Anisotropy of Shear Wave Velocity
Role of Experimental Boundary Conditions

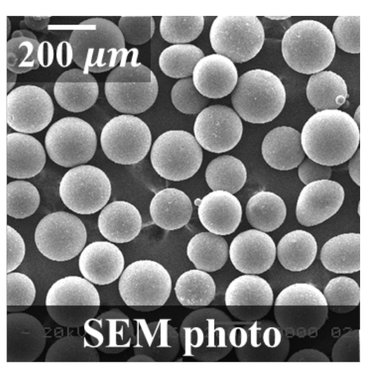
弾性波伝播速度に現れる粒状体の異方性と境界条件の関係

Natural soils display directional diversity in stiffness at small strains, which is significant for geotechnical engineering. However, the understanding of the stiffness anisotropy of soils is still limited. This research focuses on the extrinsic anisotropy induced by the experimental boundary conditions and conducts a series of shear wave propagation tests on specimens with various boundary conditions. Results reveal that a combination of rigid and flexible boundaries can cause greater stiffness anisotropy in the tested materials. Additionally, the mixed boundary conditions may induce the difference between the symmetric shear moduli G_{hv} and G_{vh}

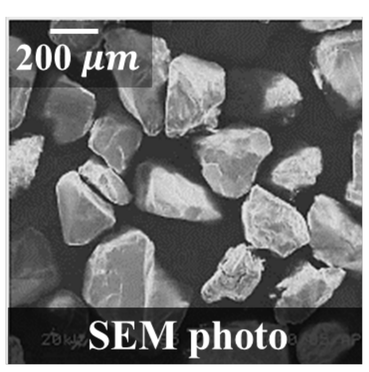
自然地盤では微小ひずみ領域にて剛性の異方性があります。しかし、地盤剛性の異方性への理解は未だ限定的であり、その一因は実験条件の制約にあると考えられます。本研究では、実験時の境界条件に起因する見かけの異方性に焦点を当て、様々な境界条件における供試体内部のせん断波の伝播特性を調べました。その結果、剛な壁面とメンブレンを用いた柔な壁面を併用した場合に、対称的なせん断弾性率（G_{hv} と G_{vh}）の値に差異が生じ、材料特性に由来しないと思われる異方性が見られました。

Materials and Apparatus

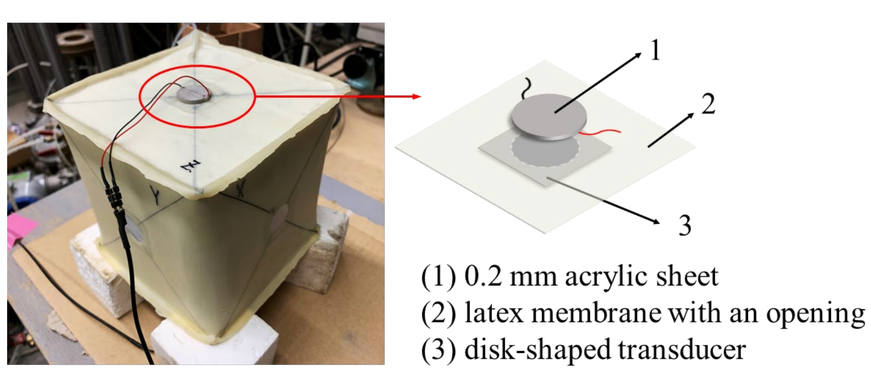
Discussions in this study are based on experimental results of two granular materials: spherical glass beads (GB) and Toyoura sand (TS). The tested materials were contained in the flexible boundary cubical cells under isotropic confinement.



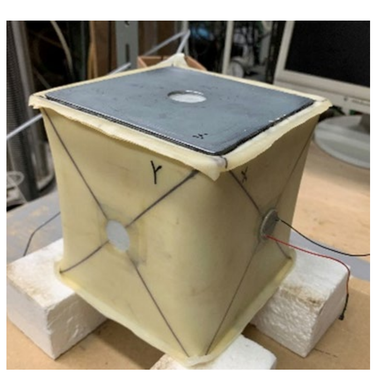
Spherical glass bead



Toyoura sand



Preparation of flexible boundary specimen



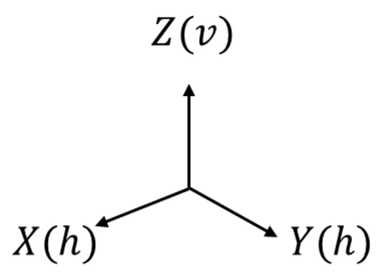
A specimen with mixed boundaries

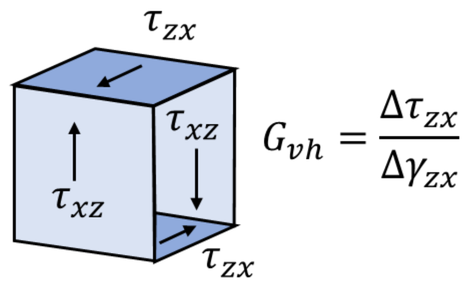
Methodology and Dynamic Wave Propagation Tests

- In S-wave propagation tests, G_0 can be calculated from shear (S-) wave velocities (V_s) according to the following equation (where ρ is soil density):

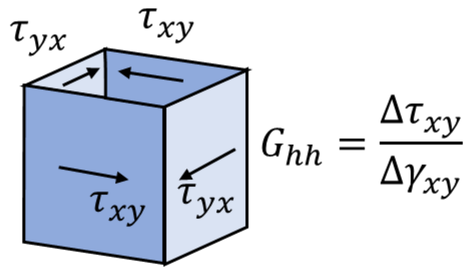
$$G_0 = \rho V_s^2$$

- The S-wave propagation tests were conducted using piezoelectric disk-shaped transducers

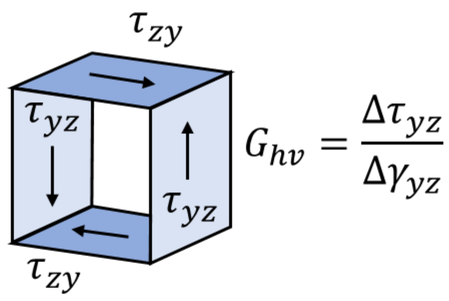




shear: zx −direction



shear: xy −direction

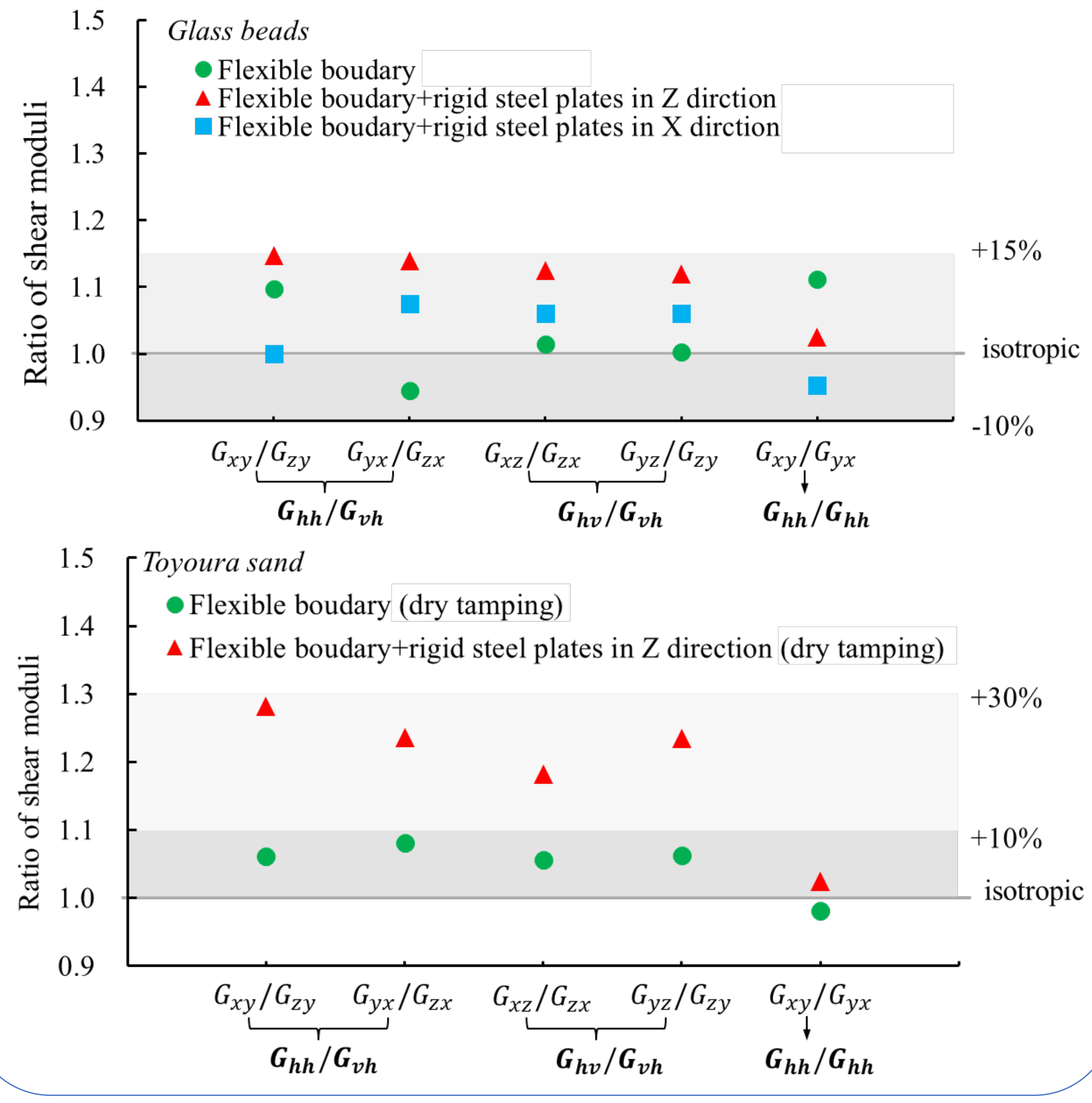


shear: yz −direction

Schematic definition of shear moduli

Experimental Results

- Mixed boundaries may contribute to larger degree of anisotropy of tested material
- Mixed boundaries may induce the discrepancy between G_{hv} and G_{vh}.



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

Junming Liu（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