Experimental Studies for Applicability of a Bedload Sensor with a Communicating Tube

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INTRODUCTION

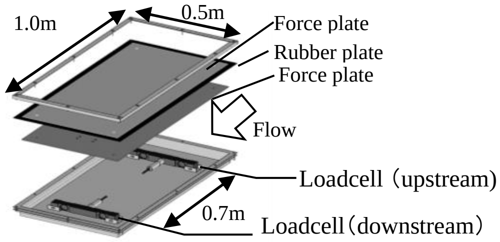

Fig.1 Schematics of submerged loadcells system

The submerged loadcells system (bedload sensor) consists of two submerged loadcells in an iron box, rubber plate and force plate (**Fig. 1**). If sediment particles of bedload are submerged, those weights are reduced by buoyancy force driven to those particles on the bed. In addition, the velocity of sediment particles can be estimated using the time lag of the temporal changes of weight measured by loadcells in upstream and downstream (Goto et al., 2016). The system was installed in Ashi-arai-dani experimental flume in the Hodaka Sediment Observatory of the Disaster Prevention Research Institute (DPRI) of Kyoto University (Itoh et al., 2014). Applicability of the submerged loadcells system in field usage tries to be evaluated by sediment supplying flume tests. In present study, attempts for modifications are reported for installation of a communicating tube relating to internal pressure in bedload sensor, because some problems are found for the system in bedload measurement using weights of bedload and those temporal changes.

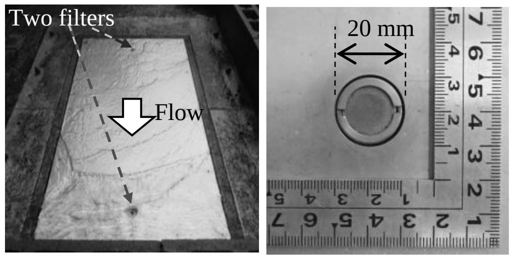

Fig.2 Two filters on the force plate (Left) and the size of filter in plain view (Right)

FIELD EXPERIMENTAL FLUME IN THE HODAKA SEDIMENT OBSERVATORY

Supplied sediment was measured by the submerged loadcells system and was compared with outlet measurement for sediment discharge at the downstream of flume in the Hodaka Sediment Observatory of DPRI. Estimated sediment discharge is at most 14 times larger than outlet measurement. Continuously increasing and decreasing weight of loadcells is monitored because of increasing of internal pressure in the iron box when bedload was moving on the force plate. Two porous metal filters were installed in the force plate to avoid internal pressure **(Fig. 2**). Filters were expected that the water pass through the filter except sediment particles and water pressure was ensured in continuity.

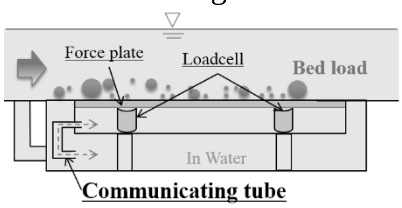

Fig.3 Schematics of a communicating tube

After installing filters, field monitoring and flume tests were continued by supplying sediment particles. However, the value of loadcell was decreasing when sediment particles passed through on the force plate. Porous metal filters could ensure the continuity of water pressure and response could be slow for internal pressure changes. Therefore, the communicating tube was newly installed in submerged loadcells system (**Fig. 3**). The communicating tube can be easy to ensure the continuity of water pressure in an iron box during bedload moving on the force plate.

LABORATORY TESTS

Laboratory tests were again conducted using the prismatic open cannel (Bed slope: 1/38.2 (=1.5 degrees), width: 0.8 m, length: 20 m). In laboratory test flume, modified bedload sensor, which is installed two porous metal filters and a communicating tube, is installed as same as in Ashi-arai-dani field experimental flume. Water and sediment particles were supplied from upstream constantly (Flow discharge: 0.05 m^3/s, 60% diameter of the grain size diagram: 69.4 mm, that is shown by Itoh et al., 2014). The data was collected at a sampling rate of 100 Hz in measurements.

Figure 4 shows one example of temporal changes of raw data (100 Hz) of weight and a moving average with every 50 samples (Itoh et al., 2014). The weight is measured during the sediment particles moving on the force plate. Decreasing value of weight is not observed during the sediment particle pass through there. After the sediment particles passing through the plate, the value of weight was reset to zero. The continuity of water pressure by the communicating tube can be ensured and applicability of bedload sensor with a communicating tube can be confirmed.

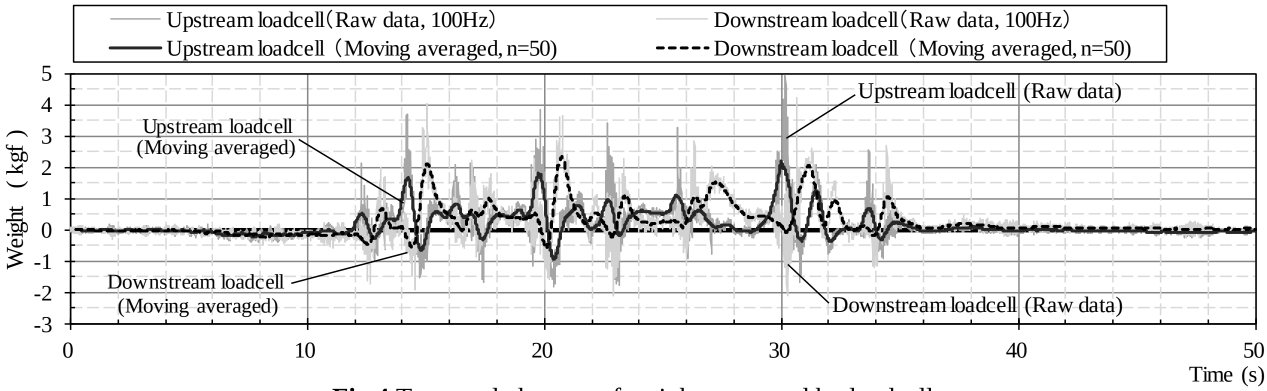

Fig.4 Temporal changes of weight measured by loadcells

CONCLUSIONS

A communicating tube is newly installed in submerged loadcells system (bedload sensor) for ensuring response for the continuity of water pressure in bedload measurements, because measurement problems relating to internal pressure are found through field monitoring at the Hodaka Sediment Observatory of the Disaster Prevention Research Institute (DPRI) of Kyoto University. Modified bedload sensor can measure moving weight of bedload particles through laboratory tests.

REFERRENCES

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Keywords: Submerged loadcells system, Bedload sensor, Bedload, Field observation, Flume tests