

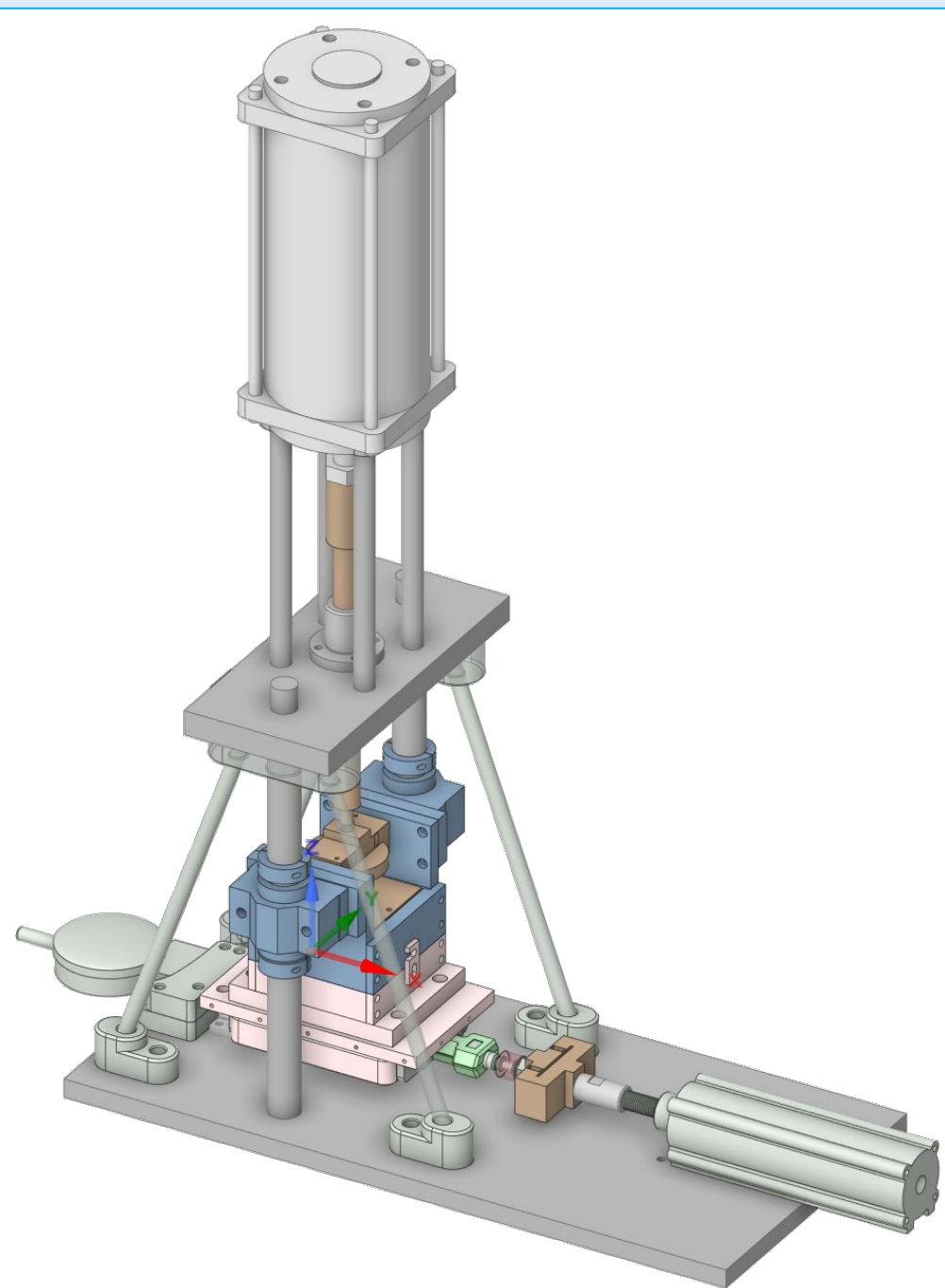
The mechanical behavior of foam-treated soil

気泡混合処理土の力学特性

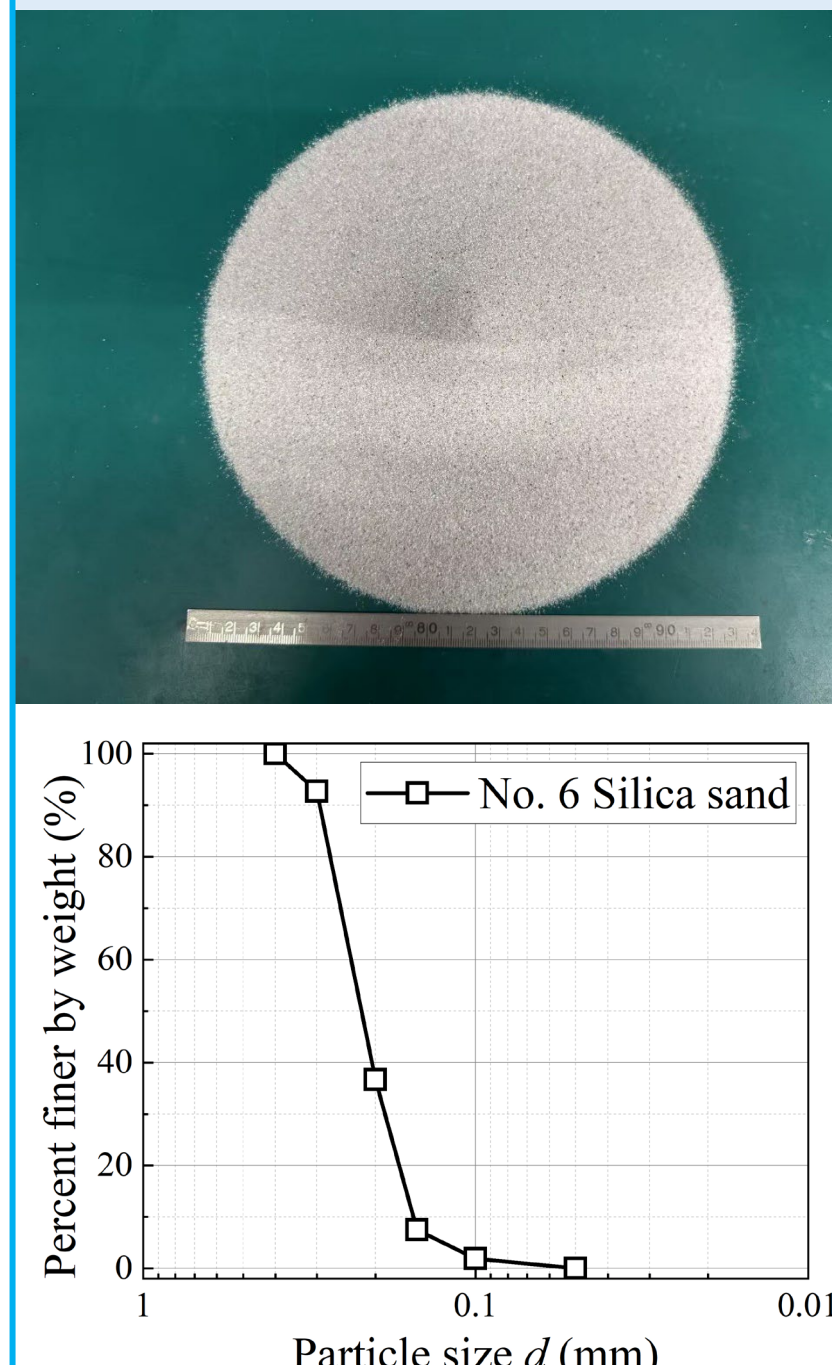
Foam-treated soil is soil that mixed with a foaming agent to alter its properties. In geotechnical engineering, foam treatment is widely used in Earth Pressure Balance (EPB) shield tunnelling. Injecting foam into the ground or excavated muck can transform the soil from a solid or granular state into a soft, plastic paste with fluid-like behavior. In this study, a direct shear apparatus was used to perform the monotonic and cyclic direct tests on foam-treated soil, considering the influencing factors such as foam content, mixing degree and stress level. The objective is to determine the optimal foam content range for foam-treated soil.

気泡混合処理土は、土に発泡剤を混合しその物理的性質を改良した材料である。地盤工学分野では、土圧バランス型シールド工法(EPB工法)において広く用いられている。発泡剤を地盤または掘削土に注入することで、土の状態は固体または粒状から、流動性を有する軟らかく塑性のあるペースト状に変化する。本研究では、改良型の一面せん断試験装置を用いて、気泡処理土の力学特性を評価した。気泡含有量、混合均一性、応力条件などの影響因子を考慮し、最適な気泡含有量の範囲を明らかにすることを目的とした。

Direct shear apparatus



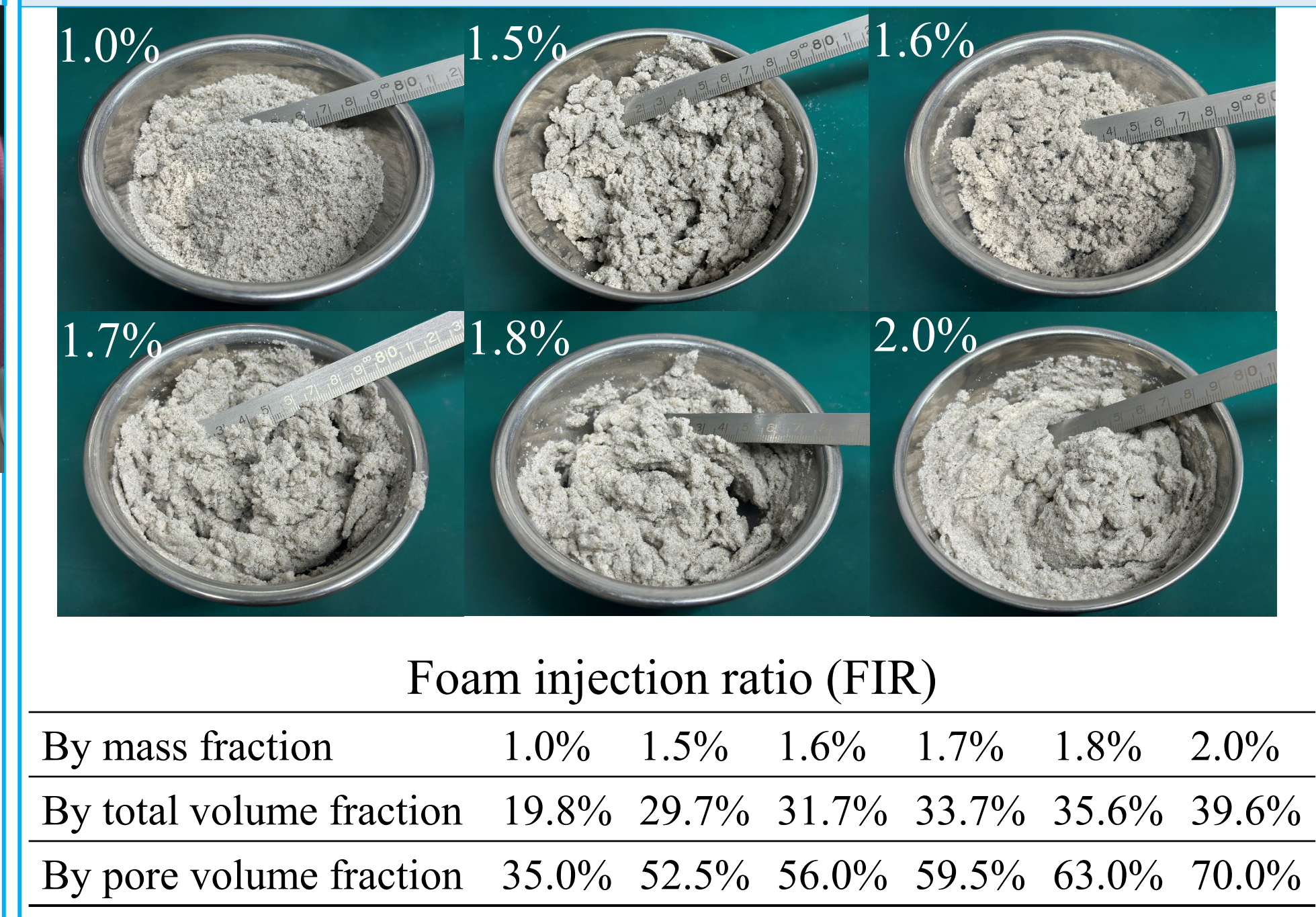
No.6 Silica sand



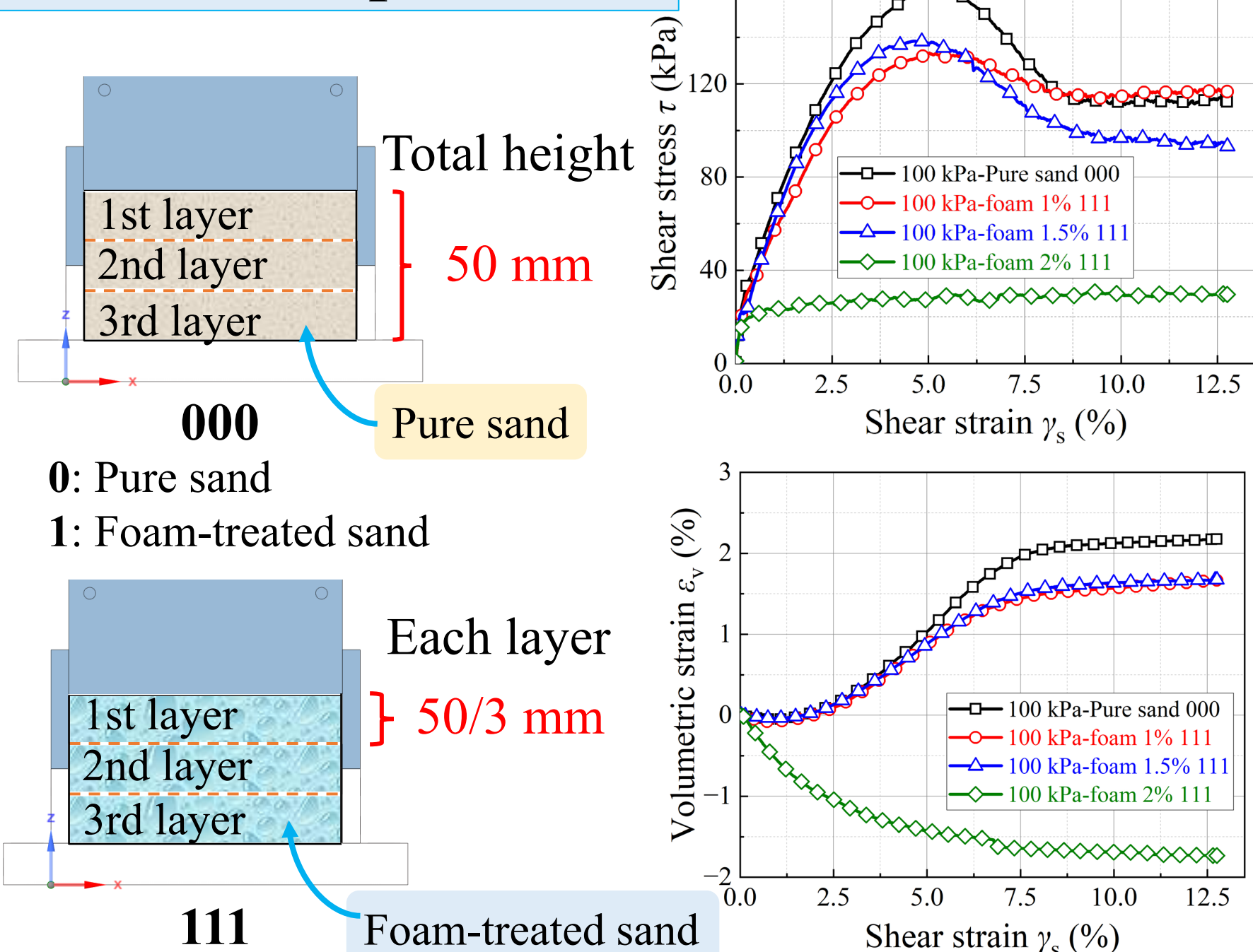
Foam

Foam property:
Foam solution concentration (C_f): 5%
Foam expansion ration (FER): 13.2
The half-life of foam: 60 ~ 90 mins

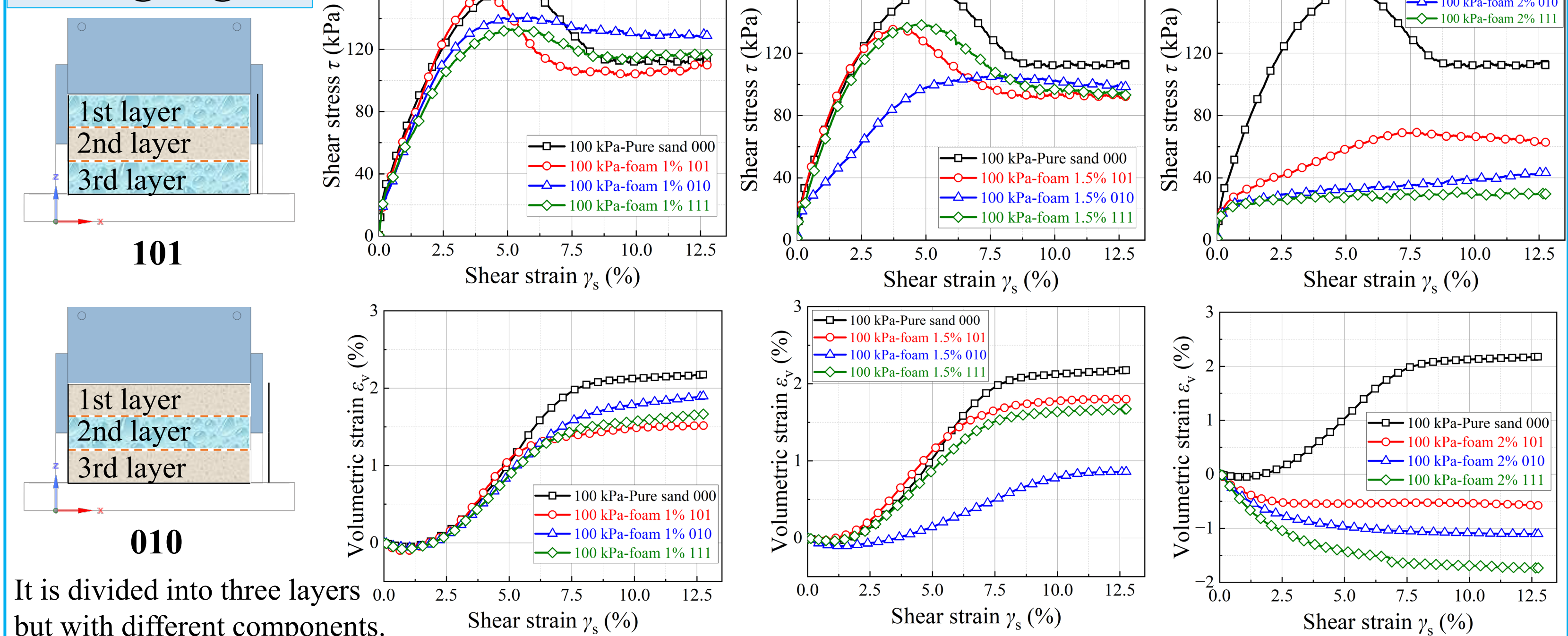
Foam-treated sand with different content



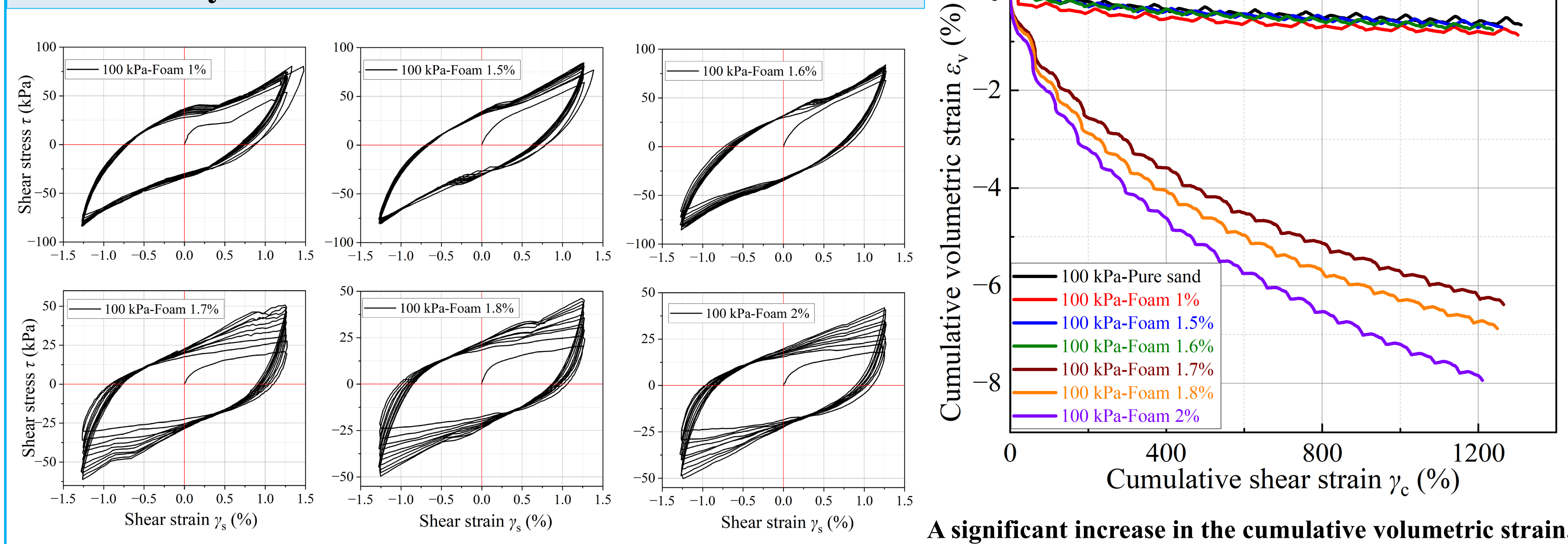
Results of simple shear



Mixing degree



Results of cyclic direct shear test



Conclusion

1. Foam can significantly reduce soil strength and increase the compressibility.
2. Foam-treated soil behaves differently with different foam mixing degree.
3. Static direct shear tests showed that shear stress decreased significantly when foam content was 2%.
4. Dynamic direct shear tests showed that an obvious jump occurred in the cumulative volumetric strain when foam content exceeds 1.6%.
5. There is an optimal foam content threshold range for the foam-treated soil.

