

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

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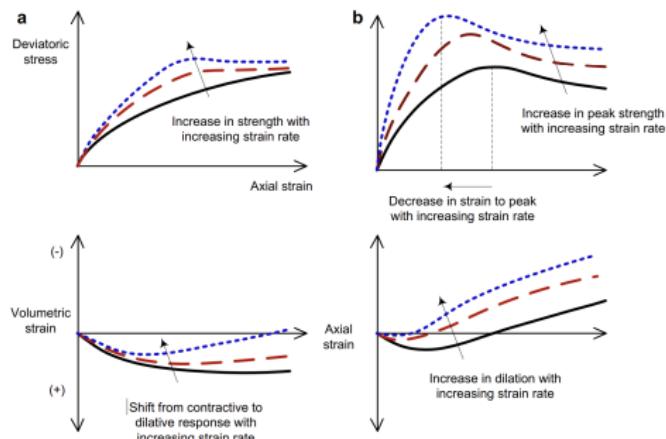


Fig. 19. Effect of increase in strain rate on stress-strain response and volumetric strains in (a) loose sand, (b) dense sand (interpreted based on data from Table 3).

"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

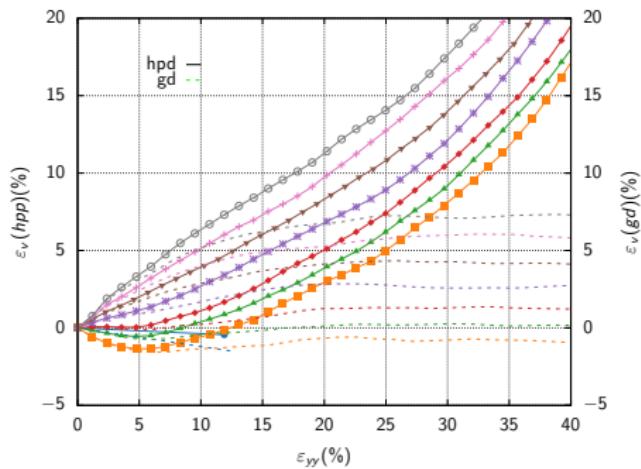


Figure 1 – Déformation Volumique

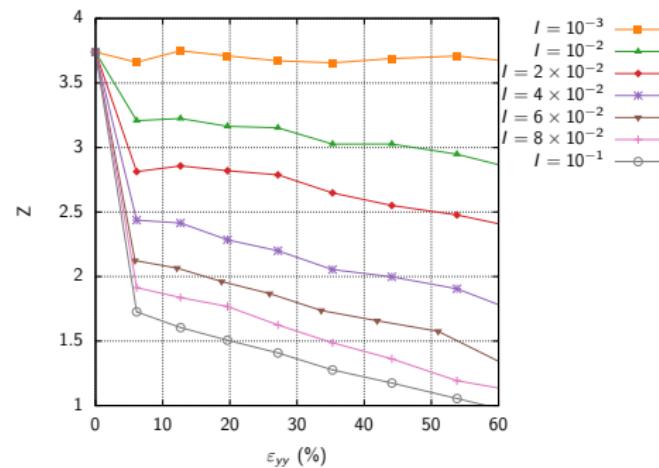


Figure 2 – Nombre de Coordination

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

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

Trouver le régime de l'état critique

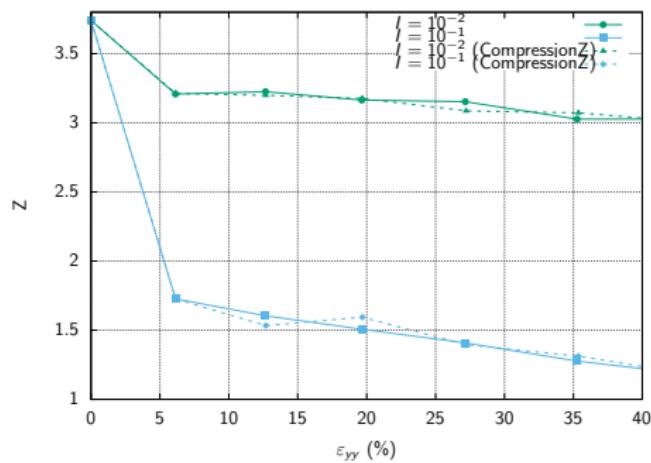


Figure 3 – Nombre de Coordination

échantillon aléatoire par compression dans l'axe Z

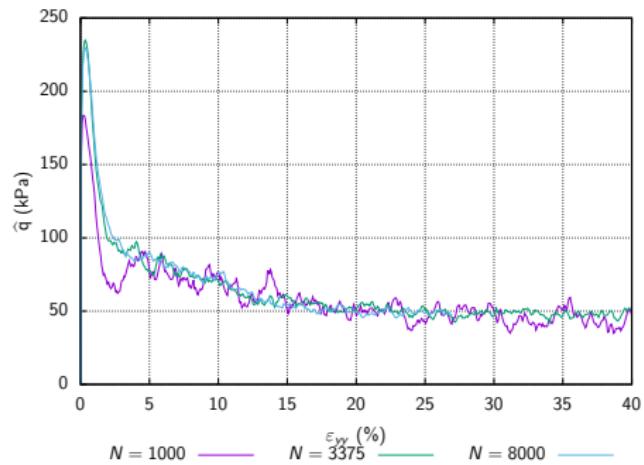


Figure 4 – Nombre de Particules

État Rankine - Modèle

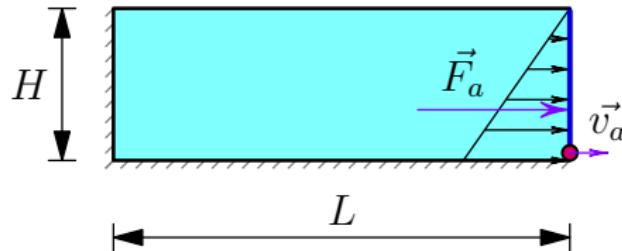


Figure 5 – Pression active :le mur s'éloigne du sol

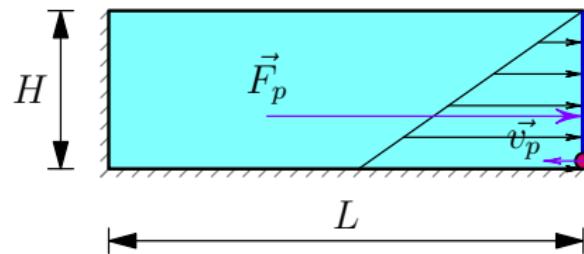


Figure 6 – Pression passive :le mur se rapproche du sol

Observer la pression sur le mur en bleu

Paramètres principaux

Symbol	Paramètre	Valeur
L	Longueur	3 m
H	Hauteur	1 m
ρ	Densité	2700 kg/m ³
E	Module de Young	1×10^9 Pa
ν	Coefficient de Poisson	0.2
φ	Angle de frottement interne	25°
ψ	Angle de dilatance	≈ 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

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

État Rankine - Stabiliser

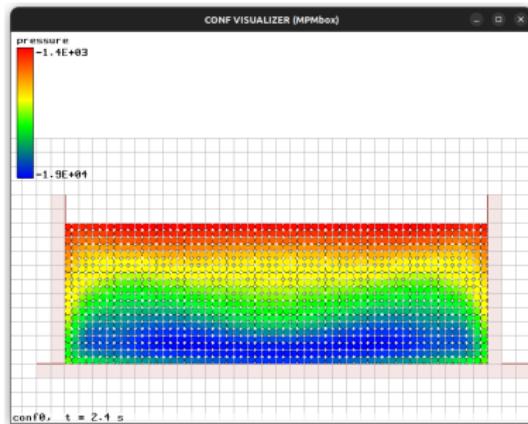


Figure 7 – Pression en bas

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

→ L'écart est 0.65 kPa

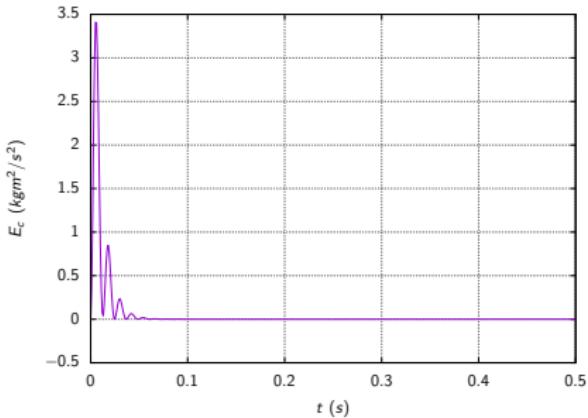


Figure 8 – Énergie cinétique

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

État Rankine - Théorie

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

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

La somme de pression $F(kN)$ appliquée 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 :

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

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

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

État Rankine reposé

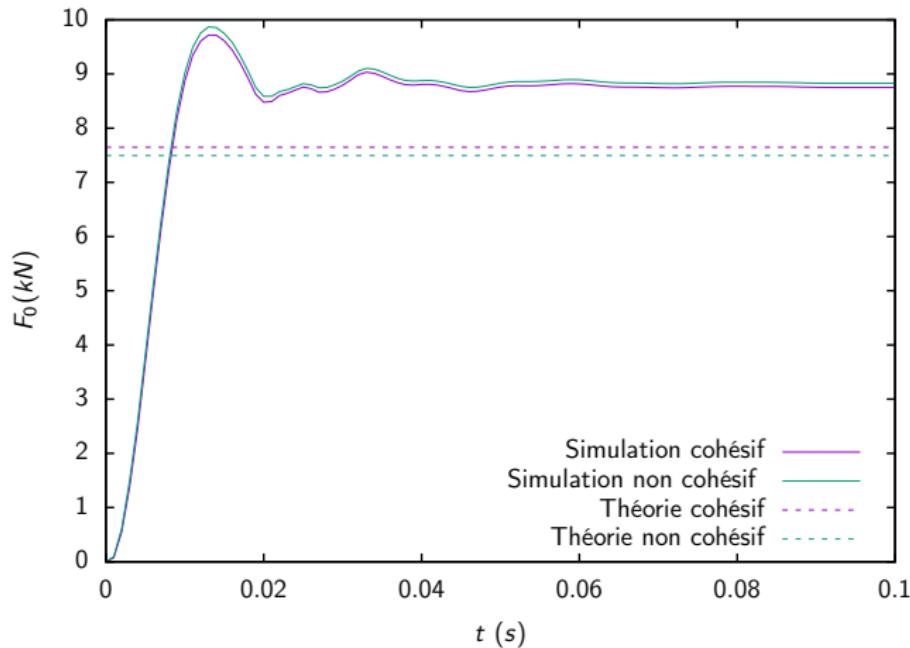


Figure 9 – Pression sur le mur en bleu

→ L'écart est 1 kPa (13%)

État Rankine - film de mur bougé

Figure 10 – Pression active

Figure 11 – Pression passive

État Rankine - Pression Active

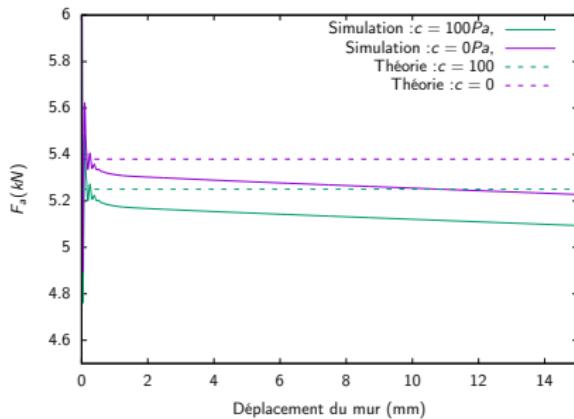


Figure 12 – Pression active
 $v = 0.005 = \text{const}$

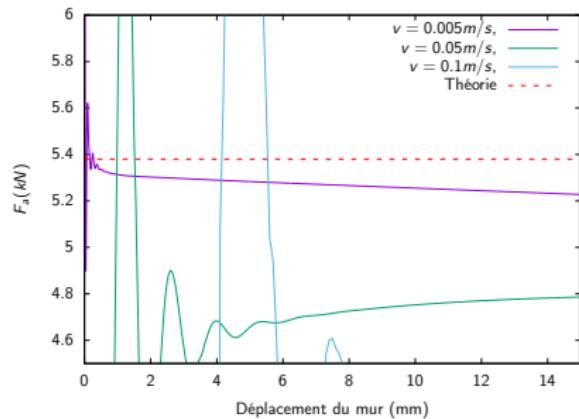


Figure 13 – Pression active
 $c = 0 = \text{const}$

Effet cinétique ? Résistance rigide du matériau ?

→ L'écart est 0.2 kN (3%)

État Rankine - Pression Passive

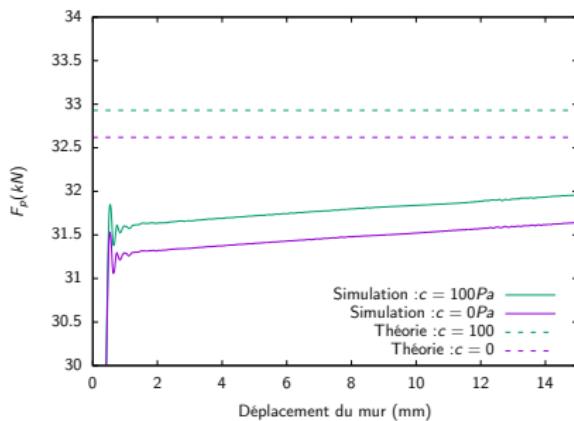


Figure 14 – Pression passive
 $v = -0.005 = \text{const}$

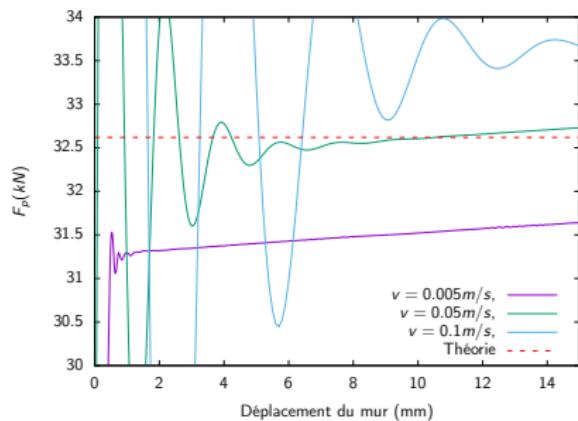


Figure 15 – Pression passive
 $c = 0 = \text{const}$

Effet cinétique ?

→ L'écart est 1 kN (3%)

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