Article Stress-strain behavior of sand at high strain rates (Mehdi Omidvar et al,2012)

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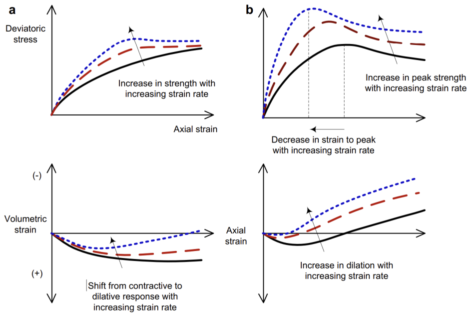

Fig. 19. Effect of increase in strain rate on stress-strain response and volumetric strains in (a) loose sand, (b) dense sand (interpreted based on data from Table 3).

"Under HSR loading, there is not enough time for strain energy accumulation, which prohibits crushing and promotes rolling-rearrangement resulting in a higher resistance to shear"

Trouver le régime de l'état critique

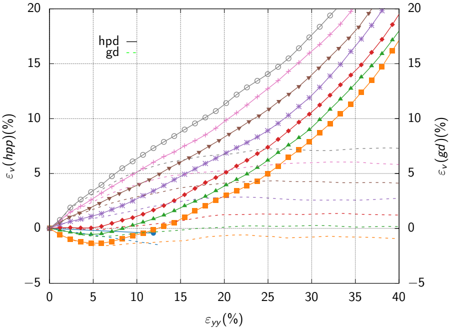

Figure 1 – Déformation Volumique

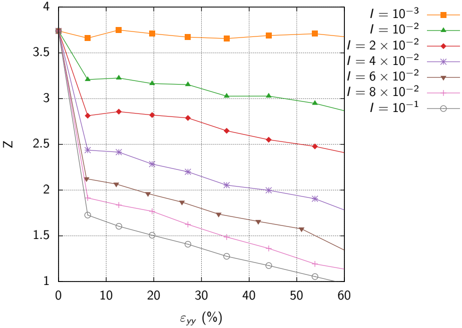

Figure 2 – Nombre de Coordination

$$\text{hpp} : \varepsilon_{yy} = \frac{\Delta h_{yy}}{h_{yy}^0} ; \varepsilon_v = \varepsilon_{xx} + \varepsilon_{yy} + \varepsilon_{zz}$$

$$\text{gd} : \varepsilon_{yy} = \ln\left(\frac{h_{yy}}{h_{yy}^0}\right) ; \varepsilon_v = \frac{\Delta V}{V_0} ;$$

$$Z = \frac{2N_{contact}}{N_{particule}} ; I = \frac{v}{H_0}\sqrt{\frac{m}{P\bar{a}}}$$

Trouver le régime de l'état critique

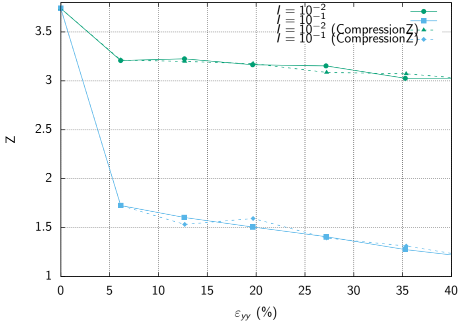

Figure 3 – Nombre de Coordination

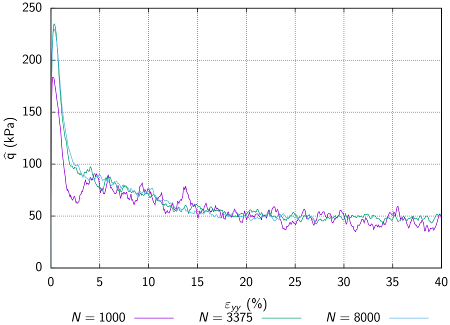

Figure 4 – Nombre de Particules

échantillon aléatoire par compression dans l'axe Z

État Rankine - Modèle

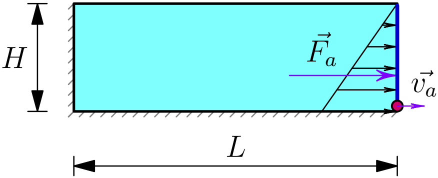

Figure 5 – Pression active

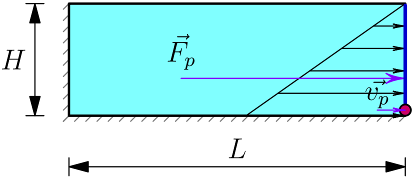

Figure 6 – Pression passive

Observer la pression sur le mur en bleu

Paramètres principaux

Symbole	Paramètre	Valeur
L	Longueur	3 m
H	Hauteur	1 m
ρ	Densité	$2700\ \mathrm{kg/m^3}$
E	Module de Young	$1 \times 10^9\ \mathrm{Pa}$
ν	Coefficient de Poisson	0.2
φ	Angle de frottement interne	25°
ψ	Angle de dilatance	$\approx$ 0°
v	Vélocité de déplacement	0.005 m/s
c	Cohésion	0 & 100 Pa
μ	Coefficient de frottement entre le mur et les PMs	0 & 0

Table 1 – Paramètres du modèle (loi Mohr-Coulomb)

État Rankine - Stabiliser

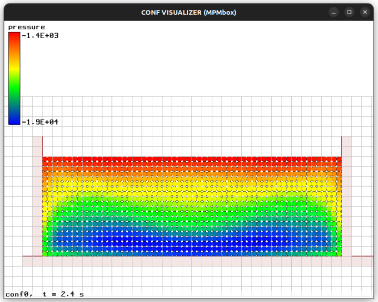

Figure 7 – Pression en bas

$$P_{\text{théorique}} = 2.65e4 \ (Pa)$$

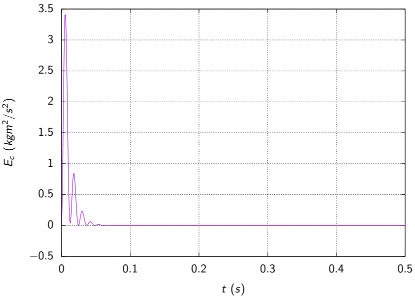

Figure 8 – Énergie cinétique

$$P_{\text{simulation}} = 2e4 \ (Pa)$$

→ L'écart est 0.65 kPa

État Rankine - Théorie

Coefficient K : la relation entre la contrainte verticale et horizontal :

- Poussée active : $K_a = \dfrac{1 - \sin(\varphi)}{1 + \sin(\varphi)} = 0.406$
- Poussée passive : $K_p = 1/K_a = 2.464$
- État au repos : $K_0 = 1 - \sin(\varphi) = 0.577$

La somme de pression F(kN) appliqué sur le mur :

Sans cohésif :

$$F_a = \frac{1}{2}\gamma H^2 K_a = 5.376861$$

$$F_a = \frac{1}{2}\gamma H^2 K_p = 32.619458$$

$$F_0 = \frac{1}{2}\gamma H^2 K_0 = 7.647$$

Cohésif :

$$F_a = \frac{1}{2}\gamma H^2 K_a - 2cH\sqrt{K_a} = 5.249425$$

$$F_p = \frac{1}{2}\gamma H^2 K_p + 2cH\sqrt{K_p} = 32.93334$$

$$F_0 = \frac{1}{2}\gamma H^2 K_p + 2cH\sqrt{K_0} = 7.495$$

État Rankine reposé

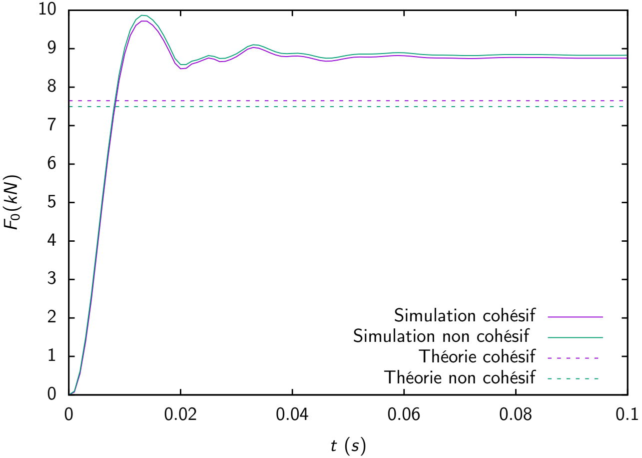

Figure 9 – Pression sur le mur en bleu

→ L'écart est 1 kPa

État Rankine - Pression Active

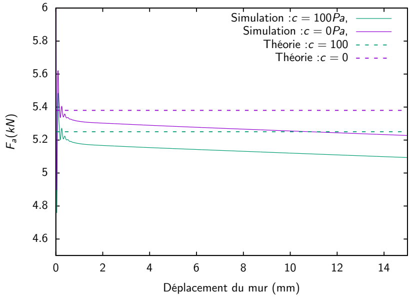

Figure 10 – Pression active
$v = 0.005 = const$

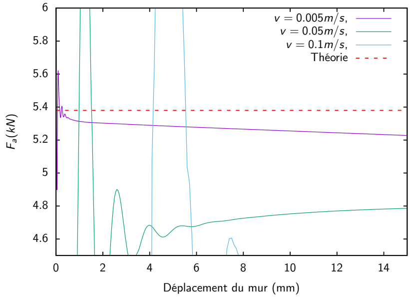

Figure 11 – Pression active
$c = 0 = const$

Effet cinétique ?

$\rightarrow$ L'écart est 0.65 kPa

État Rankine - Pression Passive

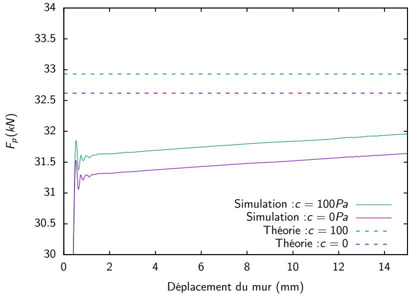

Figure 12 – Pression passive
$v = -0.005 = const$

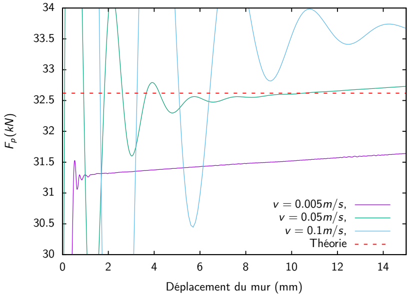

Figure 13 – Pression passive
$c = 0 = const$

Effet cinétique ?

→ L'écart est 1 kPa