III - 166

STRESS-STRAIN BEHAVIOR OF UNDISTURBED AND RECONSTITUTED SAND IN TRIAXIAL COMPRESSION

Hameed R.A., Miyazaki K., Sato Y., Hirokawa F.
Nishimatsu Construction Co., Ltd.,

1 INTRODUCTION

To evaluate the fabric or structure which may exist in relatively old deposits, two consolidated drained triaxial tests were performed on undisturbed specimens taken from a construction site for a high rise building in Tokyo. Using the materials obtained when trimming, two reconstituted specimens were also prepared. The reconstituted specimens were compacted to the in-situ density at the natural moisture content of the sample.

2 LABORATORY TRIAXIAL TESTS

Test conditions for undisturbed sand specimens (D_{50}= 0.17mm, C_u= 1.39 and particle shape= sub-angular) were reported in Hameed, 1992. Two reconstituted specimens were isotropically consolidated and drained triaxial compression tests ($T\bar{C}D$) were performed at confining pressure of σ'_c= 2.0 kgf/cm^2 equal to in-situ over burden pressure, σ_{v0}, before excavation. One specimen was over consolidated to OCR=3.5. The reconstituted specimens were prepared by compacting moist sand in eight lifts by using a small tamper (assuming moist tamping produce considerably uniform density throughout the specimen). In all four tests lubricated ends were used. Axial strain free from the effect of bedding error were measured to high accuracy by using a pair of LDT (Goto et al. 1991) and linear type LDT, LLDT (Hameed 1992) mounted to the lateral surfaces of the specimen.

3 TEST RESULTS

Two undisturbed (UDSD3, UDS-04) and two reconstituted (RMS-01, RMS-02) sand specimens were tested as listed in Table 1. Figures 1 and 2 shows the typical results. A significant difference between externally (LVDT) and locally (LLDT, LDT) measured axial strains can be seen even though the samples ends were trimmed very flat and smooth. At small strains, the relations are virtually linear, for which the maximum Young's modulus, E_{max}, can be defined. For undisturbed specimens small strain at peak may be noted. Reconstituted specimens show compressional volumetric strain at failure (Table 1). The value E_{max} is generally larger for the undisturbed specimen than the reconstituted one. This may be due to the fact that, over a long period of time, under load, soil particles are attained some kind of preferred orientation, giving the property that is characteristics of the undisturbed state, i.e there is some kind of bond or mutual relationship at point of contact with in the sample which is lost by remolding. However, the undisturbed sand specimens exhibited lower compressive strength, q_{max}, than those of the reconstituted sand specimens. This may be due to rearrangement and reorientation of particles at failure of reconstituted sand clearly different than corresponding undisturbed sand. That is, specimens of identical dry density, prepared by either undisturbed or reconstituted, effect of initial particle arrangement or initial fabric on q_{max} is wide spread (Oda 1972).

As suggested by the result of the field shear wave velocity measurements (Miyazaki 1994) and $T\bar{C}D$ test on undisturbed silty-sand (Fig. 3 Hameed 1992) taken from same depth, the in-situ sand and silt-sand layers have similar behavior. These results indicate that the undisturbed sand samples had been more disturbed. It is very likely that undisturbed sand did not exhibit the actual field behavior even when measured under confined conditions in the laboratory.

4 CONCLUSIONS

1. For all the samples the difference between externally and locally measured axial strains was significant due to the effect of bedding error.
2. Due to natural welding effects between particles of undisturbed samples, deformation characteristics are different from the reconstituted samples. In general in-situ behavior can not be reproduced in the laboratory simply by the reapplication of stress.

REFERENCES

1. Goto, S., Tatsuoka, F., Shibuya, S., Kim, Y.S. and Sato, T. (1991), " A simple gauge for local small strain measurements in the laboratory ", Soils and Foundations, 31-1: 69-180.
2. Hameed, R.A. (1992), " Deformation and strength characteristics of undisturbed stiff sand in triaxial compression ", Master of Engineering thesis, University of Tokyo, Japan.
3. Miyazaki, K. (1994), " Comparison of Young's modulus between in-situ, laboratory test and full-scale behavior of Pleistocene deposit ", Proc. 49th JSCE Annual meeting, Sapporo, Hokkaido.
4. Oda, M. (1972), " Initial fabrics and their relations to mechanical properties of granular material ", Soils and Foundations, 12-1: 19-36.

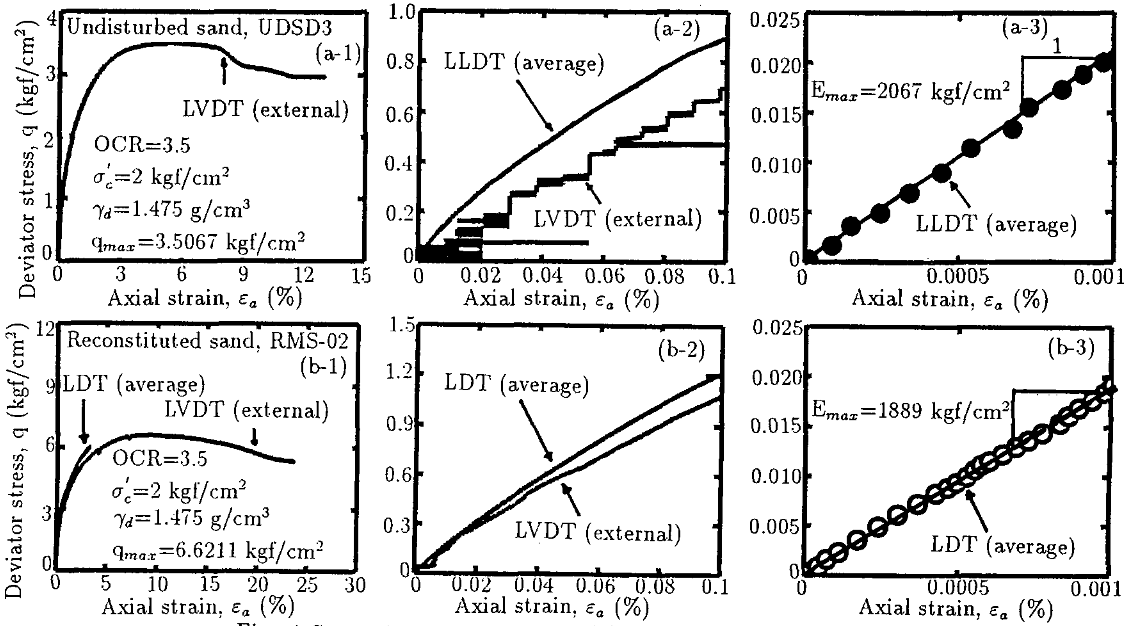

Fig. 1 Stress-Strain relations of (a) UDSD3 and (b) RMS-02

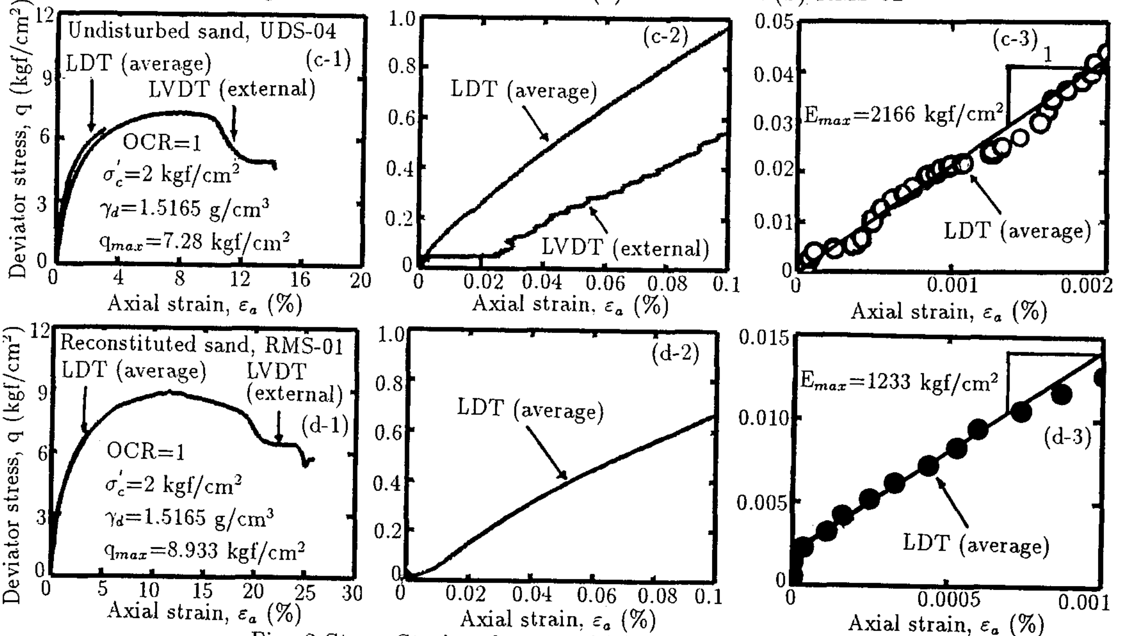

Fig. 2 Stress-Strain relations of (c) UDS-04 and (d) RMS-01

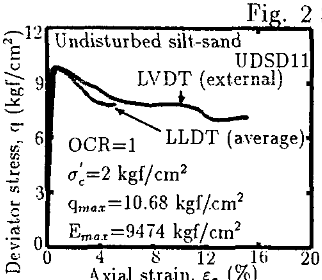

Fig. 3 Stress-Strain relation of UDSD11

Table 1 Detail of test results

TEST NO.	OCR	γ_d (gf/cm^3)	E_{max} (kgf/cm^2)	q_{max} (kgf/cm^2)	$(\varepsilon_a)_f$ (%)	$(\varepsilon_v)_f$ (%)
UDSD3	3.5	1.475	2067	3.507	5.38	-1.444
UDS-04	1	1.517	2166	7.28	7.88	-1.143
UDSD11	1	1.577	9474	10.68	0.866	+0.148
RMS-01	1	1.517	1233	8.933	11.49	+4.663
RMS-02	3.5	1.475	1889	6.621	9.38	-0.266

-: Dilative, +: Compressive