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Centrifuge Modeling for Uplift of buried Structures by Liquefaction: A New Measure for Uplift

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Uplift behavior of buried structures with and without a measure for uplift is investigated in model tests which are dynamically tested in a centrifuge modeling. Many types of damage of buried structures occur due to liquefaction during an earthquake, such as flotation, settlement, bending and buckling of buried pipes. Among those, this paper focuses only on uplift of sewerage manholes. In this study, effectiveness of a new measure for uplift which is to dissipate the excess pore water pressure is investigated to reduce uplift displacement of the manhole during earthquakes (Konishi et al. 2008).

1. MODEL DESIGN

The model is scaled down to 1/20. Silica sands were used to make model ground. The ground model was prepared in a rigid container, with nominal inside dimensions of 0.45, 0.15 and 0.30 m with a transparent front window installed in the container, through which the in-flight model behavior can be monitored as shown in Fig. 1. The original subsoil layer of relative density, Dr ≈ 85%, was first prepared by compacting moist silica sands. Then, to install the model manholes, a trench of volume 2.3 × 2.3 × 3.2 m was excavated. The manhole was placed on gravel with thickness of 0.2 m at the bottom of the trench (Fig. 1). The same silica sand as the original model ground was air-pluviated in the trench with viscous water to form a loose deposit (Dr ≈ 36%).

Target prototype manhole is standard No. 1 Manhole (JSWA, 2001), hollow cylinder, reinforced concrete manholes, typical of modern manhole in Japan.

The measure for uplift constitute a filtering net which is installed at a part of connection of a sewerage pipe and manhole, and a pipe which is installed at the part of filtering net in the manhole in the manhole (Konishi et al. 2008).

2. TEST RESULTS

Figure 2, which plotted the relationship between the uplift displacement and peak acceleration on the shake table for 5 tests (NW211, NW212, NW213, NW311 and NW321), shows effects of the measure for uplift. Uplift amount for the manholes with the measure for uplift was smaller than that of the manholes without the measure for all tests.

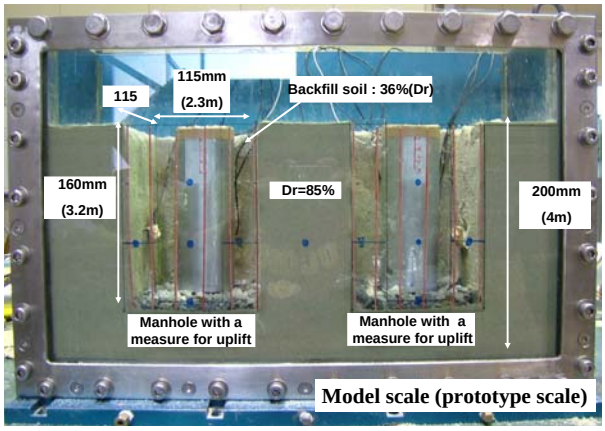

FIG. 1. Model manholes installed in the excavated ground before back-filling with loose soils.

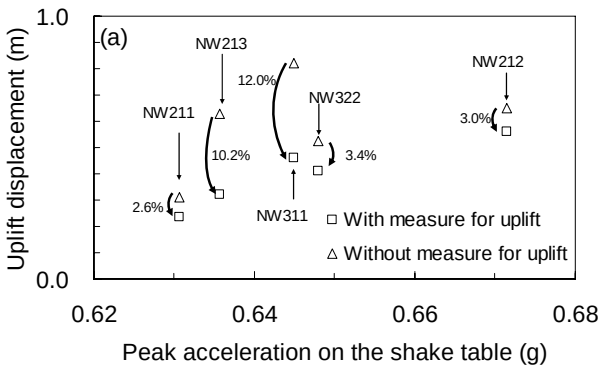

FIG. 2. Relationships between peak acceleration on the shake table and uplift displacement of the manhole.