Effect of water flow in internal erosion of sandy soils

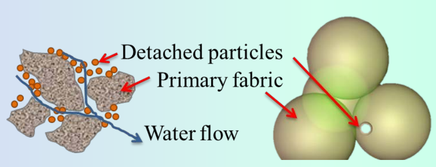
流水がもたらす砂質土の内部侵食

The phenomenon of internal erosion refers to the detachment of soil particles from the main structure due to the action of a fluid flow; both suffusion and piping are result of internal erosion in the ground, and can cause disasters in hydraulic structures due to heavy rainfalls. In order to know the influence of water penetration into the ground, a series of permeability tests had been performed in a highly erodible soil, applying water with various hydraulic gradients from the top part of specimens with different densities, and letting fine particles drain out, leaving the coarse skeleton behind.

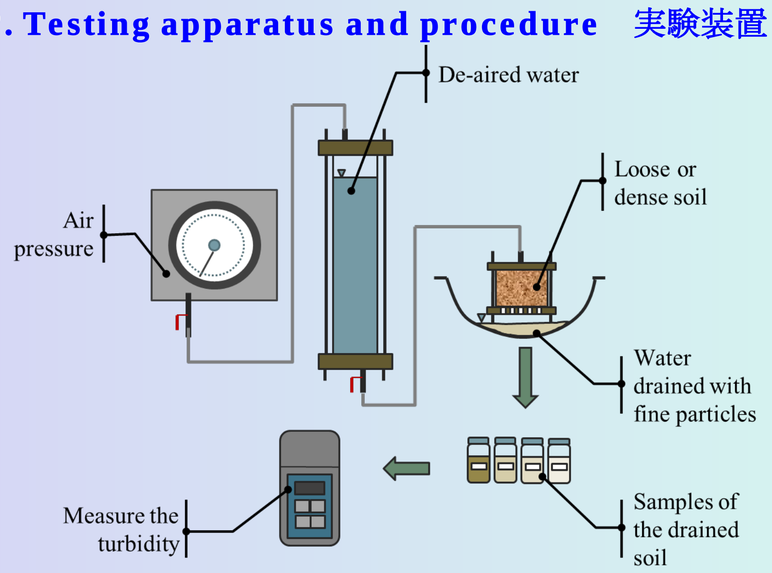
豪雨時などに、土中に水が浸透しパイピング（漏水）を起こすことで河川構造物を中心に大きな被害が出ています。その原因として地盤内の浸透流によって地盤内部の土が流出する内部侵食が挙げられます。
本研究では、内部侵食現象を室内供試体内で再現することを目的として、試料を異なる密度調整に調整し、異なる動水勾配下での透水実験を実施しました。その際、細かい土粒子は水と共に排出を許し、土の流出量と排水の濁度を測定しました。

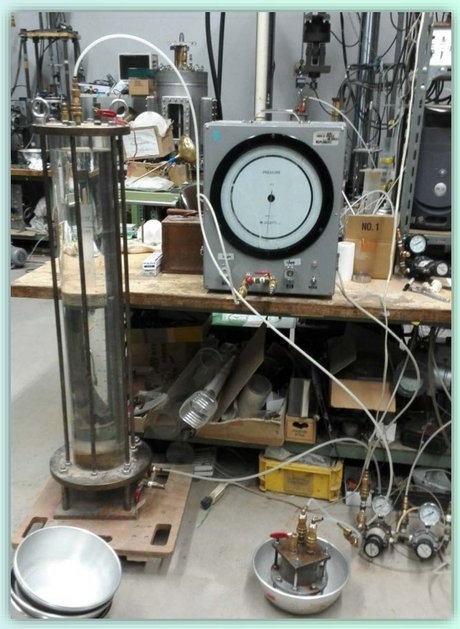
1. Internal erosion　内部侵食とは

Internal erosion refers to the detachment of soil particles from the main soil structure due to the action of a fluid flow
内部侵食とは水の流れによる土（細粒分）の流出



2. Testing apparatus and procedure　実験装置と方法



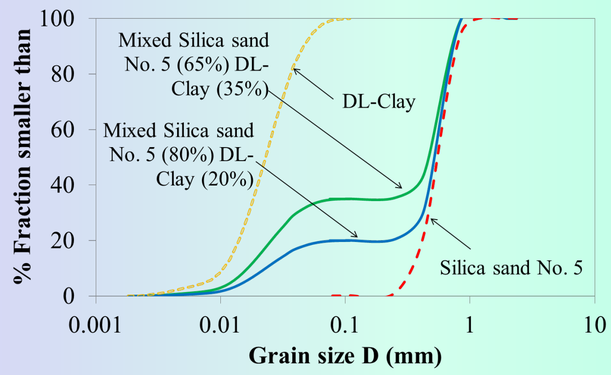


Water pressure is applied to the top part of the specimen and the water with detached particles is recollected from the bottom. The pressure applied was varied in every test. The weight of particles drained out was measured by drying the water in the oven. Additionally, the turbidity of the water expelled was measured during the experiments.

Open bottom and gauze

Turbidimeter

3. Test material　実験材料

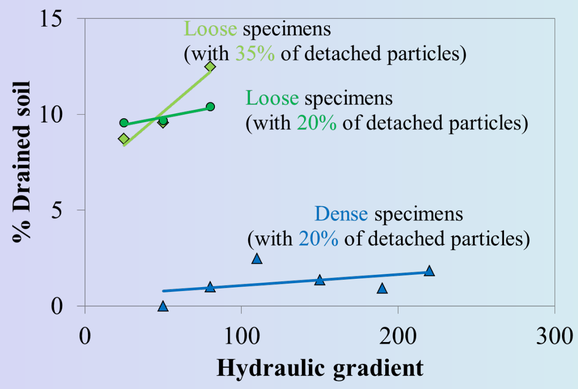


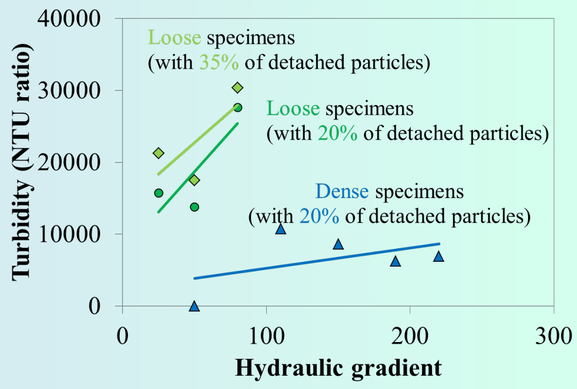
- Mixtures of silica sand number 5 colored red (mean diameter D_{50} of 0.5mm) as primary fabric, and non-plastic yellowish brown silt called DL-Clay (mean diameter D_{50} of 23μm) as detached particles were used

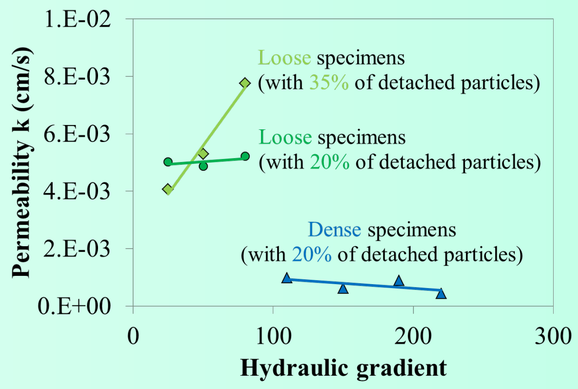
- Three soil conditions were studied:

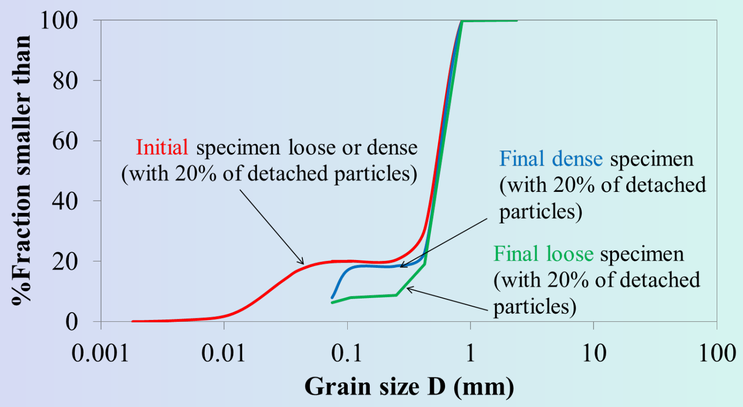
(1) loose soil (Dr= 4~10%) with 65% of primary fabric
(2) (silica sand) and 35% of detached particles (DL-clay) (2) loose soil (Dr= 4~10%) with 80% of primary fabric and 20% of detached particles
(3) dense soil (Dr= 88~90%) with 80% of primary fabric and 20% of detached particles

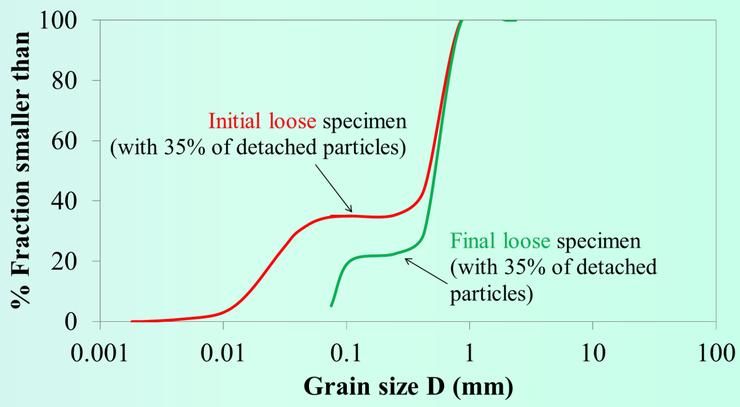
4. Results　実験結果











5. Specimens after the test　試験後供試体

Dense soil

Loose soil

Samples of drained water and fine particles

Dense soil

Loose soil

6. Summary　結論

- The tests in loose specimens were performed for two combinations of soils (20% and 35% of detached particles), however the particles expelled are of the same proportion in both cases, meaning that the amount of detached particles is not as significant as the gradient of water.

- It was found that specimens with relative density around 4 to 10% exhibited a large amount of particles displaced (around 13% of the total), and for the specimens with relative density around 90% the particles drained out represented 3% of the total

- Turbidity can be related to the amount of particles removed, and therefore the measuring of the turbidity can be used in field in order to estimate the grade of internal erosion

本研究に関する担当研究室は桑野研究室です.
部屋は東京大学生産技術研究所B棟3階のBw−304
電話：03-5452-6843, FAX：03-5452-6844
E-mail: kuwano@iis.u-tokyo.ac.jp

For further information, contact below.
Prof. Reiko Kuwano,
#Bw-304, Institute of Industrial Science
TEL：+81-3-5452-6843, FAX：+81-3-5452-6844
E-mail: kuwano@iis.u-tokyo.ac.jp

Luisa Fernanda Santa Spitia (2016)