



Experimental investigation on the stability of shield tunnel excavation face in upper loose and lower dense water-rich strata

Authors:

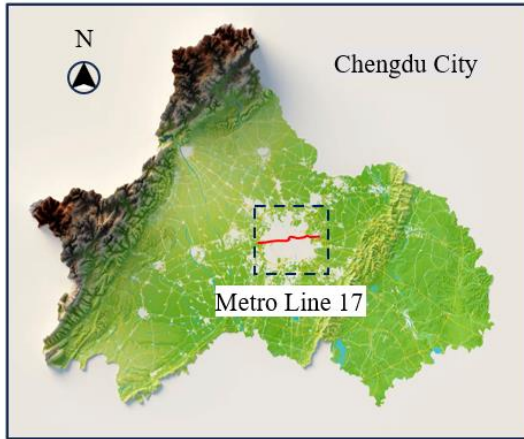
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Key words:

Shield tunnel, Upper loose and lower dense strata, Excavation face stability, Water pressure ratio

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➤ Engineering background



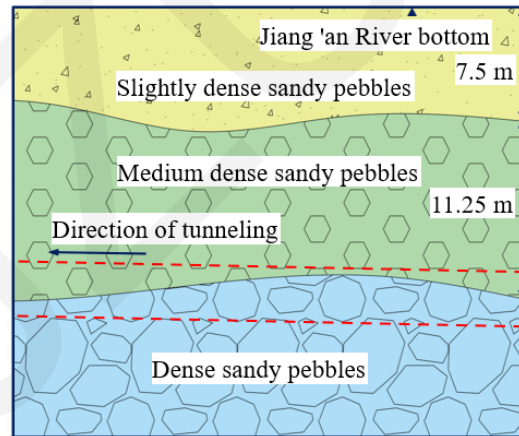
Metro line 17



Location of the stations

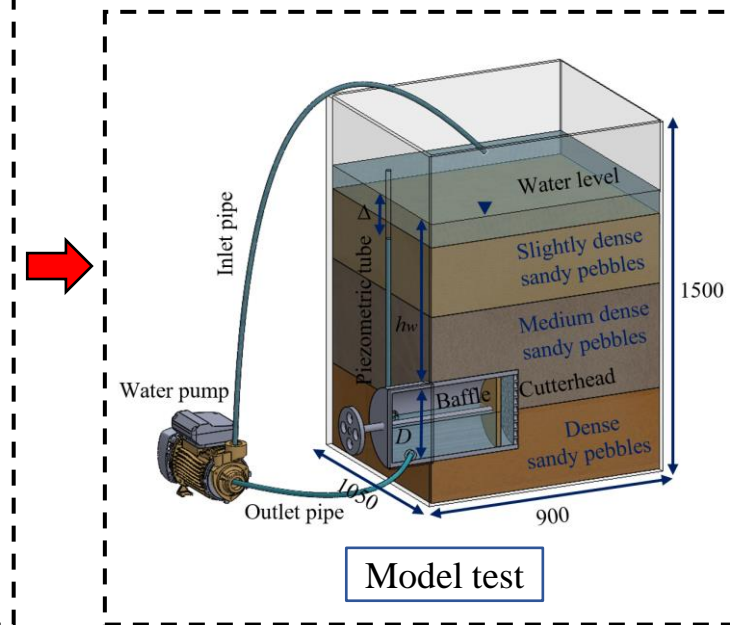


Jiang'an River



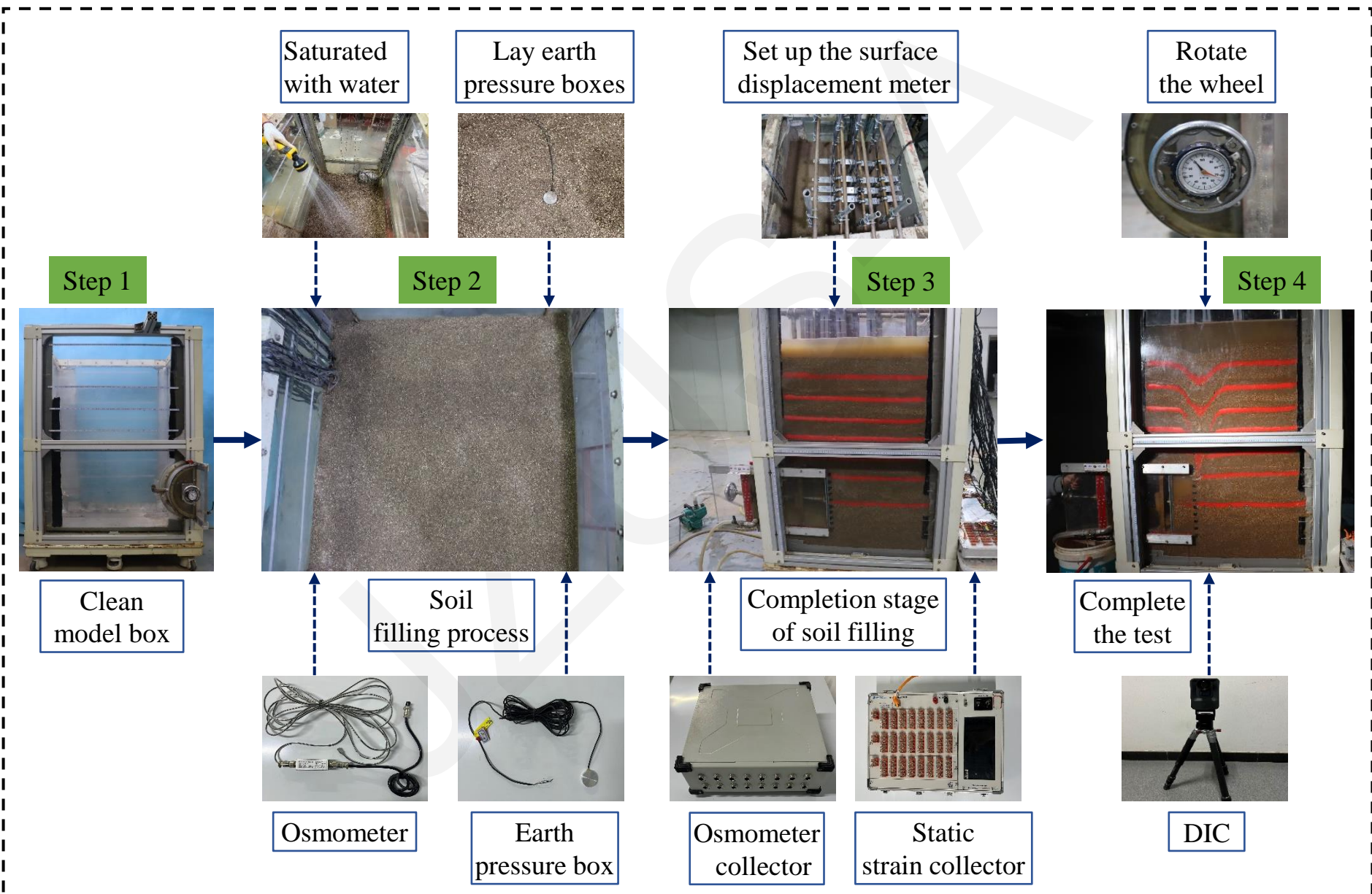
Stratigraphic profile

This study is aimed at **the upper loose and lower dense water-rich sandy pebble strata**. Specifically, we carry out model tests to investigate the active instability **under different water pressure ratios (α)**. The variation rules of surface settlement, water pressure, earth pressure on the cutterhead, and earth pressure in the strata with regard to the backward distance (L) of the baffle are investigated.



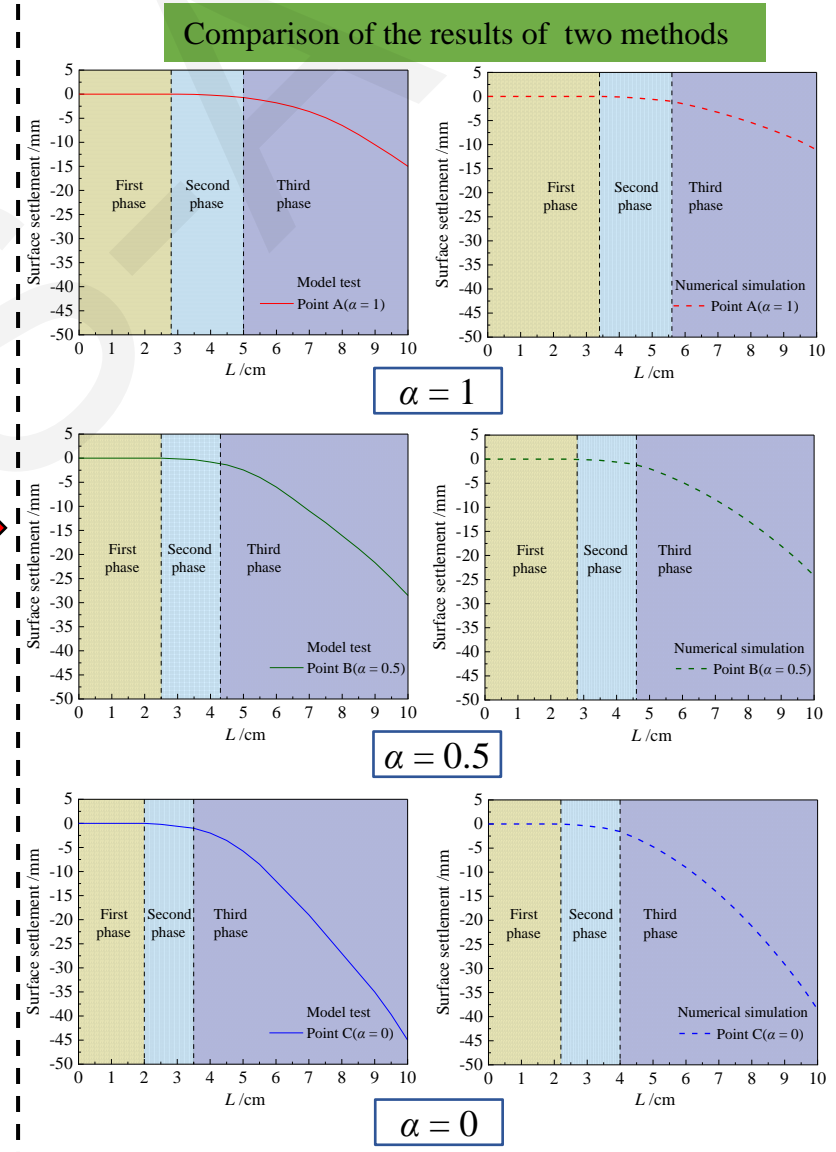
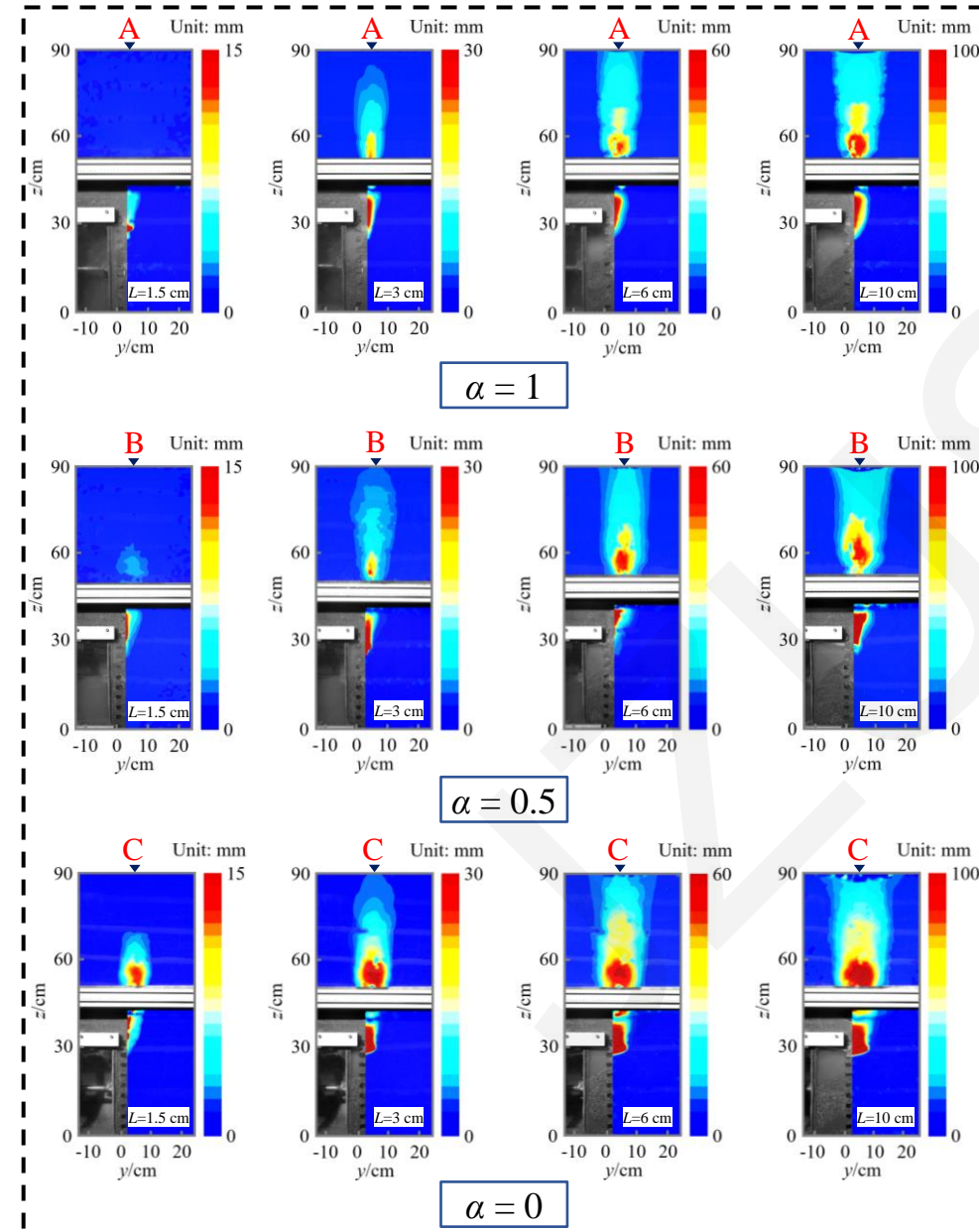
Model test

➤ Testing procedure

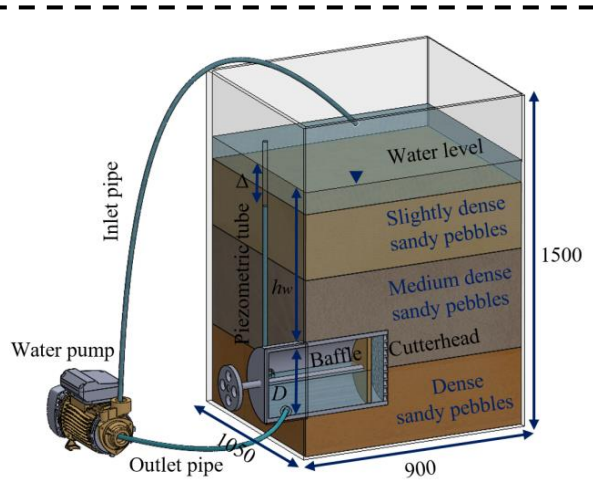


➤ Surface settlement analysis

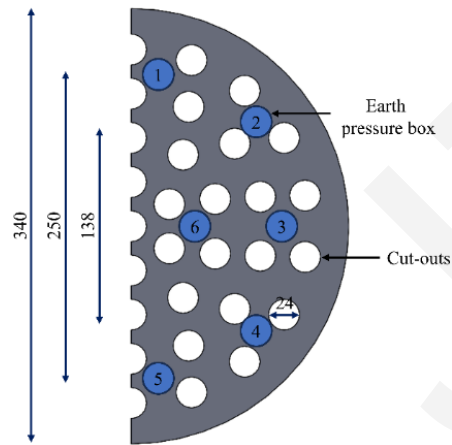
Under different water pressure ratio (α) conditions, the variation rule of peak displacement of surface settlement is categorized into three phases.



➤ Limit equilibrium state analysis

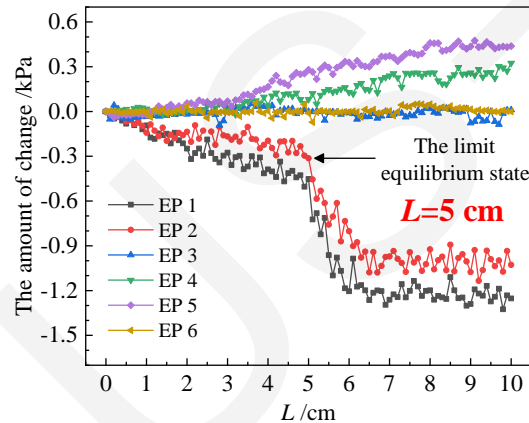


model test device

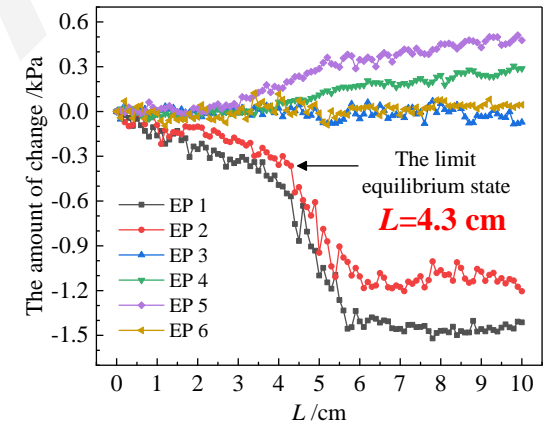


Distribution of earth pressure boxes

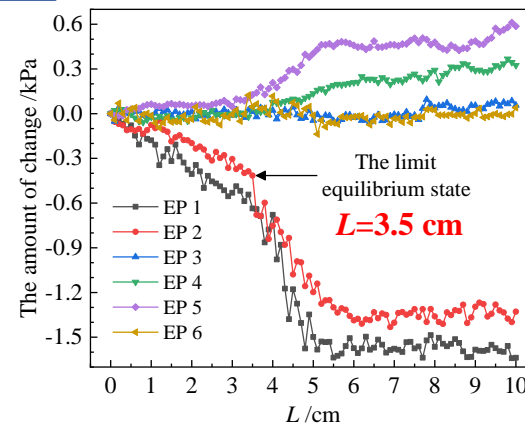
The decrease of α will lead to greater changes and a more rapid change of the earth pressure on the cutterhead, which will **cause overall instability and displacement of the strata in advance.**



$\alpha = 1$

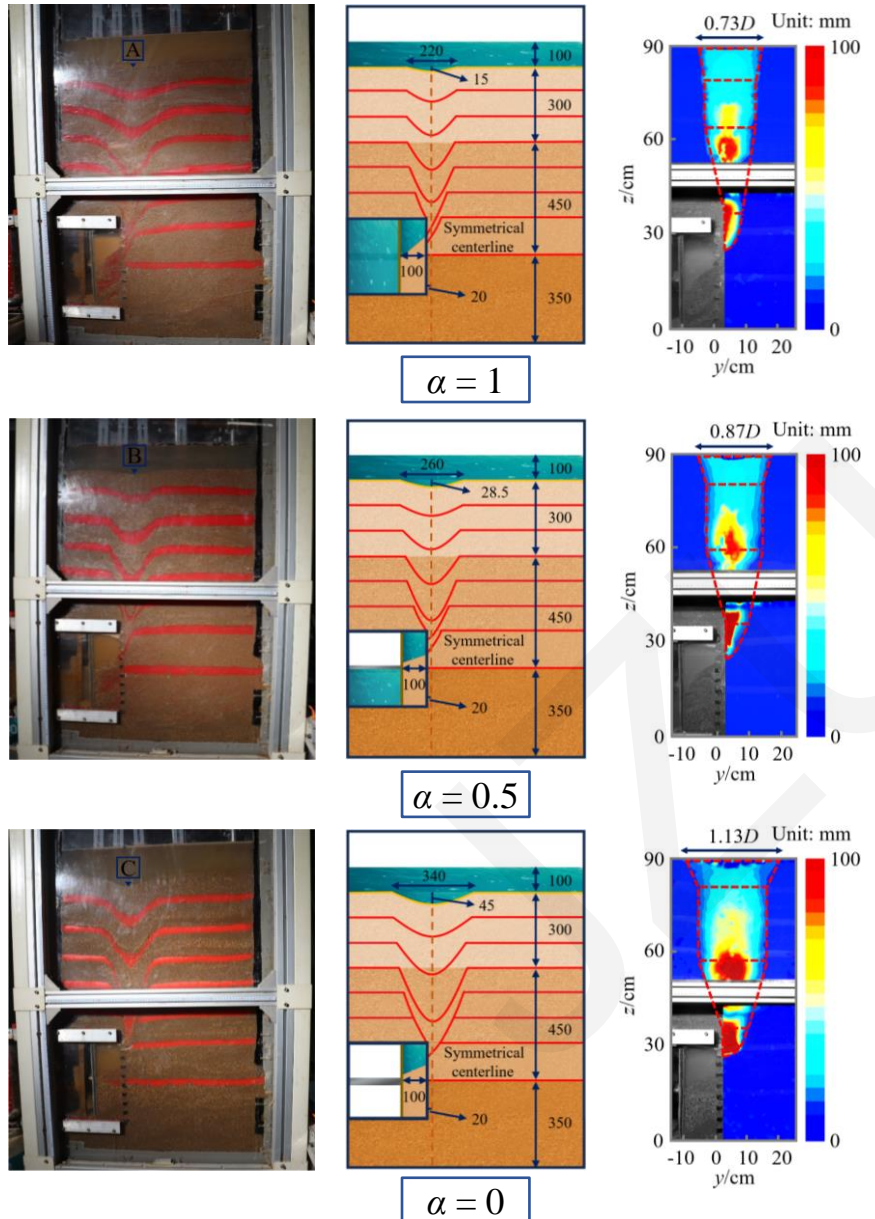


$\alpha = 0.5$



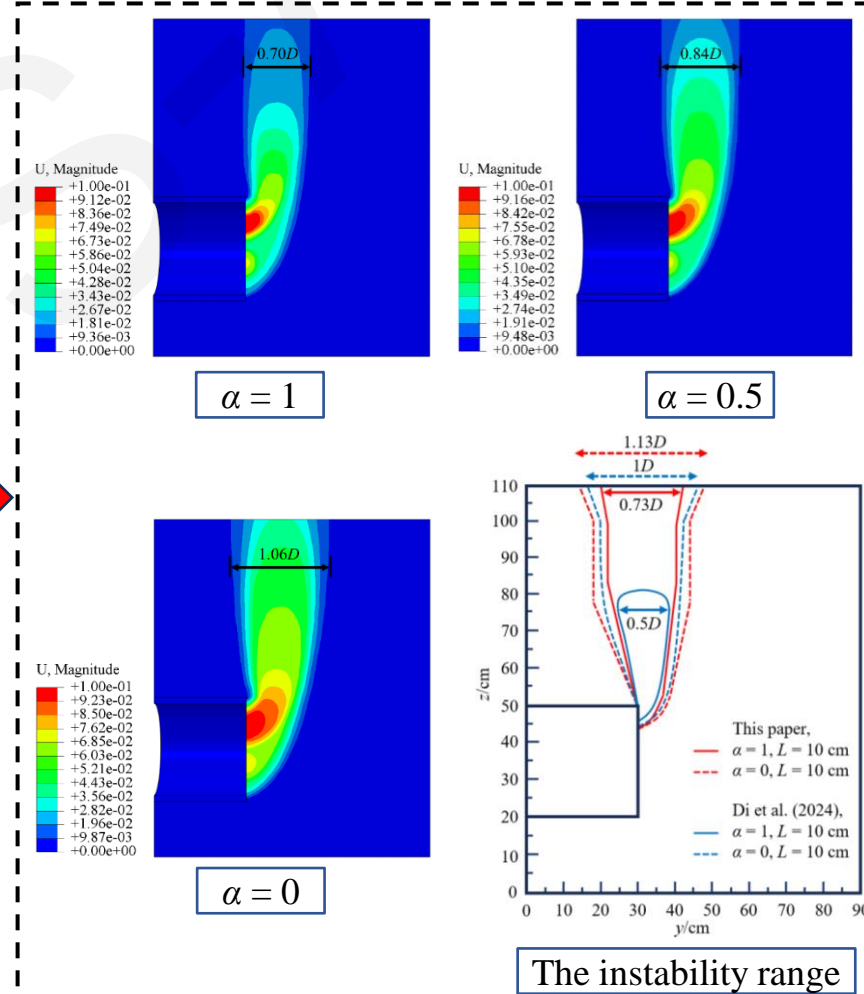
$\alpha = 0$

➤ **Instability pattern analysis**



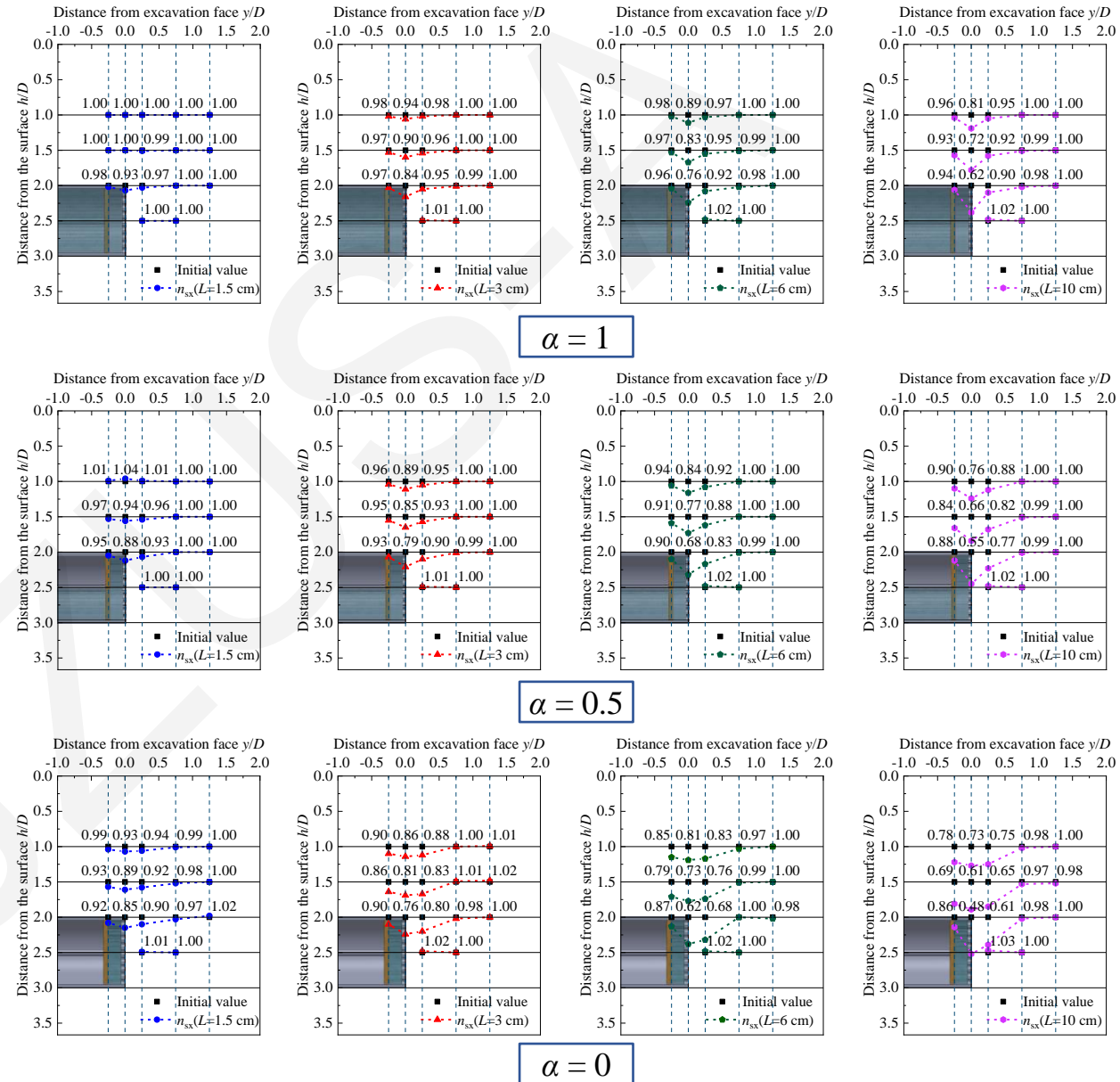
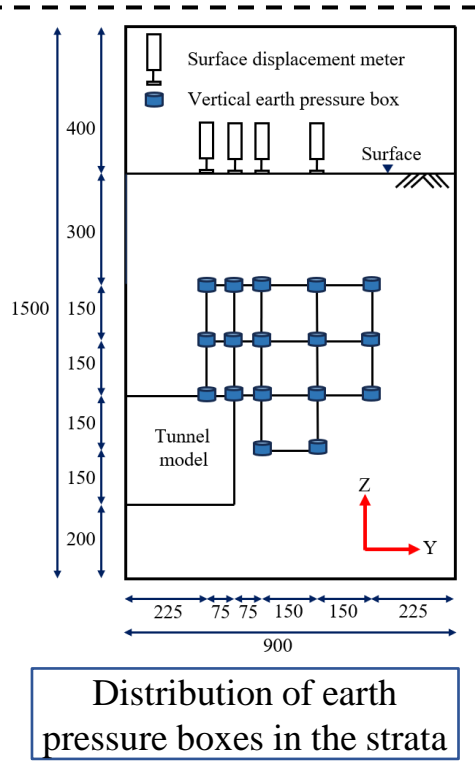
With the decrease of α , the instability range of the stratum increases.

Under the same α value, the instability range of the upper loose and lower dense sandy pebble strata is larger than that of the homogeneous sandy strata.



The instability range

➤ Instability pattern analysis



With the decrease of α , the disturbed range of earth pressure in the strata becomes larger. Moreover, **with the increase of L , there is a gradual reduction in earth pressure** at various locations, and this trend becomes **more pronounced with smaller values of α .**

➤ Water pressure analysis

With the decrease of α , the seepage path range will increase, which is consistent with the results obtained from the numerical simulations. Meanwhile, the decrease of α will cause the water to carry more soil particles into the chamber, resulting in a larger instability range of the strata.

