A house built upon sand…

“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 \( \tau \) and \( \sigma_n \) on any arbitrary plane develop stress tensor (symmetric)

\[
\mathbf{T} = \sigma \mathbf{n} \hat{n}
\]

or

\[
T_i = \sigma_{ij}n_j
\]

\[
\sigma_n = \mathbf{T} \cdot \hat{n}
\]

Mohr circle construction
Application to accretionary wedge

Assume

- On verge of failure everywhere
- $\mu, \lambda^*, \mu_b, \lambda_b$

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

Pore Fluid

$$\lambda = \frac{p_f - \rho_g D}{\left| \sigma_z - \rho_g D \right|}$$

Often:

$$\sigma_z - \rho g (1 - \lambda) z \cos(\alpha)$$

**Sandbox tectonics**

Rheology – “Brittle failure” – friction dominates
[comp $\sigma$ positive $\rightarrow$ ]
Applications:

A)

![Diagram of sand piles](image1)

Figure 10.5
Figure by MIT OCW.

B)

![Diagram of slope failure](image2)

Figure 10.6
Figure by MIT OCW.

B)

![Diagram of snow plows](image3)

Figure 10.7
Figure by MIT OCW.
Consider stress only – only variable for brittle failure
neglect strain, velocity, inertia, …

Possible paradoxes:
Type A) “$\angle_{\text{int}} = \angle_{\text{repose}}$” $\Rightarrow$ “strong $\Rightarrow$ steep”
Type B) strong $\Rightarrow$ flat
Viscous fluid, type A&B weak $\Rightarrow$ flat

Complicating factors:
Pore pressure; based decollement