12.005 Lecture Notes 10

A house built upon sand…

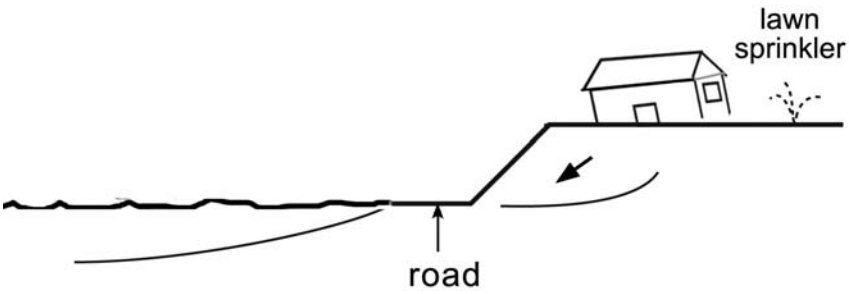

Figure 10.1

Figure by MIT OCW.

"Theory" Sand follows Amonton's Law: $\tau = \mu|\sigma_n|$
(Mohr – Coulomb)

Modify for pore fluid: $\tau = \mu|\sigma_n| - |p_f|$

Need to express τ and σ_n on any arbitrary plane develop stress tensor (symmetric)

$$\underset{\sim}{T} = \underset{\approx}{\sigma}\hat{n}$$

or

$$T_i = \sigma_{ij} n_j$$

$$\sigma_n = \underset{\sim}{T} \cdot \hat{n}$$

Mohr circle construction

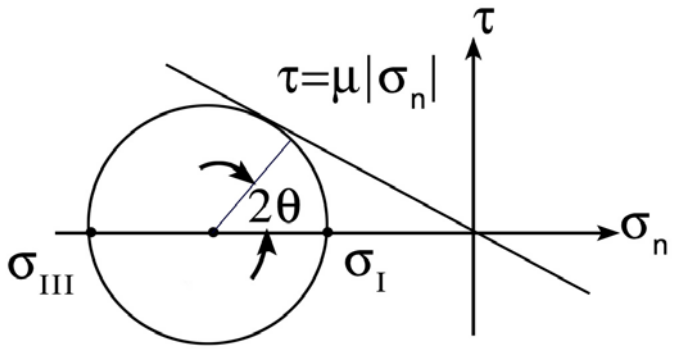

Figure 10.2

Figure by MIT OCW.

Application to accretionary wedge

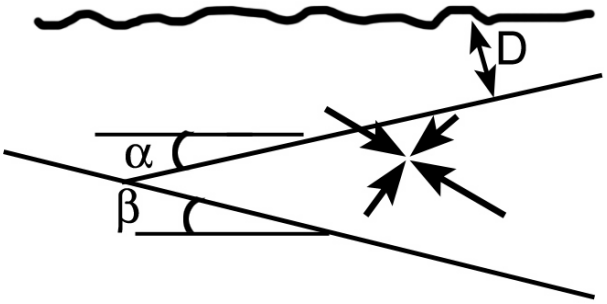

Figure 10.3

Figure by MIT OCW.

Assume

- On verge of failure everywhere
- μ, λ^* μ_b, λ_b

Trigonometry relates $\alpha, \beta, \mu, \mu_b$, …

Pore Fluid

$$\lambda = \frac{p_f - \rho_w g D}{|\sigma_{zz} - \rho_w g D|}$$

Often:

$$\sigma_{zz} \; ; \; -\rho g (1-\lambda) z \cos(\alpha)$$

Sandbox tectonics

Rheology – "Brittle failure" – friction dominates
[comp σ positive $\rightarrow$]

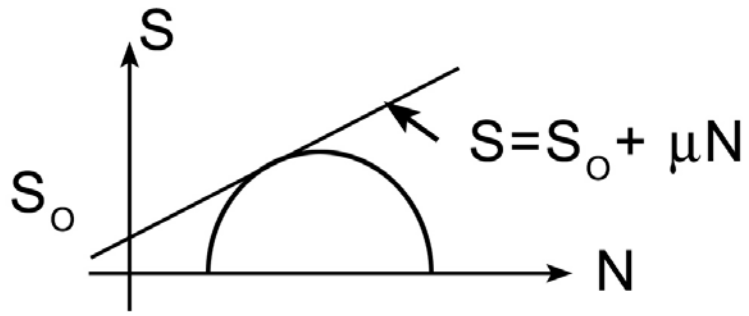

Figure 10.4

Figure by MIT OCW.

Applications:

A)

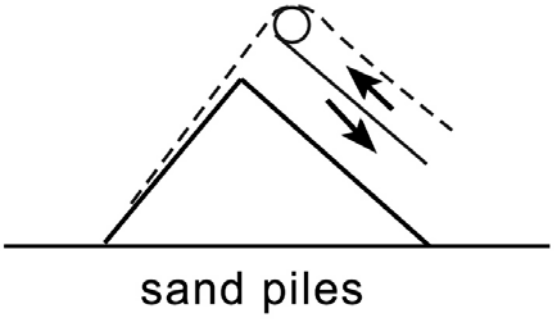

Figure 10.5

Figure by MIT OCW.

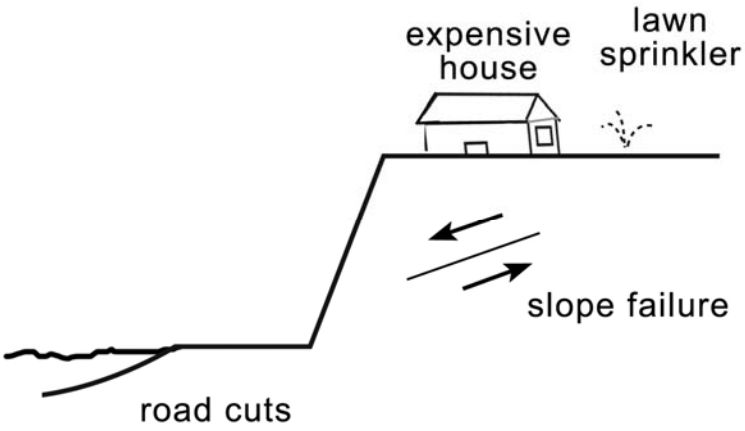

Figure 10.6

Figure by MIT OCW.

B)

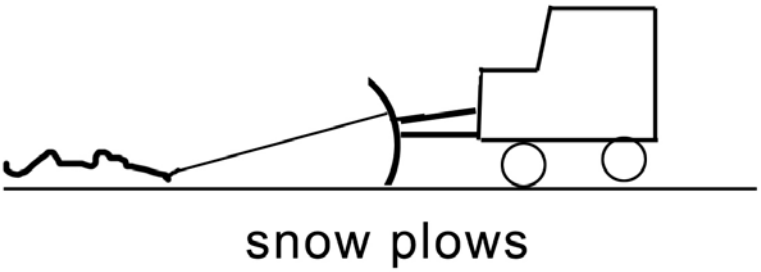

Figure 10.7

Figure by MIT OCW.

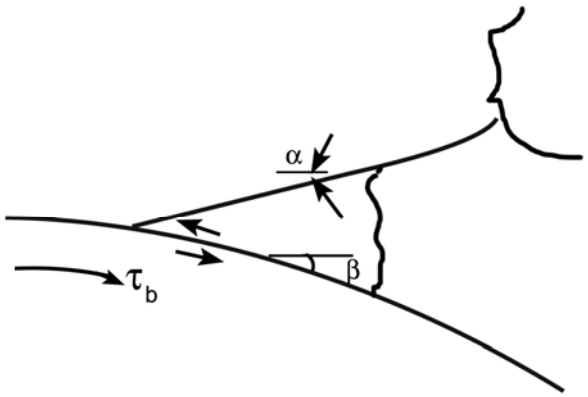

Figure 10.8

Figure by MIT OCW.

Consider stress only – only variable for brittle failure
neglect strain, velocity, inertia, …

Possible paradoxes:

Type A) "$\angle_{\text{int}\mu} = \angle_{repose}$" $\Rightarrow$ "strong $\Rightarrow$ steep"

Type B) strong $\Rightarrow$ flat

Viscous fluid, type A&B weak $\Rightarrow$ falt

Complicating factors:

Pore pressure; based decollement