

Earth Pressure on an Unyielding Wall Due to a Strip Surcharge

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ABSTRACT

The horizontal pressure acting on a non-yielding wall due to a strip loading was studied in this paper. Based on the experimental results, the following conclusions were made. If the strip surcharge was located near the face of the wall, the surcharge loading would induce a decrease of lateral pressure in the upper part of the compacted backfill. It may be deduced that the surcharge applied on the top of the soil near the wall would compress the soil element vertically. The induced lateral deformation would make the compacted soil "less passive" and the lateral soil thrust to decrease. This phenomenon would disappear if the surcharge loading was removed. The experimental lateral soil thrust induced by surcharge loading was apparently smaller than the theoretical predictions.

KEY WORDS: Surcharge ; Compaction ; Earth Pressure ; Retaining Wall.

INTRODUCTION

In the field, the retaining wall would support not only the horizontal pressure caused by the soil mass behind the wall, but also the pressure increase due to surcharge loading. To estimate the horizontal pressure on the retaining structures caused by surcharge loading, geotechnical engineers generally utilize the equations and charts suggested in the U.S. Navy Facilities Design Manual DM-7.2 (1982), which were based on the theory of elasticity and method of images.

However, this topic still needs more study because the methods suggested in DM-7.2 manual did not consider different boundary conditions in the field. Several investigations were conducted to observe the lateral pressure increase due to surcharge. Rehnman and Broms (1972) studied the lateral pressure increase on a basement wall by full-scale tests. Sherif and Mackey (1977) observed the pressure increased on a retaining wall with repeated loading, for simulating some structures like bridge abutments and basement walls, which support loads from moving vehicles. This subject has also been investigated by Smolczyk et al. (1979), and Van Den Berg (1991).

The purpose of this research is to observe the horizontal pressure variation against the non-yielding wall due to the surcharge load on the

compacted backfill, to simulate the field condition mentioned above.

To obtain a better understanding of the lateral pressure variation due to surcharge, the large-scale non-yielding model retaining wall system at National Chiao Tung University (NCTU) was employed. Air-dry Ottawa sand was used as the backfill material. Dry sand was placed into the soil bin in layers, and then compacted to a relative density of about 75 %. Vertical surcharge was applied on the top of the backfill, and horizontal pressure at the wall was monitored with soil pressure transducers. The parameters of this research included the magnitude of surcharge, and horizontal distance from the surcharge to the model wall.

Based on research results, a better understanding regarding the variation of lateral pressure due to a surcharge loading on the compacted backfill against a non-yielding retaining structure was obtained.

EXPERIMENTAL APPARATUS

To investigate the behavior of earth pressure at-rest against retaining structures, an instrumented non-yielding retaining-wall facility was developed at National Chiao Tung University. To simulate the field condition, the backfill behind the wall was densified with a vibratory soil compactor.

The model wall shown in Fig.1 is 1,500 mm-wide, 1,600 mm-high, and 45 mm-thick. To investigate the distribution of earth pressure with depth, sixteen strain-gage-type soil pressure transducers (SPT, Kyowa PGM-02KG, capacity = 19.6 kN/m², Kyowa PGM-05KG, capacity = 49.05 kN/m²) were embedded in the central zone of the model wall. To eliminate the soil-arching effect, all soil-pressure transducers were quite stiff and were installed flush with the wall.

To constitute a plane strain condition for model test, the soil bin is designed to minimize the lateral deflection of sidewalls and the friction between the backfill and sidewalls. To eliminate the friction between backfill and sidewalls, a lubrication layer consisted of plastic sheets was furnished for all model wall experiments. The lubrication layer consists of one thick and two thin plastic sheets were hung vertically on each sidewall of the soil bin before the backfill was deposited. The thick sheet was placed next to the soil particles. It is expected that the thick sheet would help to smooth out the rough interface as a result of