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2D and 3D discrete numerical modelling of soil arching

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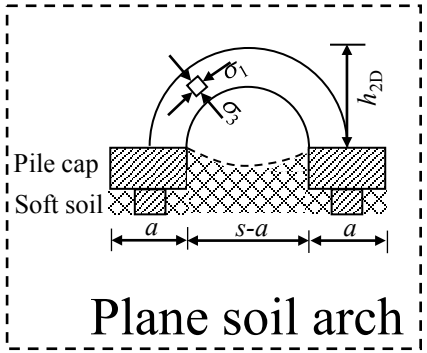
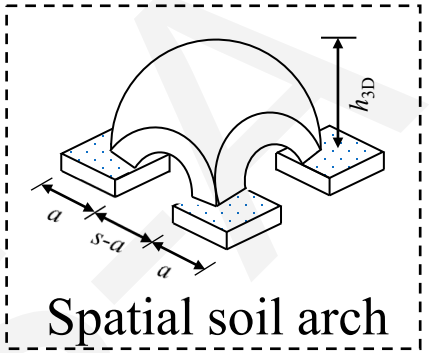
Outlines



Similarities

Differences



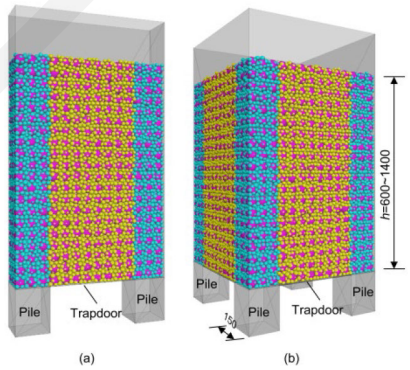
Deformation characteristics

Maximum displacement

Force chains

Stress-displacement response

2D & 3D DEM trapdoor model



Fill porosity

Friction coefficient

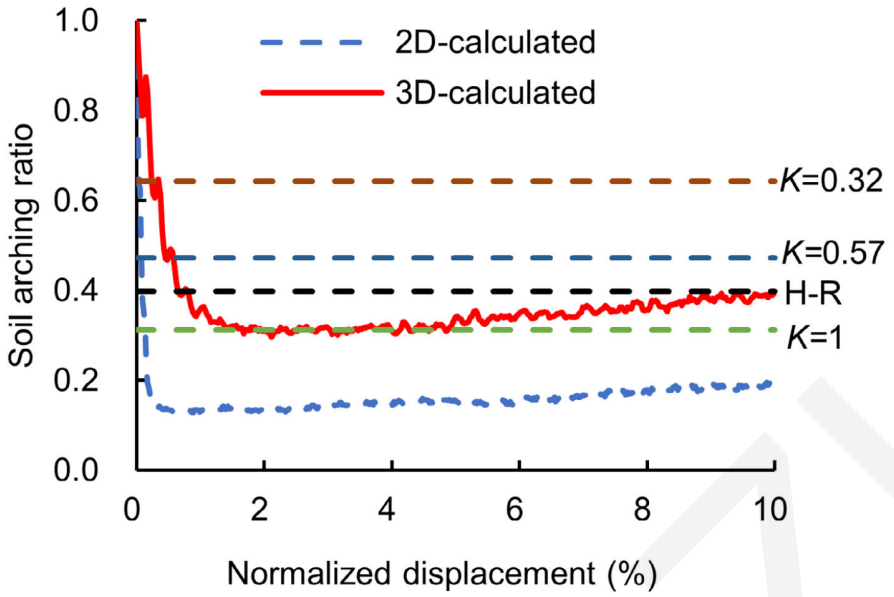
Pile clear spacing

Embankment height

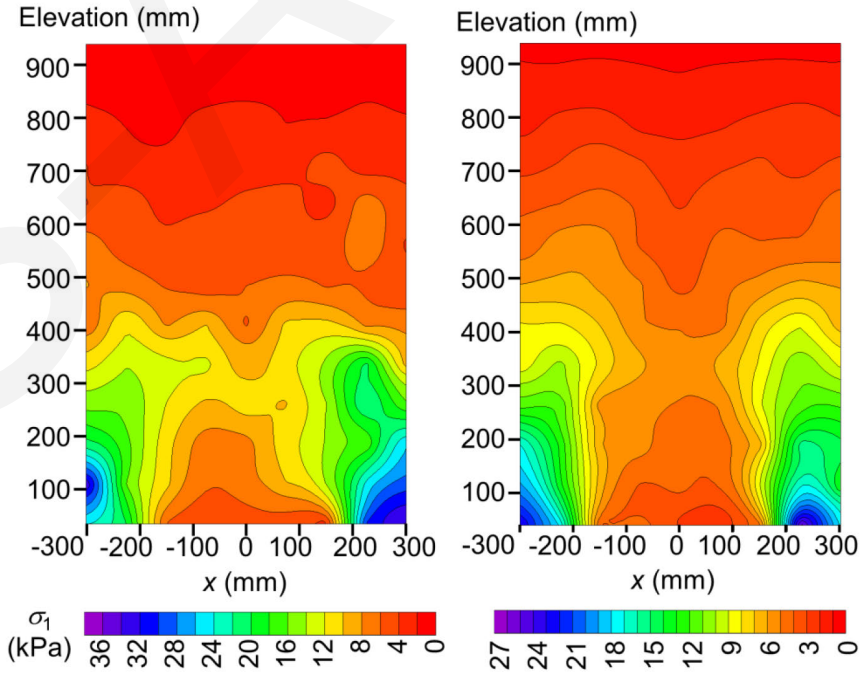
Analysis & interpretation

Parametric study

Stress-displacement response



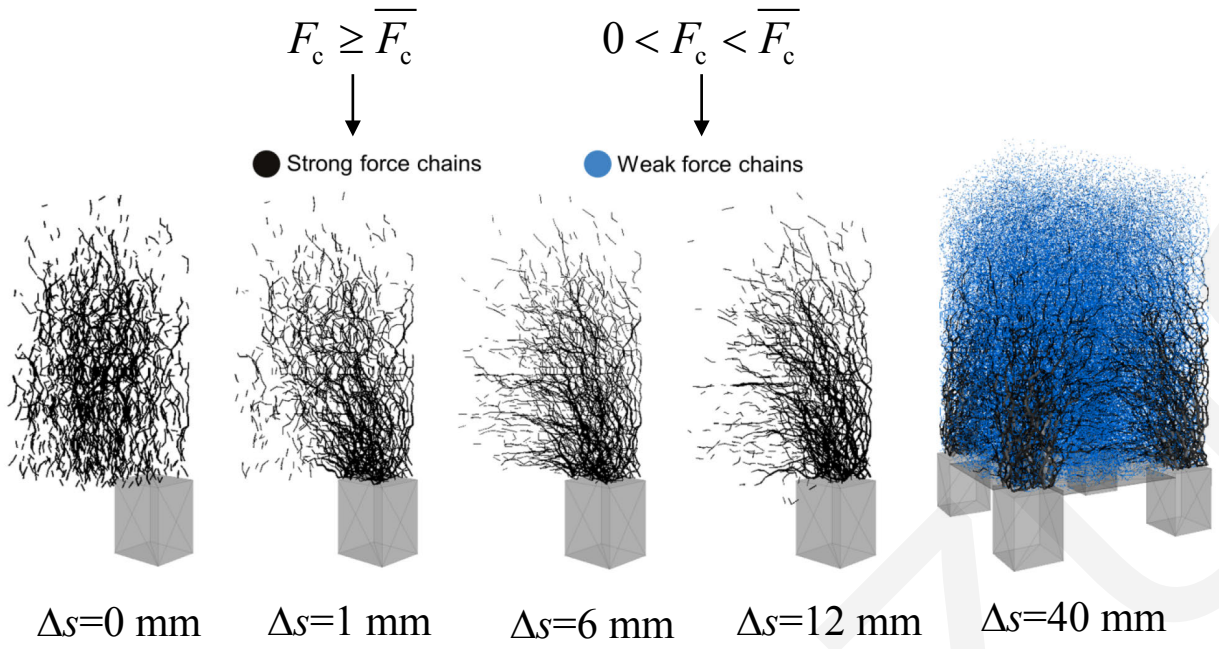
Evolution of the soil arching ratio with trapdoor settlement



2D model 3D model

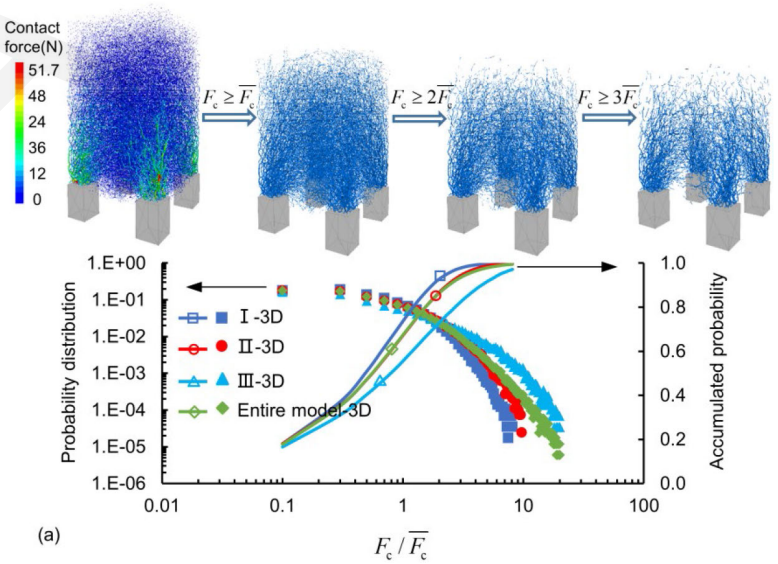
Contour of σ_1 at section s(b)

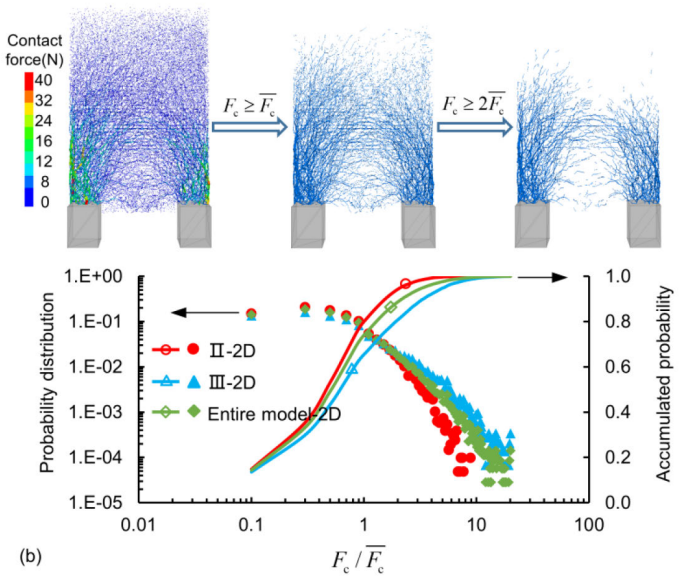
Force chains



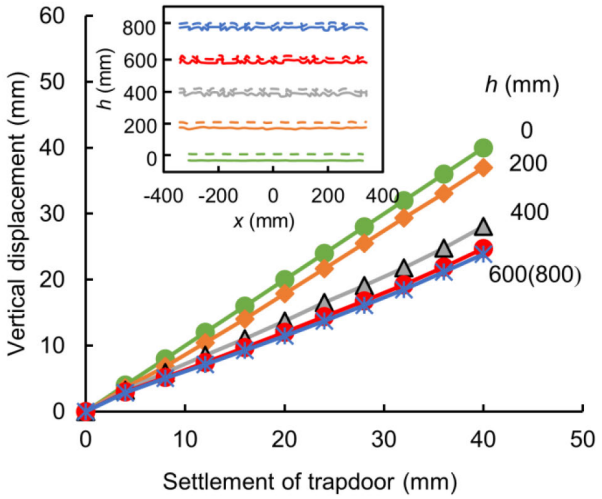
Force chains develop with settlement of the trapdoor

Contact force probability distributions

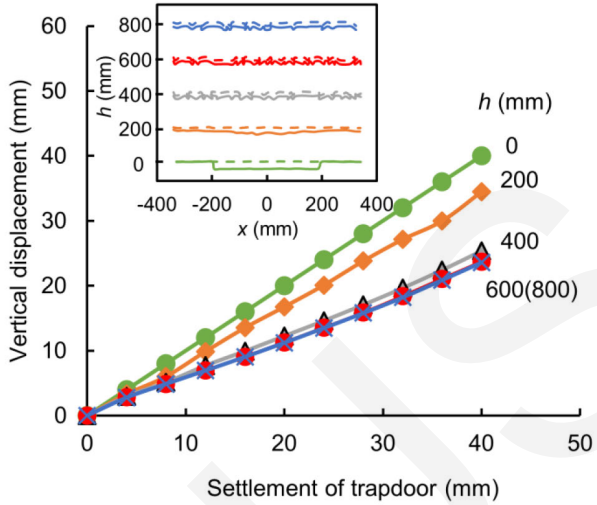




Maximum vertical displacement

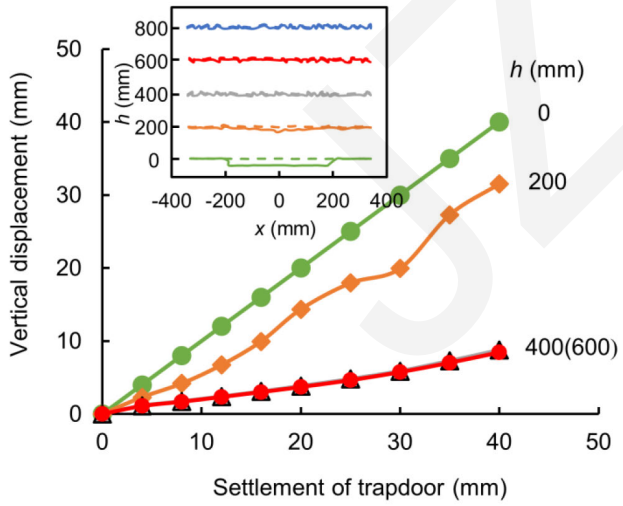


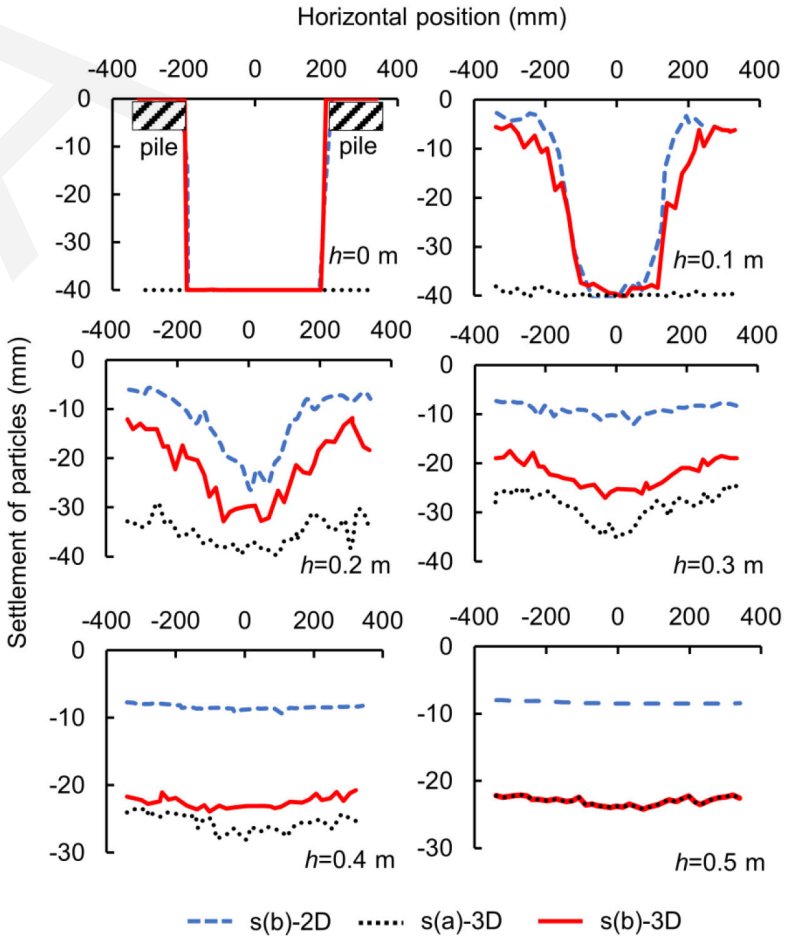
Section s(a)-3D



Section s(b)-3D

Section s(b)-2D

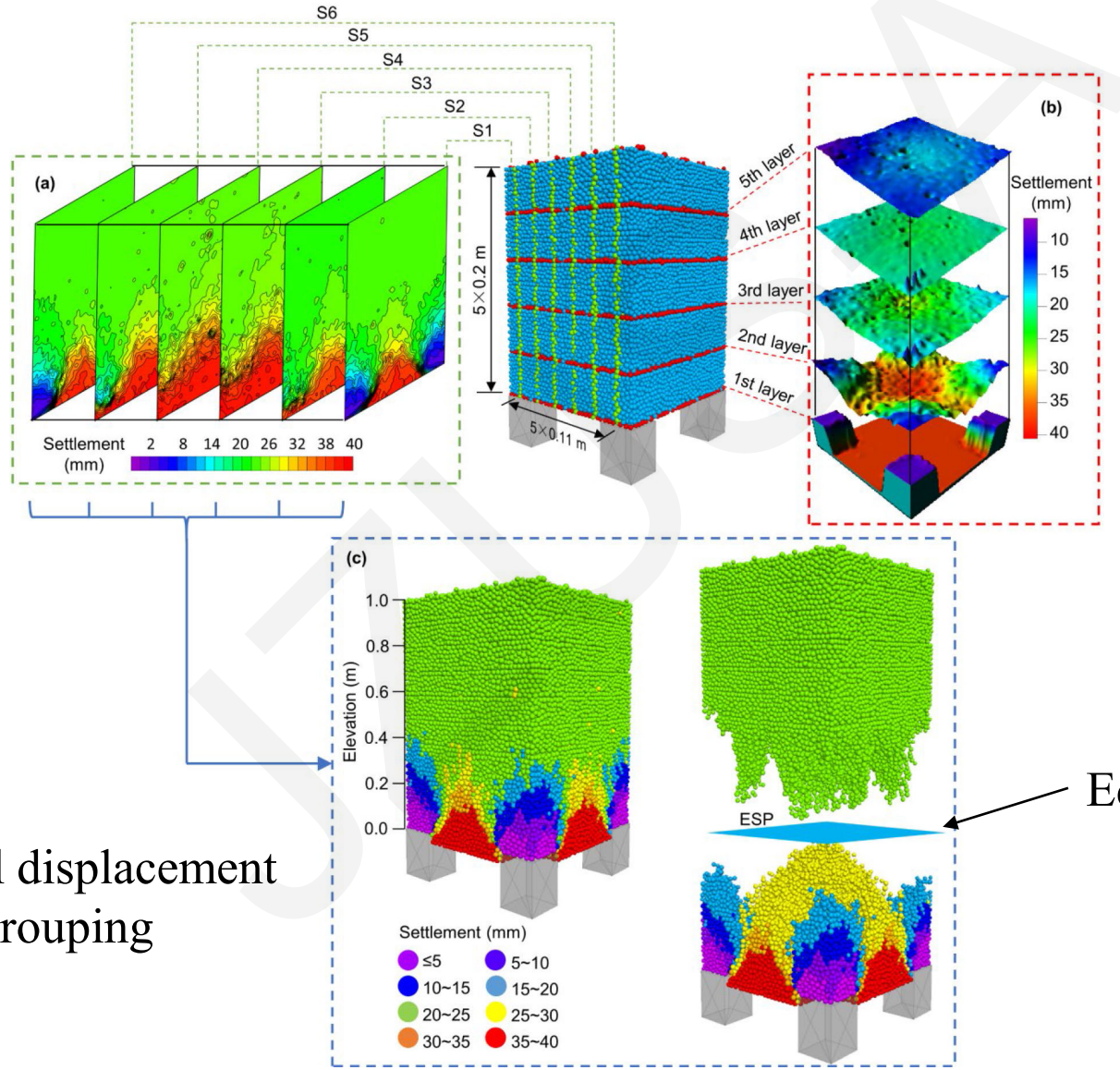




Vertical displacement profiles at different sections along the elevation (where *h* represents the elevation)

Deformation characteristics

Vertical displacement contour



Settlement profiles

Vertical displacement grouping

Equal settlement plane

Summary and Conclusion

- A plane soil arch in a 2D embankment overestimates the degree of load transfer and underestimates the settlement at the crest and within the embankment along the elevation in a 3D embankment. A lower equal settlement plane can be found in a 2D embankment.
- An increase of fill height and friction angle, and a decrease of pile clear spacing and porosity can help improve the degree of load transfer and settlement reduction in both 2D and 3D embankments. Porosity has a more significant effect on reducing settlement than the other three factors.
- The height of the ESP increases as the pile clear spacing increases, but remains stable in 2D and 3D models whatever the embankment thickness, friction angle and porosity.
- Some differences emerge with respect to reducing the settlement of soils, especially for partially mobilized soil arching. Increasing fill height mainly reduces the settlement of soils in the portion of the 3D embankment above the square subsoil area, but has less influence on the portion above the rectangular subsoil area.