Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)
©2012. Japan Geoscience Union. All Rights Reserved.

SIT42-02 Room:105 Time:May 22 11:45-12:00

Pressure transmission in a granular system

KATSURAGI, Hiroaki[1]*

[1]Dept. Earth & Environ., Nagoya Univ.

Usual fluids such as water obey a very simple pressure transmission law, so called the Pascal's principle. Then, how does pressure transmit in the earth? Since the structure of the earth is complex in terms of rheological properties, the answer for this question is not so easy. To understand the fundamental pressure transmission manner in the earth, we have experimentally studied the pressure transmission in a granular column. Although the actual constituents of the earth are much more complex than ideal granular matters, a small granular column has been used, as a first step. Moreover, we restrict ourselves within the pressure, i.e., we do not consider the shear stress components. Glass beads or sand are poured into a small cylindrical container. Then, an intruder is penetrated into it very slowly. The intruder is subjected to the drag force and induces pressure. We have simultaneously measured the drag force and the pressure at the wall. We found that they show nonlinear relations. It is known that the static wall pressure exhibits a saturation tendency in the deep region of the granular column. This tendency is called Janssen effect. The Janssen effect is based only on the static pressure balance. There has not been any pressure transmission law for pressed or plunged granular column, although it should be a fundamental principle to discuss the granular rheology. Only the penetration drag has been measured so far [1,2]. Our result reveals the simple but nontrivial scaling for the pressure transmission in a plunged granular column. More specifically, we obtained the empirical pressure transmission scaling, using the measured data. In the scaling, dimensionless thickness of the granular layer plays an important role. That is a source of nonlinearity of the drag force and pressure transmission. Moreover, we have checked the history dependence of the granular pressure transmission. Influences of various sample preparation methods and cyclic loading tests were experimentally evaluated. As a result, we found the universality and robustness of the nonlinear scaling.

References:
[1] M. B. Stone et al., Phys. Rev. E 70, 041301 (2004).
[2] G. Hill, S. Yeung, and S. A. Koehler, EPL 72, 137 (2005).

Keywords: granular matter