Face Stability Analysis of Shield Tunneling Based on Particle Flow in Different Depth of Sandy Cobble Stratum

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Abstracts: In order to study the minimum support force of the shield excavation face of the sand pebble stratum. Based on monitoring data by the exploration of Chengdu Rail Transit Line 18, and the numerical parameters of the soil are calculated by numerical triaxial compression test using the PFC and FLAC3D. A numerical model for deep buried shallow excavation of sand and gravel stratum is established. The particle flow is used to simulate the excavation of sand and gravel stratum, and finally, the surface settlement and minimum support force under different depths and different supporting forces are obtained. The results show that, with the increase of the support force, the excavation surface will gradually stabilize and the surface settlement will decrease. When analyzing the stability of the excavation face of different buried deep gravel tunnels and support force, the minimum support force without considering surface settlement is decreased, the minimum support force required to control surface settlement is increased. Using the above method, according to the ground settlement control requirements, the proper depth of the excavation sand pebble tunnel and the support surface of the excavation face can be obtained, and the economic benefits of the project can be improved.

Key words: Sandy Cobble Stratum, Shield tunnel, Face stability, Finite element,Discrete element

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Table 1 Testing mesoscopic parameters

Poisson ratio (test)	Cohesion (test)	Internal friction angle (test)	Equivalent Modulus	Coefficient of friction	Porosity	Stiffness ratio	Normal contact stiffness
Parameters/unit	c/kPa	Φ/°	E_c/Pa	c		Kn*Ks^{-1}	Kn/Pa
0.3	143.9	35.9	2.85e7	0.24	0.28	3	3.5e6

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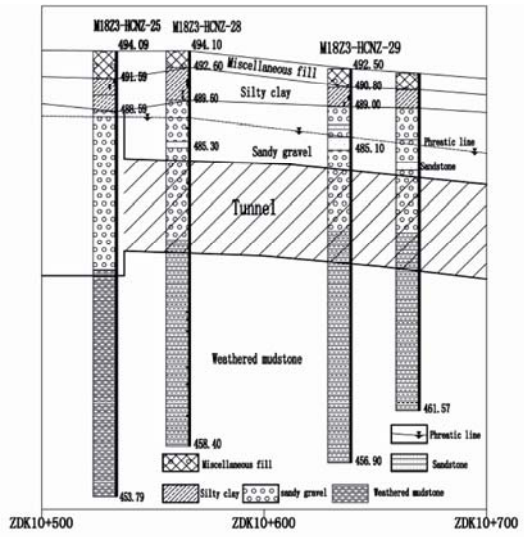
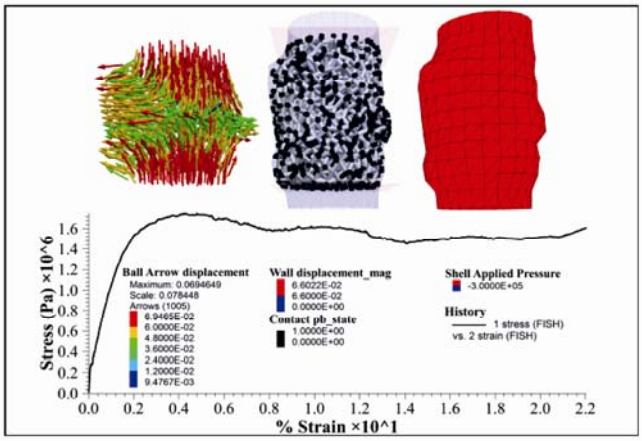
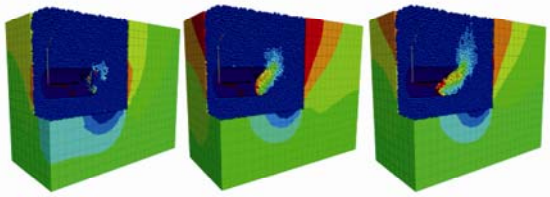
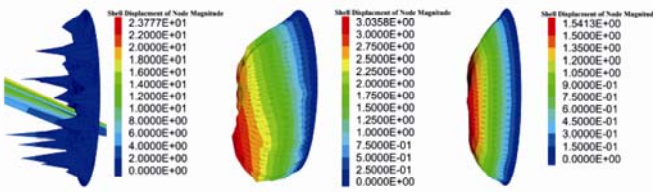
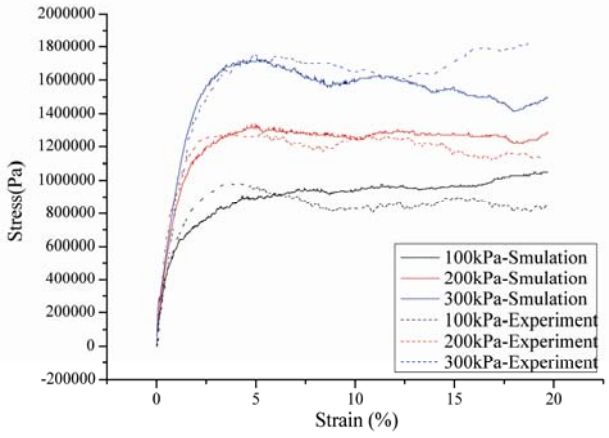
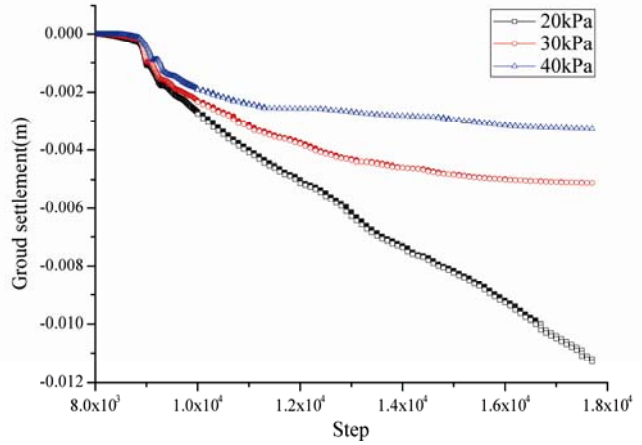

M1823-HCNZ-25
M1823-HCNZ-28
M1823-HCNZ-29
Miscellaneous fill
Silty clay
Sandy gravel
Tunnel
Weathered mudstone
Phreatic line
Sandstone
ZDK10+500
ZDK10+600
ZDK10+700


Stress (Pa) ×10^6
% Strain ×10^1
Ball Arrow displacement
Wall displacement_mag
Shell Applied Pressure
Contact pb_state
History
1 stress (FISH)
vs. 2 strain (FISH)






Stress(Pa)
Strain (%)
100kPa-Smulation
200kPa-Smulation
300kPa-Smulation
100kPa-Experiment
200kPa-Experiment
300kPa-Experiment


Groud settlement(m)
Step
20kPa
30kPa
40kPa