Experimentally Obtained Outline of State-boundary Surface of Artificial Pumice

実験により導出された人工軽石の state-boundary surface の概形

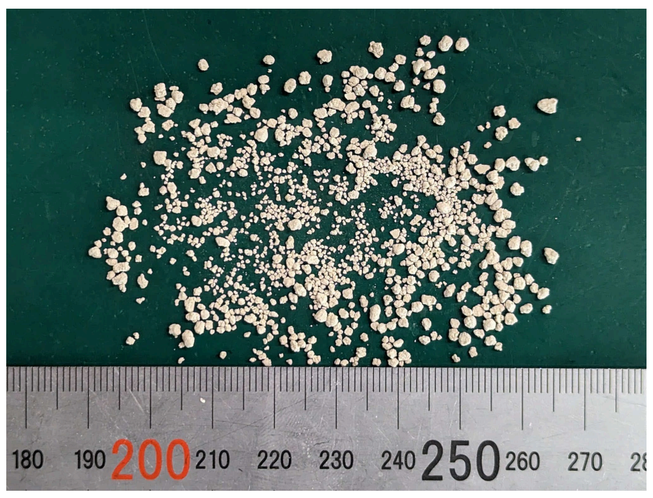
軽石は、斜面崩壊などの地盤災害の原因としてしばしば指摘される材料です。土の力学挙動を考えるとき、多くの場合で平均有効応力p'・軸差応力q・間隙比eをパラメーターにとります。ここで、 p'-q-e空間上にて、土の応力状態(p', q, e)の存在範囲をその内部に制限する曲面のことをstate-boundary surface (SBS) と呼びます。本研究では、人工的に作製した軽石の SBS の概形を、排水・非排水条件での三軸圧縮試験により求めました。得られた状態径路は互いに交差し、網目状となりました。これを包み込む曲面を構成し、排水・非排水いずれの状態径路も妥当に抑え込むことが確認できました。

Pumice soil is often an important factor in ground disasters such as slope failures. When we think about mechanical behaviour of soil, we usually take three parameters: mean effective stress p', deviator stress q, void ratio e. In three-dimensional space p'-q-e, state-boundary surface is a surface to which stress state (p', q, e) is confined. This study obtained an outline of SBS of artificial pumice by drained and undrained triaxial compression tests. The state paths crossed each other, which formed a mesh. We composed a surface which covers the mesh and confirmed that it reasonably keeps drained and undrained state paths inside itself.

Experiment

Test procedure

1. Specimen preparation
   - $e \approx 2.25$
2. Saturation
3. Normal consolidation
   - Creep for 60 min
4. Monotonic shearing
   - To 20 % of axial strain
5. Sieving

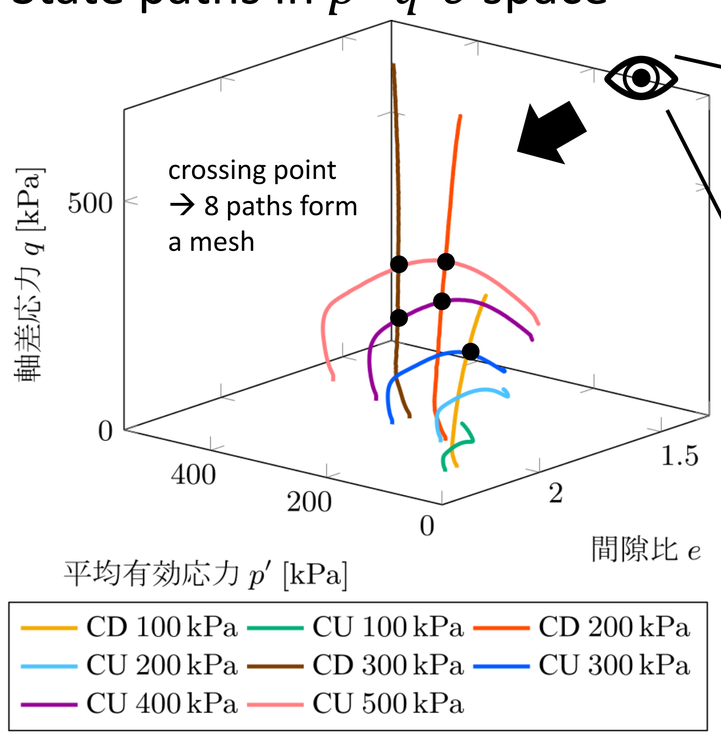


Artificial Pumice ($D_{50} = 1.1$ mm)

No.	Condition	Confining pressure	Hardin's relative breakage
1	CD	100	0.129
2	CU	100	0.050
3	CD	200	0.169
4	CU	200	0.086
5	CD	300	0.191
6	CU	300	0.118
7	CU	400	0.130
8	CU	500	0.128

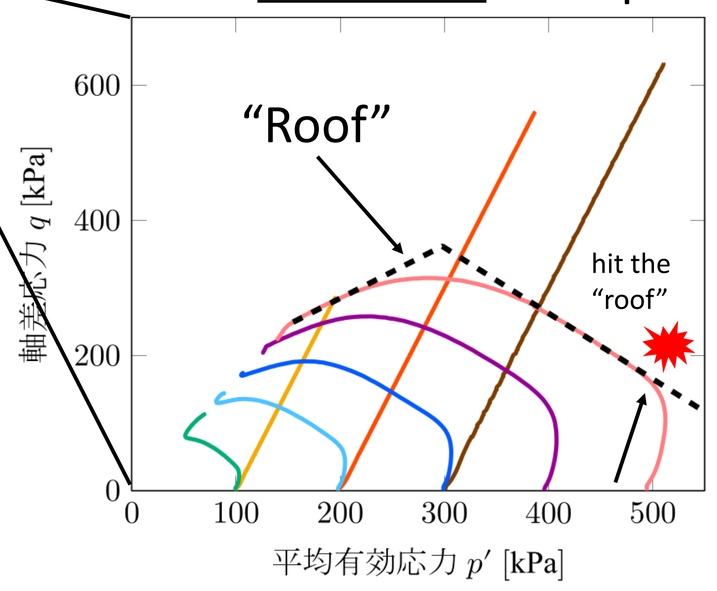
Results

State paths in p'-q-e space

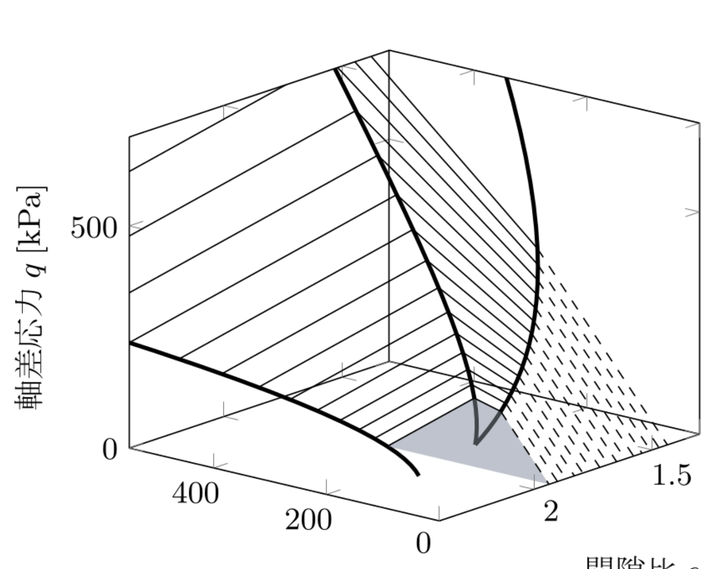


A mesh formed by 8 state paths indicates an SBS, on which every state path moves

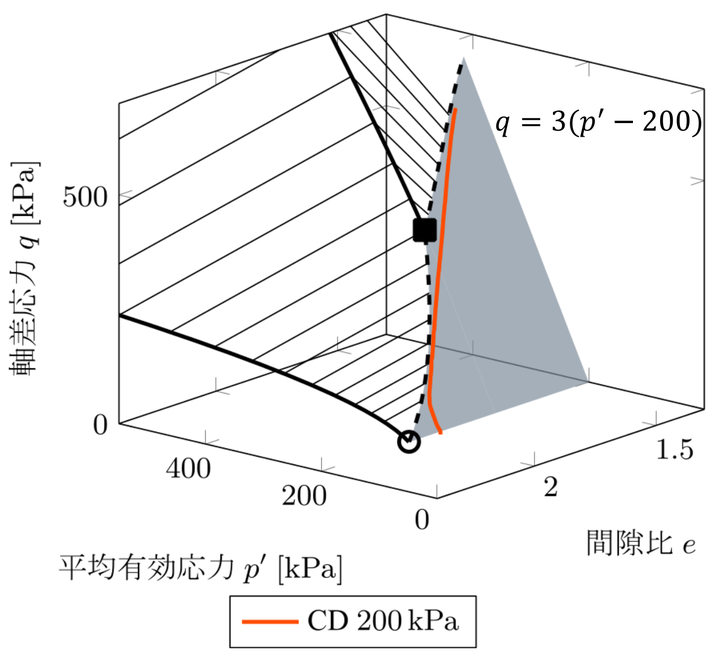
Set a polyline "roof" on each undrained state path



An undrained state path cannot increase q endlessly because p'changes → it hits the "roof"



Obtain a surface by fitting the undrained "roofs"
→ Any undrained state path cannot go out of it



Cut the "roof" surface with a plane which binds a drained state path
→ drained state path also goes beneath the "roof" surface

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

真下康平(2024)
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