Stress in Static Sandpiles

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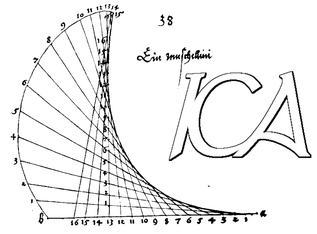
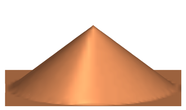
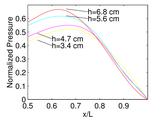


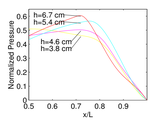
Ground pressure beneath a sandpile



conical sandpile



rape seed



sea sand

Pressure minimum below the center of the pile

↓

DIP

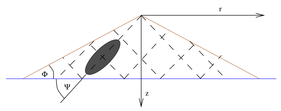
FPA Fixed Principal Axis

$$\partial_r \sigma_{rr} + \partial_z \sigma_{rz} = 0$$
$$\partial_r \sigma_{rz} + \partial_z \sigma_{zz} = \rho g$$

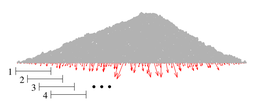
2 equations – 3 unknowns

Search for relations between the elements of the stress tensor

Assumption:
The principal axis of the stress tensor has a fixed inclination

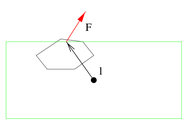


Calculation of the pressure



$$p_i = \frac{1}{l_i} \sum_{k \in i} F_k^{\perp}$$

Calculation of the stress tensor

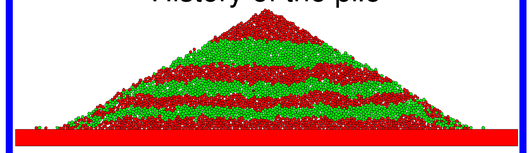


$$\sigma_{ij} = \frac{1}{2V} \sum (l_i F_j + l_j F_i)$$

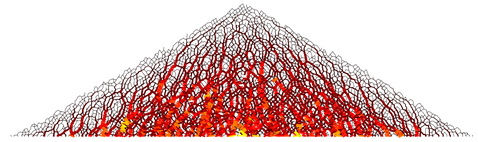
Heap #1

- Layered Sequence
- 3249 particles
- 7 corners, round

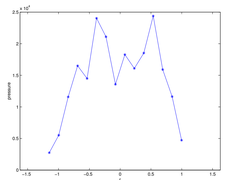
History of the pile



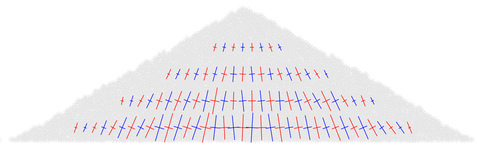
Network of Forces



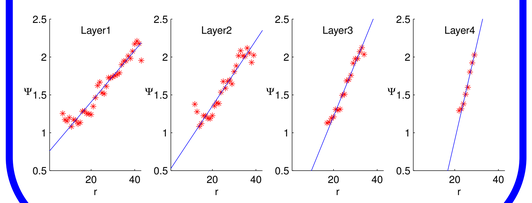
Pressure onto the ground



Principal axis of the stress tensor



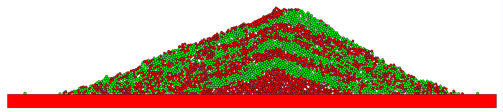
Angle of the major principal axis



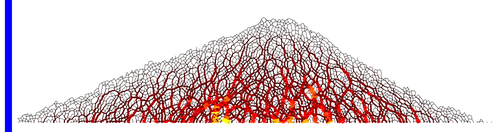
Heap #2

- Wedge Sequence
- 3336 particles
- 7 corners, round

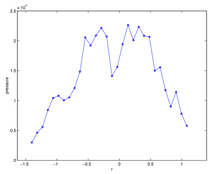
History of the pile



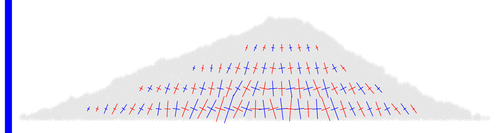
Network of Forces



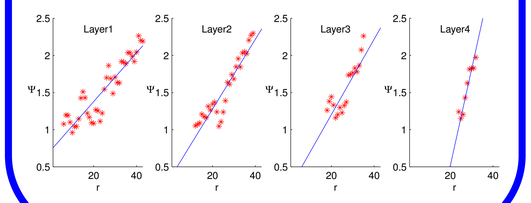
Pressure onto the ground



Principal axis of the stress tensor



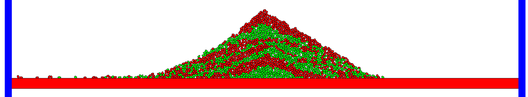
Angle of the major principal axis



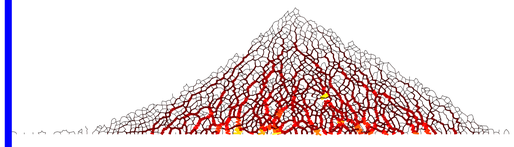
Heap #3

- Wedge Sequence
- 1502 particles
- 6,7,8 corners, elliptic

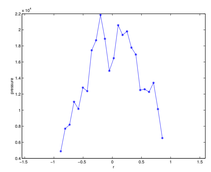
History of the pile



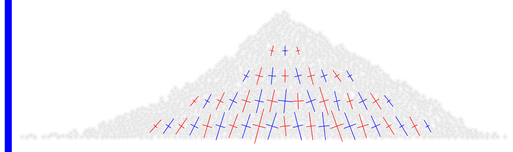
Network of Forces



Pressure onto the ground



Principal axis of the stress tensor



Angle of the major principal axis