Ⅲ－A174 Seismic earth pressure in model tests of retaining walls

Yulman MUNAF, Junichi KOSEKI, Institute of Industrial Science, Univ. of Tokyo
Fumio TATSUOKA, Department of Civil Engineering, Univ. of Tokyo
Masaru TATEYAMA, Kenichi KOJIMA, Railway Technical Research Institute

Introduction

To compare seismic performances, a series of model tests on different type of retaining walls was performed. The seismic earth pressures acting on the wall measured at seismic coefficient about *0.2* are presented in this paper.

Testing Procedure

Two types of tests were conducted on models of cantilever, gravity, leaning, and three types of reinforced soil retaining walls. One is tilting test to simulate pseudo static condition, and the other is shaking table test to simulate dynamic condition. To measure the distribution of normal stress (normal component of earth pressure; denoted as σ) and shear stress (τ) acting along the back face of the wall, several two component load cells were installed in the center part of the facing. To mobilize friction, sand paper was glued on the facing surface. Refer to Munaf et al. [1,2] for testing procedures in detail and Koseki et al. [3] for cross sections of models. It should be noted that the measured data during shaking table test of reinforced soil type 3 model are not presented because they were lost due to misoperation, but that results from shaking table test of fixed wall as shown in Fig.1 are presented.

Results and discussions

Fig.2 and 3 compare the distribution of σ, among different type of walls at initial condition and at seismic coefficient k_h = 0.2 (=*tan(θ)*;*θ* is the tilting angle) respectively. At initial condition, the measured earth pressure coefficient $K(= \sigma/(\gamma_d z+p))$; γ_d is dry unit weight, z is depth and p is surcharge) was about 0.1. However, for the three reinforced soil type walls, some reduction in K as observed at the lower part of wall. At k_h=*0.2*, the value of K increased to about 0.15 on the average, while its reduction at the lower part of reinforced soil walls was still observed. Compared to the extent of scattering of the measured data, the effects of different wall types were not clearly observed except for the above-mentioned difference for reinforced soil walls. Fig. 4 and 5 compare the distribution of σ for shaking table tests at initial condition and at base acceleration about 200 gal, respectively.

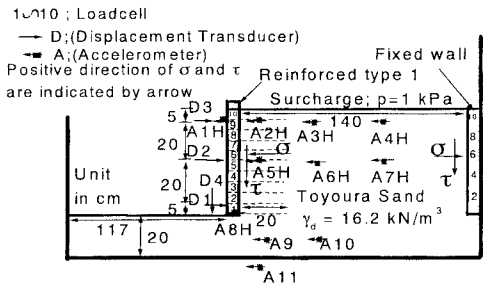


Fig.1 Cross section of model test for reinforced type 1 and fixed wall type

It should be noted that the peak values of σ near the end of each shaking step (100 cycles at 5 Hz) as typically defined in Fig. 6 is plotted in Fig. 5. Similarly to tilting test, the value of K increased from about 0.1 to about 0.15 by shaking, except for the fixed wall which showed the highest value of K (around 0.3). In both figures, reduction in K at lower part of

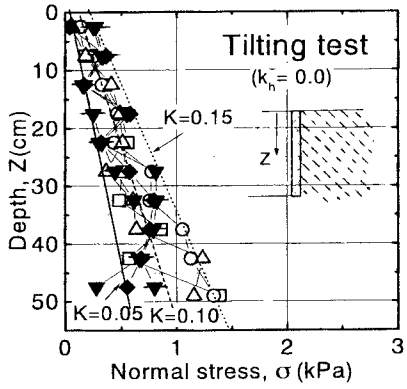
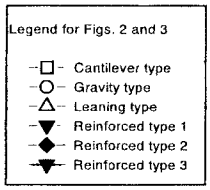


Fig.2 Measured normal stress at initial condition for tilting test



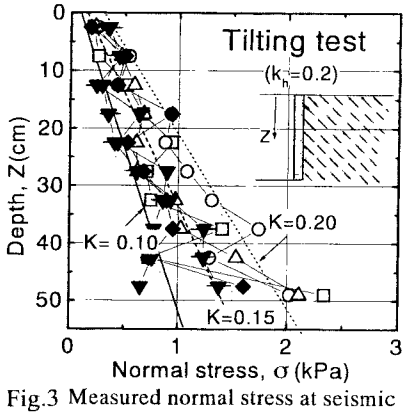


Fig.3 Measured normal stress at seismic coefficient 0.2 for tilting test

Key words : retaining wall, model test, seismic response, earth pressure, wall friction angle.
7-22-1, Roppongi, Minato-ku, Tokyo 106-8558,Phone: 03-3402-6231 Ext.2573,Fax:03-3479-0261

reinforced soil walls was again observed. Fig. 7 and Fig. 8 compare the distribution of wall friction angle δ (= *arctan*(τ/σ)) for shaking table test. Although the values of δ were largely scattered, they were on the average smaller than $\phi_{psc}=51^{\circ}$ (the peak angle of internal friction measured by plane strain compression tests on the same Toyoura sand as employed for the model test) but rather close to $\phi_{ss}=38^{\circ}$ (the peak friction angle at simple shear condition estimated from ϕ_{psc} based on Tatsuoka et al.[4]). Effects of shaking and those of different wall type on the values of δ were not clearly observed.

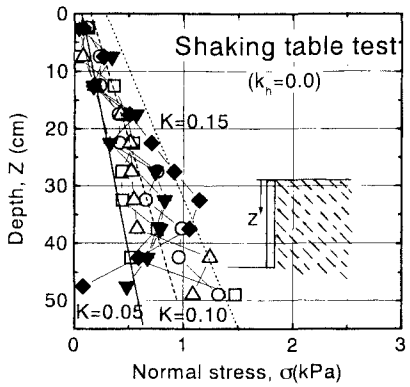


Fig.4 Measured normal stress at initial condition for shaking table test

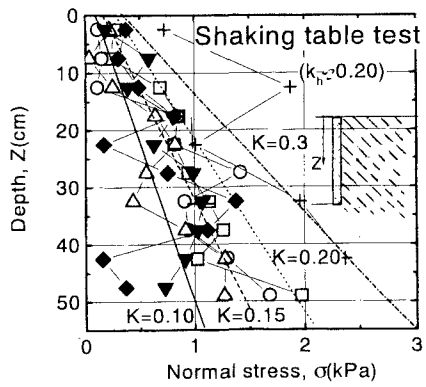
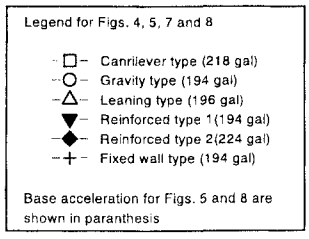


Fig.5 Measured normal stress at seismic coefficient about 0.2 for shaking table test



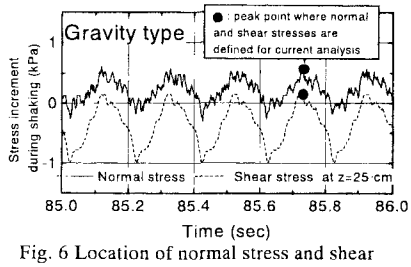


Fig. 6 Location of normal stress and shear stress used in analysis

Conclusions

The following conclusions can be derived:

1. Measured earth pressure coefficient increased from about 0.1 to about 0.15 at k_h about 0.2
2. Measured wall friction angle scattered largely, but it was relatively close to peak friction angle of sand at simple shear condition.
3. No clear effect of different wall types was observed until k_h about *0.2*, except for the reinforced soil walls and the fixed wall.

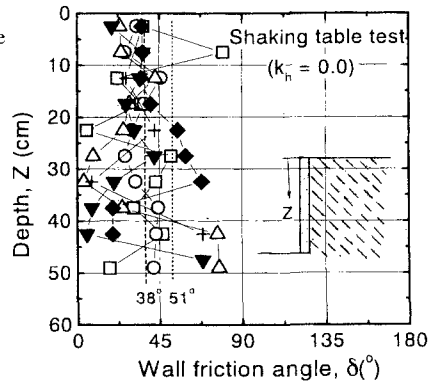


Fig.7 Wall friction angle at initial condition for shaking table test

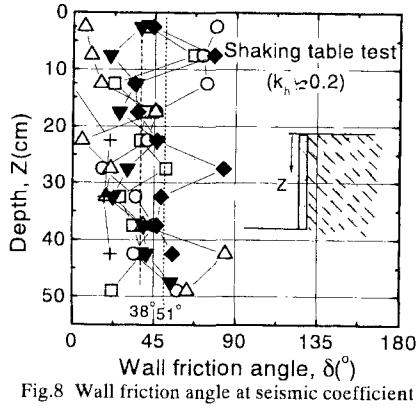


Fig.8 Wall friction angle at seismic coefficient about 0.2 for shaking table test

References

1). Munaf, Y., et al.(1997) "Failure Pattern of Several Retaining Wall Models by Tilting Tests", The 32nd annual conference of JGS. 2). Munaf, Y., et al.(1997) "Shaking Table Tests of Cantilever Type Retaining Wall model", The 52nd annual conference of JSCE.3) Koseki, J.,et al.(1998)"Comparison of Model Tilting/shaking Tests on Several Types of Retaining Walls with Stability Analyses", this conference(in Japanese). 4). Tatsuoka, F., et al.1991, "Progressive Failure and Particle Size Effect in Bearing Capacity of a Footing on Sand", *Geotechnical Engineering Congress 1991*, Mclean, F., Campbell, and Harris, D., Editors, ASCE, Geotechnical Special Publication No. 27, Vol. 2, pp. 778-802.