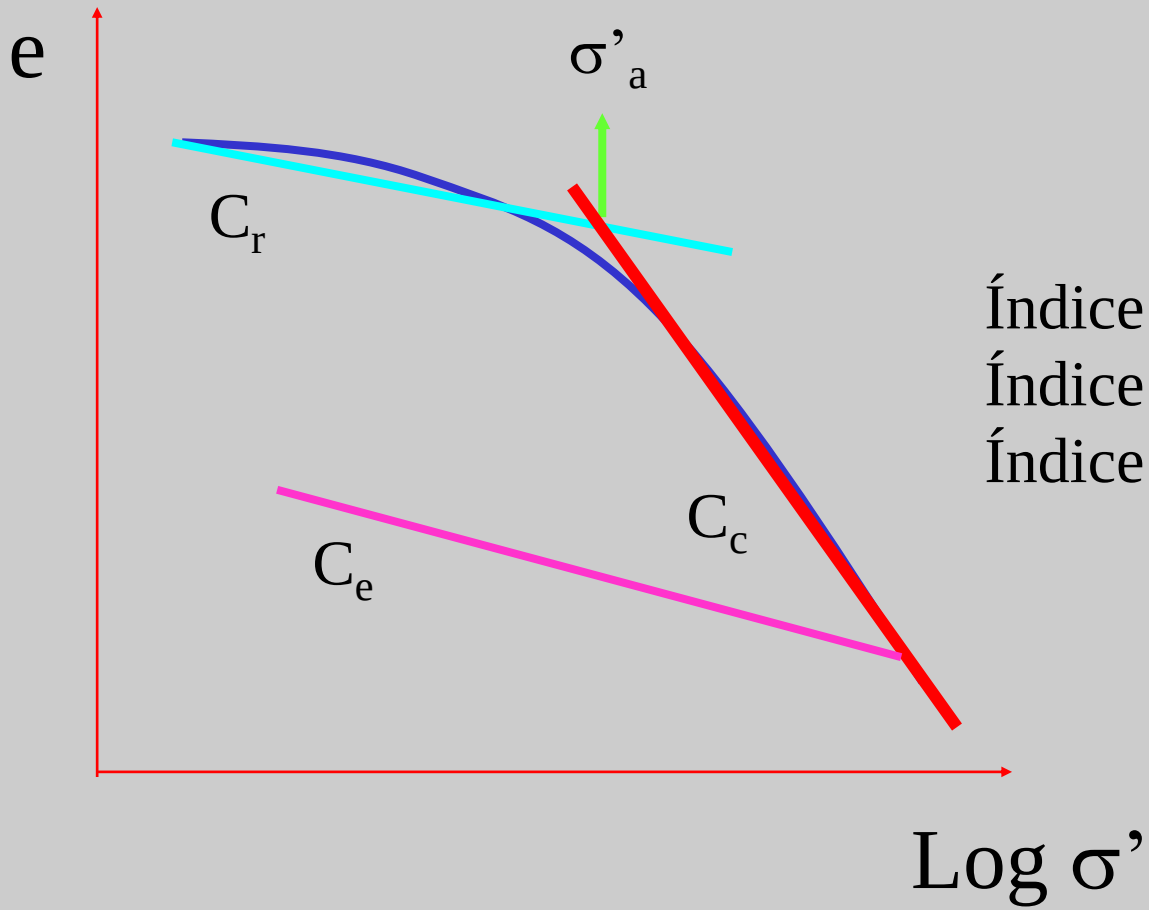
Solos Normalmente Adensados

A pressão de pré-adensamento é igual à pressão efetiva existente no solo por ocasião da amostragem

Solos Sobre-Adensados

A pressão de pré-adensamento é muito superior à pressão efetiva existente no solo por ocasião da amostragem

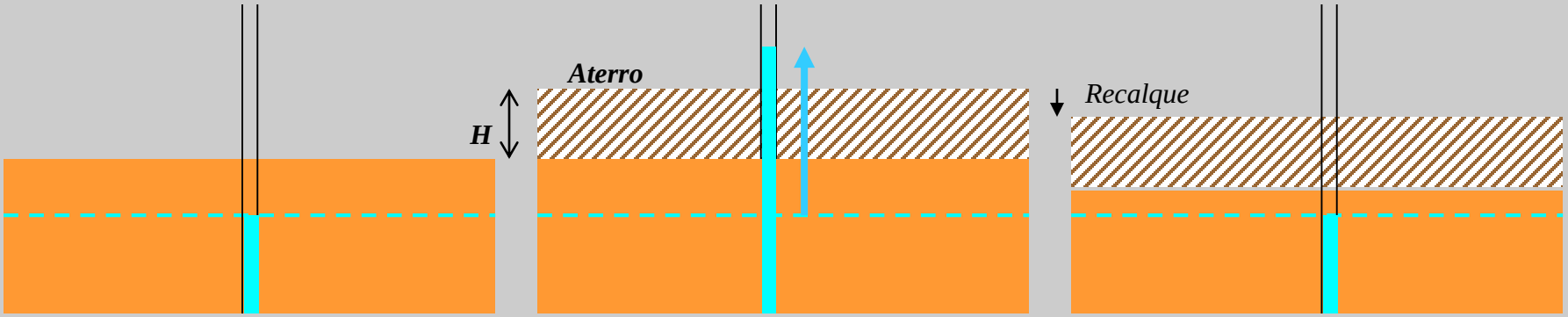
$$(Razão\ de\ Sobre\ Adensamento)\ RSA = \frac{\sigma'_a}{\sigma'_v}$$



Índice de Compressão - C_c
Índice de Recompressão - C_r
Índice de Expansão - C_e

$$\rho = \frac{H_1}{1+e_1}\left[C_r \log\left(\frac{\sigma'_a}{\sigma'_i}\right) + C_c \log\left(\frac{\sigma'_f}{\sigma'_a}\right)\right]$$

$$\gamma_{aterro} * H = \Delta\sigma = \Delta u$$



σ_i **aumento** → σ_f **constante** → σ_f

u_o **aumento** → $u_{\max}$ **diminuição** → u_o

σ'_i **constante** → σ'_i **aumento** → σ'_f