Effect of Ground Movement Direction on Ultimate Lateral Resistance of Line Alignment Piles in Clay

Pham Ngoc Quang, Ohtsuka Satoru, Fukumoto Yutaka

Nagaoka University of Technology, Nagaoka, Japan 940-2188, s155066@stn.nagaokaut.ac.jp

In earthquake engineering, pile foundation has been designed against the lateral load resulting from the horizontal ground movements by earthquake, which it may lead to the structure distress or failure. This study focuses the ultimate lateral resistance of piles group against horizontal ground movement. For two dimensional analysis of the horizontal section of pile and ground, FEM has been applied to calculate the ultimate lateral resistance of pile groups against horizontal ground movement. Georgiadis et al. (2013) [1], Zhao et al. (2017) [2][3] analyzed the ultimate lateral resistance of piles group by computing the limit load for the prescribed on piles. This study newly defines the boundary condition for assessment of ultimate lateral resistance of piles group against horizontal ground movement and make clear the effect of ground movement direction on total ultimate lateral resistance and load bearing ratio of piles. Rigid plastic FEM analysis is employed to analyze the limit state of the pile-soil system directly.

In this study line alignment of piles is studied as piles groups. The direction effect of ground movement on the ultimate lateral resistance was investigated through the case study with the change in pile spacing. According to the results, it can be seen that the change in both the total ultimate lateral resistance and the failure mode of ground around piles are observed. This trend is found to be owing to the change in the failure mode of ground peripheral of piles. Since each pile in the group affects other piles, it leads the load bearing ratio of piles significantly depend on pile position such as the front or back piles. The load bearing ratio increased with the increase in pile spacing, but it was obtained different remarkably among piles in groups when the direction of ground movement varies from 0 to 90 degrees.

KEYWORDS: *Ultimate lateral resistance, RPFEM, direction of ground movement, load bearing ratio*

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Evaluation of Soil Properties in Yangon City by Microtremor Measurement

Takumi Matsumoto, Takaaki Ikeda

Nagaoka University of Technology, Nagaoka, Japan 940-2188, s163310@stn.nagaokaut.ac.jp

Our research focuses on seismic risk assessment in Yangon, Myanmar. There is plate boundary around Myanmar, and the Sagaing fault runs in the central part, so the earthquake risk is very high. The ground motion due to an earthquake may cause greatly damage. In this study, for the purpose of seismic vulnerability evaluation of surface ground, we attempted the evaluation of the soil properties of surface ground by using microtremor in Yangon City. Also, this study is a part of the study of SATREPS, and is collaborated with Yangon Technological University.

In microtremor measurement, GEODAQS2-2S typed a velocimeter was used, and velocities in two horizontal directions and in one vertical direction was measured. The target area is in Yangon City. Microtremor motion were measured on different ground conditions such as reclaimed land, riverside and residential areas, and data were got from 20 points. Microtoremor was measured three or four times at one site and each measurement recorded 5 minutes. The H/V spectrum was calculated from the waveform data acquired. Predominant periods and soil properties were estimated from H/V spectrum (Nakamura and Ueno, 1986).

As a result of microtremor measurement, predominance of H/V spectrum presents at each point. The predominant period of 20 measurement points are 0.5sec   1.25sec. This reveals that the ground of Yangon City is relatively soft. In the soft ground along the river, the predominant period is larger than that of inland, which agrees with the fact that the ground along the river is softer than the inland ground. We find that H/V spectrum can be used to evaluated soil properties in Yangon City.

In order to verify the results from microtremor measurement, further studies will compare the result from boring data with that. In addition, we plan to carry microtremor measurement in many sites and calculate the site amplification factor in Yangon City.

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Examination of Relationship Between House Damage and Soil Property Due to Earthquake a Study on Ojiya City, Niigata

Kotaro Tomidokoro, Takaaki Ikeda

Nagaoka University of Technology, Nagaoka, Japan 940-2188, s163301@stn.vagaokaut.ac.jp

In Ojiya city, Niigata, there were serious damages in the 2004 Mid Niigata Prefecture Earthquake. Especially, many houses suffered intense damage. According to the damage distribution of the house, we can find that the houses damage level was different by the locations. In the past study, it was reported that the damage level was different even in a near site because the damage was affected by surface ground characteristics. It was thought that the surface ground characteristics influenced the house damage of Ojiya city.

In this paper we evaluate surface ground characteristics at damaged area using the microtremor date. We use CV-374AV (Tokyo Sokushin Co. LTD) for the microtremor measurements, which are built in a three-component velocity meters of natural period 10 second. We set a measurement line of about 2.5km length in the East-West directions to cross the damage area. Eastern end of measurement line was set in near the Shinanogawa-River and western end of measurement line was set in mountain area. The total number of the measuring points and interval distance of each point are 25 points and about 100m. Mictotremor measurement was carried out 2 or 3 times per measuring point. Each measurement was recorded for 3 minutes at a sampling rate of 100 Hz.

The surface ground characteristics was evaluated from H/V spectral ratio. H/V spectral ratio is the spectral ratio between horizontal spectrum and vertical spectrum. The peak period of H/V spectral ratio means the natural period of the surface ground. (Nakamura and Ueno,1986)

The distribution of peak period from H/V spectral ratio can be divided into three areas. The three areas were named by area A, area B and area C from the river side.

Area A is located within 1km from the river, peak period founds at less than 0.5 second. Area B is located about 1.1 to 2.0 km from the river, peak period founds at 0.3 to 0.5 seconds. Many house damages confirmed in this area. Area C is a mountain area, peak periods appeared between 0.3 and 0.6 seconds. The predominate period of the wooden house is about 0.1 to 0.5 seconds. These periods agree with peak period of area B. In the future study, we will conduct microtremor measurement in the high density and work on a detailed study of relationship between house damage and surface ground characteristics.

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Evaluation of Dynamic Ground Behavior at Near Source Area During the 2016 Kumamoto Earthquake by Numerical Analysis Approach

Shun Nemoto, Takaaki Ikeda

Nagaoka University of Technology, Nagaoka, Japan 940-2188, s163304@stn.nagaokaut.ac.jp

The Kumamoto earthquake struck in Kumamoto prefecture district in 2016. The 2016 Kumamoto earthquake is a series of earthquake. It includes two intense earthquakes which were Mw6.2 event on April 14 and Mw7.0 event on April 16. These earthquakes are called fore-shock and main-shock respectively. Seismic intensity of 7 was recorded twice in Masiki Town near source area. It was the first time that the seismic intensity 7 was observed twice in the same earthquake series. Earthquake damage in Kumamoto prefecture was enormous, with 208 people dead, and more than 180000 houses were damaged. Furthermore, damage of road bridge, ground subsidence and slope failure were caused along the active fault. More than 150 slop failures occurred and it caused isolate area by road blocking. Heavy damage occurred in the lifeline including the water resource facility. Especially damage in the Akita water source area and Numayamazu water source area, which located near the Kiyama River basin of Higashi-ku, Kumamoto City. In this area, many pump towers tilted and function stopped. Also we found ground subsidence. It was thought that the damage of the pump tower caused by earthquake induced ground subsidence. We need to consider ground subsidence in various ways. In this study, we try to evaluate of the surface ground behavior during the earthquake by numerical analysis approach. Especially focused on acceleration and strain in the surface ground. The analysis method is 1-dimensional earthquake response analysis of DYNEQ (Based on equivalent linear method) and YUSAYUSA2(Based on effective stress method). The ground model was modeled on the local geological survey results. We calculated the dynamic ground behavior during the foreshock and main shock. Comparing these results, we clarified the behavior during the Kumamoto earthquake.

Influence of Fertilization of Organic Compost and Green Tuff for Microbial Community Structures and Chemical Components in Green Onion Cultivation Fields

[1]Kyohei Kuroda, [1,2]Tomoka Arata, [1]Nana Ohmine, [1]Ayaka Miyata, [1]Miyu Kawazoe, [3]Tatsuya Ohike, [2]Yuga Hirakata, [2]Masashi Hatamoto, [2]Shinya Maki, and [2]Takashi Yamaguchi

[1]National Institute of Technology, Miyakonjo College, Miyakonojo, Japan 885-8567,
kkuroda@cc.miyakonojo-nct.ac.jp
[2]Nagaoka University of Technology, Nagaoka, Japan 940-2188
[3]Towada Green-tuff AgroScience Co., Ltd., Meguro-ku, Japan 152-0011

Fresh-cut green onion is frequently used as a condiment for cooking in the world. Recently, although domestic production volume of fresh-cut green onion has gradually increased, the green onion produced from China is frequently utilized due to cheaper price. Therefore, cost-effective cultivation method has been required for domestic green onion production. In this study, to obtain the high yield of green onion, we focused on 'cut back' procedure, which cuts the green onion leaves on the ground at 2–3 times during cultivation. If we increase the 'cut back' numbers, high productivity can be observed, and we can decrease the price of domestic fresh-cut green onion. In this study, to increase the 'cut buck' numbers of green onion cultivation, we fertilized fermented waste mushroom media, fermented bamboo powder, and green tuff into the fields, and evaluated changes of soil microorganisms and chemical components to address the mechanisms.

This study prepared 5 test fields using green houses. Two test fields (Test 1–1 and 1–2) were fertilized above organic composts and minerals. Another two test fields (Test 2–1 and 2–2) were fertilized same fertilizers of Test 1–1 and Test 1–2 and mycorrhizal compost. One test field was added chemical fertilizers, which are frequently used by domestic farmers. All tests were fertilized almost same nitrogen, phosphorus, and potassium concentration. We collected 25 soil samples from 5 places from each green house. To analyze soil microorganisms and avoid the sampling error, we gathered 25 soil samples into 5 samples in one green house. Finally, we tested soil microorganisms from 25 sampling points in 5 green houses at each sampling day. We sampled soils at before fertilization, after fertilization, before 1st cut back, after 1st cut back (before 2nd cut back), after 2nd cut back, and after 3rd cut back. Microbial community analysis based on 16S rRNA gene sequence was performed using MiSeq targeting 515F–909R, and data were analyzed using QIIME 2. Chemical analyses of humus, pH, electric conductivity, NH_4^+–N, NO_3^-–N, effective phosphate, cation exchange capacity, phosphate absorption coefficient, potassium, calcium carbonate, magnesia, and total base were performed. In this conference, we will present the changes of microbial communities and chemical parameters by fertilizing different fertilizers.

Application of Immobilized Beads in Natural Rubber Processing Wastewater

Tran Phuong Thao[1], Vu Thi Hoa[2], Hatamoto Masashi[1], Yamaguchi Takashi[1], Nguyen Lan Huong[2]

[1]*Nagaoka University of Technology, Nagaoka, Japan 940-2188, s175005@nagaokaut.ac.jp*

[2]*Hanoi University of Science and Technology, Hanoi, Vietnam*

Rubber industry is facing an environmental problem associated with its discharged high concentrations of COD and TSS wastewater. Currently, anaerobic sludge is commonly used as a biological method to treat this high-strength wastewater. However, the common sludge is suspended sludge, which requires a long time to activate and form into granular sludge.

This study is the first case applying immobilized sludge onto polyvinyl alcohol (PVA) bead as a novel alternative in an upflow anaerobic reactor (UAR) for natural rubber processing wastewater (NRPW) treatment. The assessment on performance of this PVA bead was carried out via TSS and COD removal efficiency, as well as methane conversion ratio.

The 10 L of UAR was packed with 4 L of PVA bead, operated at ambient temperature during 167 days. The NRPW was collected from acetic acid coagulation of latex, adjusted to neutral pH, and supplied with increasing OLR to find the tolerance of this UAR to the NRPW. The UAR using immobilized PVA beads rapidly got acclimated to the operational conditions and stably removed over 80% influent COD at OLR upto 8.8 kg-COD•m^{-3}•day^{-1}(Phase I). In phase II, the reactor performance deteriorated due to the increase in the influent COD concentration (from 3600 to 5900mg/L) and the decrease in HRT (from 9.3 to 7.5 hours). After adjusting the influent COD and HRT to reduce OLR, it took about 20 days for the reactor to recover in phase III. This reactor reached COD and TSS removal efficiency of 92.7% and 77.7%, respectively; methane production rate of 0.28 L-CH4/gCODremoval under OLR of 9.9 kg-COD•m^{-3}•day^{-1} and HRT of 11 hours.

The PVA bead shows promising advantages, i.e. high settleability allowing high flowrate (short HRT) and no excess sludge wash-out improving effluent TSS concentration. In this case, the UAR using PVA beads could accommodate higher OLR wastewater than the previous UASB [1, 2]. The methane recovery rate was lower than previous studies, which might be caused by short HRT and the lower operational temperature (less than 30ºC).

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