Suction of Several Granular Materials and Its Contribution to Arching

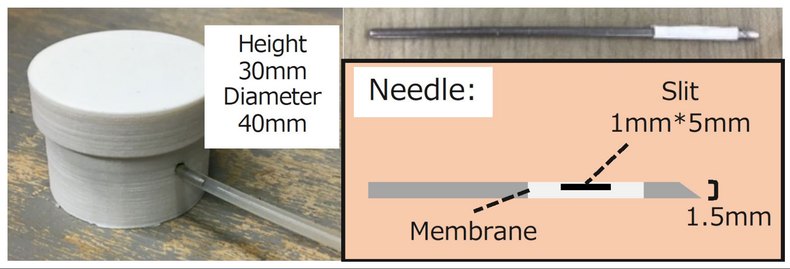
様々な粒子のサクション及びその空洞保持への寄与

Suction between particles plays an important role in the stability of ground. Previous studies mainly focus on small size particles. Suction between larger size particles (>0.2mm) has not been well investigated. In this research, using a simple suction measuring device, small suction of larger particles, which size is categorized as sand, was measured. Effect of several factors on suction was analyzed in microscopic perspective. Then, contribution of suction to the stability of cavity in sandy ground was investigated by a series of simple model tests.

地盤内の粒子間に働くサクションは、地盤の安定性を考える上で重要な役割を果たします。一方、既往のサクションの検討は粘性土から細砂の粒径まで（<0.2mm）が主であり、それ以上の粒径における検討は進んでいません。本研究では、簡易サクション計測装置を作成し、砂の粒径範囲における微小なサクションを計測するとともに、諸因子がサクションに与える影響を微視的観点から考察しました。また、この計測結果に基づき、砂質地盤内の空洞保持におけるサクションの寄与について、簡易的な土層試験をもとに確かめました。

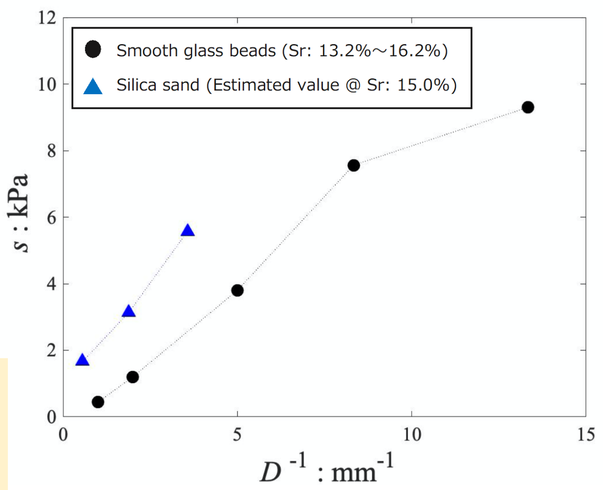
Suction measurement（サクション計測）

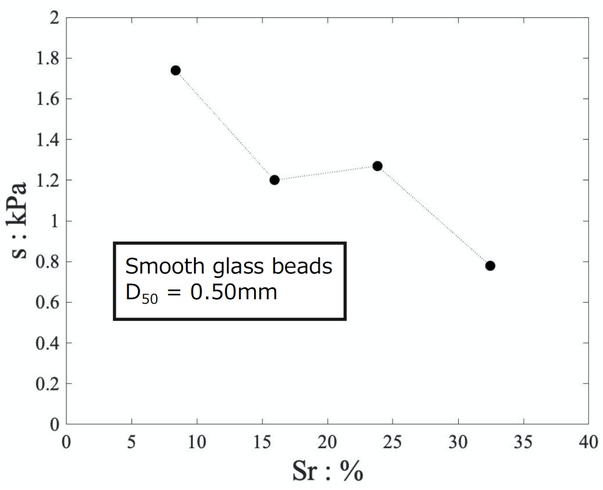
Simple suction measuring device（簡易サクション計測装置）



✓ Capable of measuring small suction between 0.1 kPa to 20 kPa

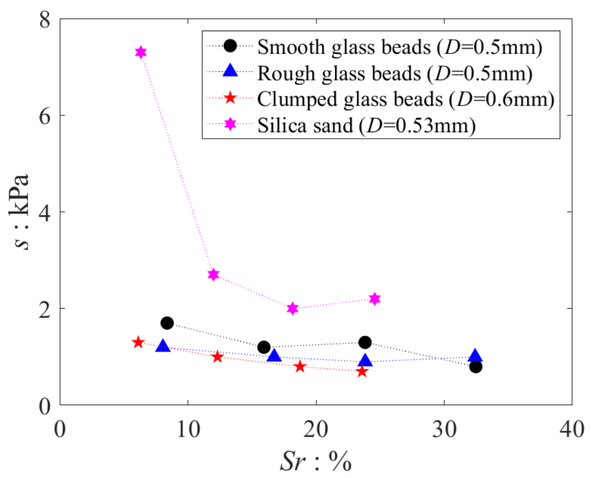
Size & Degree of saturation (Sr)





✓Smaller particle size / Lower Sr causes larger suction
✓Inverse of particle size (D^{-1}) and suction have a strong liner relationship
✓Particle size is more dominant

Shape & Roughness



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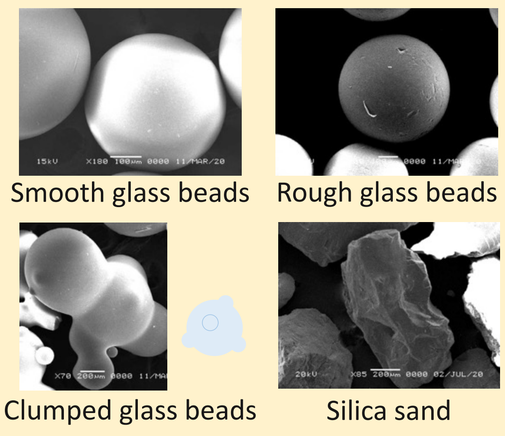
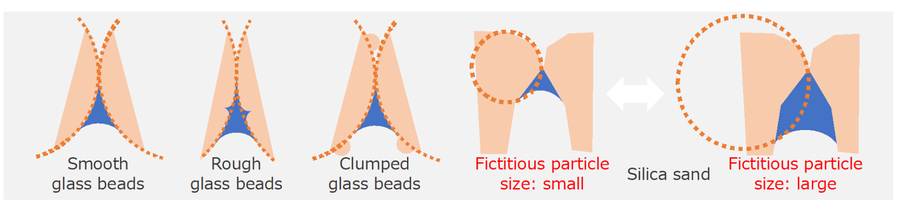
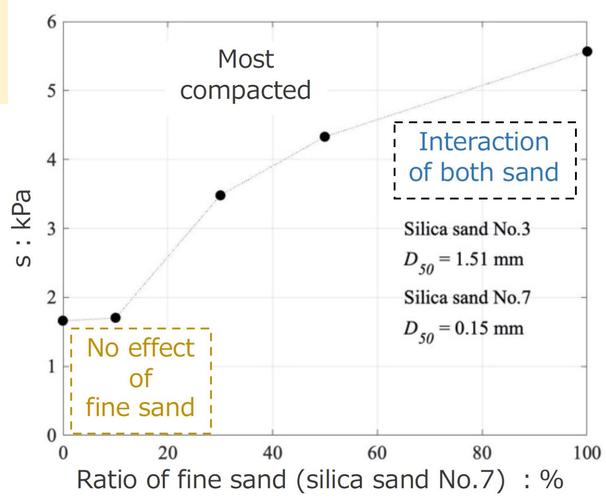


✓ Little difference between smooth glass beads, rough glass beads and clumped glass beads
✓ In silica sand case, suction is stronger when Sr is low
✓ These can be interpreted based on fictitious particle size（見かけの粒径）

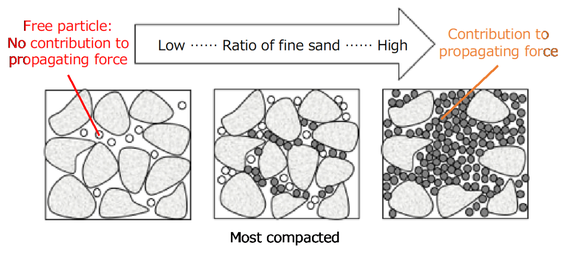


Fictitious particle size（見かけの粒径）

Gap-graded soil (Silica sand No.3 / Silica sand No.7)



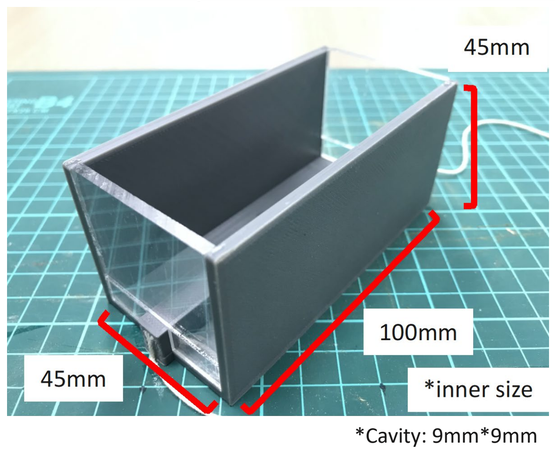
✓Suction increases as ratio of fine sand gets higher
✓Fine sand does not affect suction when ratio of fine sand is low
✓Free particle（自由粒子）, which does not propagate force, may not affect on suction



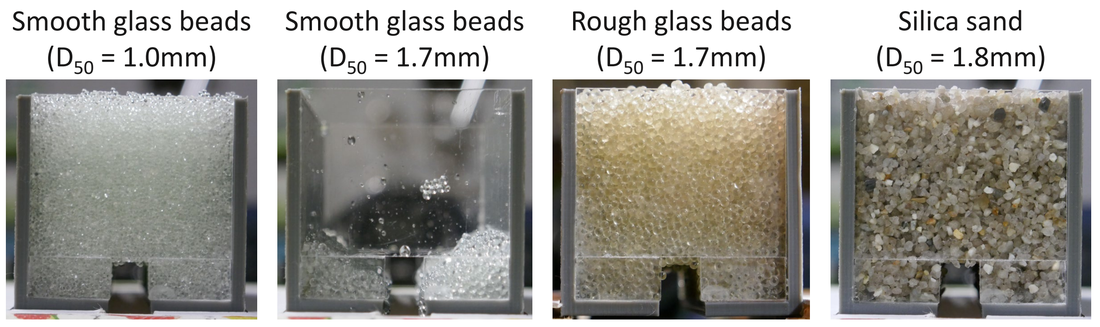
Free particle（自由粒子）

Simple model test（簡易土層試験）

Small simple model（小型簡易土層）



*Cavity: 9mm*9mm



✓ All suction, roughness and shape contribute to the stability of cavity
✓ Not only suction but also other mechanical properties (friction, interlocking, etc.) seem to be related with the formation of arching

For further information, contact below.
Prof. Reiko Kuwano, Dr. Masahide Otsubo
Bw-304, Institute of Industrial Science, the University of Tokyo
TEL: +81-3-5452-6843
E-mail: kuwano@iis.u-tokyo.ac.jp

横山大智 (2021)
桑野研究室
東京大学 生産技術研究所 Bw-304
電話: 03-5452-6843
E-mail: kuwano@iis.u-tokyo.ac.jp