Development and its Applicability of Portable Ground Bearing Capacity Device

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ABSTRACT

Geotechnical investigations of site and bearing capacity analysis are very important procedures for construction of building. Plate loading test is conventional method usually used to measure a bearing capacity of ground directly. But this method is not used widely because it needs large measurement space, long time for measurement and rather costly for single house foundation survey. Therefore, development of easy and cheapest way of bearing capacity survey instruments that could solve aforesaid problems associated with plate loading test is keen interest of Japanese geotechnical engineers. In this context, the authors have developed a portable ground bearing capacity survey devices which could solve aforesaid problems. The relationship curve between the loading pressure and penetration directly gives the ground bearing capacity value.

KEY WORDS: ground plate loading tests; simplified and compact bearing capacity test; embankment; unconfined compression test

INTRODUCTION

Ground plate loading tests are commonly used for evaluating the bearing capacity of grounds. In the ground plate loading test, the ground deformation, strength and the bearing capacity characteristics are evaluated from the relation between loads and subsidence by loading 30cm diameters plate with a jack. However, this type of test requires wide working space since a reaction force pile and a loading beam (sometimes a heavy machine) are necessary as reaction equipment. Therefore a lengthy time and a lot of money for the preparation will become a problem. Until now, various bearing capacity apparatuses has been developed and utilized in fields (e.g., Jamiolkowski, et.al, 1985; Hanna, et.al, 1998; Yamamoto, et.al, 2009).

We have been developing simplified and compact ground bearing capacity test device which can be easily applied in the narrow area where a regular ground plate loading test can not be performed. In this article, the features of this new simplified and compact bearing capacity test device is explained and to evaluate the performance of the test device, a comparison of test results from plate loading test and unconfined compression test is described as well. Furthermore examples applied to the solidified improving strength study on reservoir bottom sediment and the study on soil embankment behind stone castle are reviewed to evaluate the applicability of this test device.

ASSESSMENT FOR THE BASIC PERFORMANCE OF THE PORTABLE BEARING TEST DEVICE

Features

The features of the presented bearing test device are shown in Table 1. The maximum sizes during the measurement operation are 50cm in height, 67cm in width, and 8.0kg in weight. Thus, it can be said, compact and light weight test device. Therefore it is portable and applicable in narrow areas. This assessment is performed by loading 5 types of loading plates (16-50mm) onto the targeted ground directly. Using a weight of a research staff as a reaction force, 4000kN can be loaded at maximum. The measurement time including a set up is approximately 30minutes. Therefore, the measurements at multiple sites can be possible in a short time. It is desirable to have more than 10 times of measurement at one site to improve accuracy. Since the loading plates are relatively small, applicable sites for loading test should be cohesive soil - sandy soil area, where is relatively small size of particle area.

Table 1   Features of Simplified and Compact Bearing Test Unit

<table>
<thead>
<tr>
<th>Item</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>Height 49.8cm × Width 67.0cm</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 8.0kg</td>
</tr>
<tr>
<td>Purpose</td>
<td>Evaluate ultimate bearing capacity</td>
</tr>
<tr>
<td>Reaction</td>
<td>Weight of research staff, etc</td>
</tr>
<tr>
<td>Frequency</td>
<td>More than 10 times/site is desirable</td>
</tr>
<tr>
<td>Measurement period</td>
<td>Approx. 30 minutes/site</td>
</tr>
<tr>
<td>Results</td>
<td>Load pressure = Curve of settlement</td>
</tr>
<tr>
<td>Max Pressure</td>
<td>Approx. 4000 kN/m² (Depend on weight of research)</td>
</tr>
</tbody>
</table>

An usage of simplified and compact test device is shown in Fig.1. The weight of a researcher is applied as a load reaction force. Loading is done by pneumatic pressure of a hand operated pump and the loadings are performed onto measuring ground surface with load level control system.

Fig.2 shows a diagram of relationship between loading pressure and subsidence using test device. The settlement increases proportionally with the increase of loading pressure, and the settlement increases remarkably after the particular point of loading pressure. In this study,