III-178 CHANGE IN DENSITY IN SAND DURING CONE PENETRATION

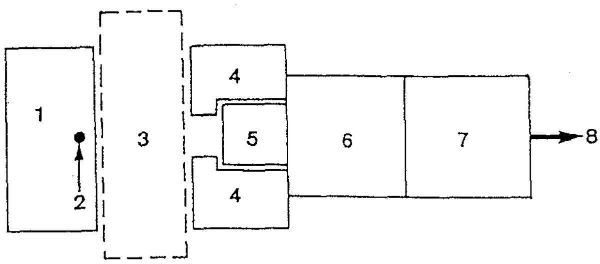
T. SHIBATA, Professor, Dept. of Civil Engineering, Kyoto University.
M. MIMURA, Research Associate, DPRI, Kyoto University.
A.K. SHRIVASTAVA, Doctoral Student, Dept. of Civil Engineering, Kyoto University.
T. MURAKAMI, Graduate Student, Dept. of Civil Engineering, Kyoto University.

INTRODUCTION

In our previous papers we have reported on the development of RI-Cone penetrometers (Shibata et al 1991 and 1992), where we have noted the problem of deformation around advancing cone and how this might affect the radio-isotope measurements. In order to study these changes, an experimental procedure was sought by which density variations around the advancing cone penetrometer could be determined. Radio-isotope thin wall scanner technique was modified to study the density changes.

TEST EQUIPMENT AND PROCEDURE

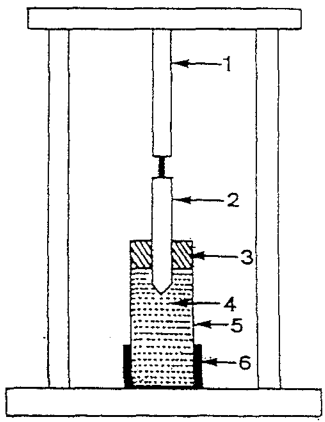
Thin steel plate chamber of dimensions 140cm x b10cm x h25cm was built. The probe was made up of steel. Its dimensions were 35.6 mm diameter and 60° tip angle to conform to the size recommended by the ICSMFE subcommittee.



1. Lead (Pb) shield; 2. Source (Co^{60}); 3. Chamber 4. Lead (Pb) shield; 5. Detector; 6. Photo-multiplier tube; 7. pre-amplifier; 8. to personal computer for data collection

Fig. 1: Schematic diagramme of radio-isotope measurement of density

The test procedure was consisted of preparing the sand bed in the chamber. This was accomplished by means of pluviation of sand.Sand samples of various initial density were prepared. Desired density was attained by controlling the width of the aperture through which the sand was displaced. Once the model ground was prepared in the chamber, the chamber was placed on the thin wall scanner and the initial densities were determined at eight different sections at the depth interval of 2cm. The characteristic of the thin wall scanner is that for the production of gamma-photon it uses the cobalt (Co^{60}) as the source. NaI crystal was used as the detector. Both the source and the detector were covered with the Lead (Pb) shield in order to avoid the direct radiation.Such a system is shown in Fig.1.Thereafter, the chamber was placed on the penetration frame. The desired level of penetration was accomplished by means of manual oil pressure jack. In general,after every 2cm of penetrationthe chamber was placed on the thin wall scanner and was scanned at the predetermined eight sections. This was done in order to facilitate the comparison at the later stage (Fig. 2).



1. push rod; 2. model cone (60^0, 35.6mm) 3. guide; 4. model ground; 5. chamber 6. chamber holder

Fig. 2: Schematic diagramme of the penetration system

RESULTS AND DISCUSSION

In the current study various Keisa sands were used. Results reported in here are those of Keisa sand No.8 (D_{50}= 0.09mm, Gs = 2.636). Sand specimen of relative density (Dr) 30% (loose sand) and 55% (medium dense sand) were prepared. Fig.3a shows the contour of the density distribution within the chamber for loose sand before penetration. Fig 3b shows the changes in the density distribution after 10 cm of penetration. Similarly Fig. 4a and Fig. 4b show ther initial and final density distribution after 10 cm of penetration for dense sand.

As mentioned above the spatial distribution of density in the chamber was measured before and after each penetration. Results reported are those of initial and after final penetration. Based on the

initial limited data base, following qualitative conclusions are drawn:
(1) all the tests data indicate that the generated density regime in the chamber is complex.
(2) for loose sand, a densification below the cone tip as well as around the shaft is noted. In the far field, general tendency is either of densification or of insignificant change (Fig. 3b).
(3) for dense sand, like the loose sand the same tendencies are observed (Fig4b).
Though only the results of the final penetration are shown here, similar tendencies are observed after every increment of penetration. This general tendecy of densification along the shaft is different from those observed by others (e.g., Chong, 1988). At present no satisfactory answer could be provided and further studies are required to clear this behaviour as well as to quantify the above mentioned results.

REFERENCES

Chong, M. K. (1988), "Density Changes of Sand on Cone Penetration Resistance." ISOPT-1, Vol.2 ,pp. 707-714.

Shibata, T., Mimura, M., Shrivastava, A. K., and Nobuyama, M. (1991), " Design Aspects of Neutron-Moisture Cone Penetrometer." Bull Dias. Prev. Res. Inst., Kyoto Univ., Vol 41, Part 4, pp. 225-241.

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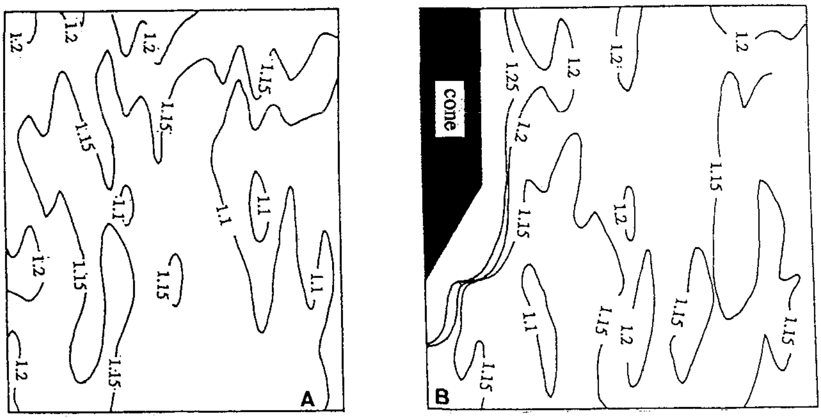

Fig. 3: A. Initial density distribution inside the chamber (initial density=1.148 g.cm^{-3} ; Dr = 30%); B. density distribution after 10cm penetration.

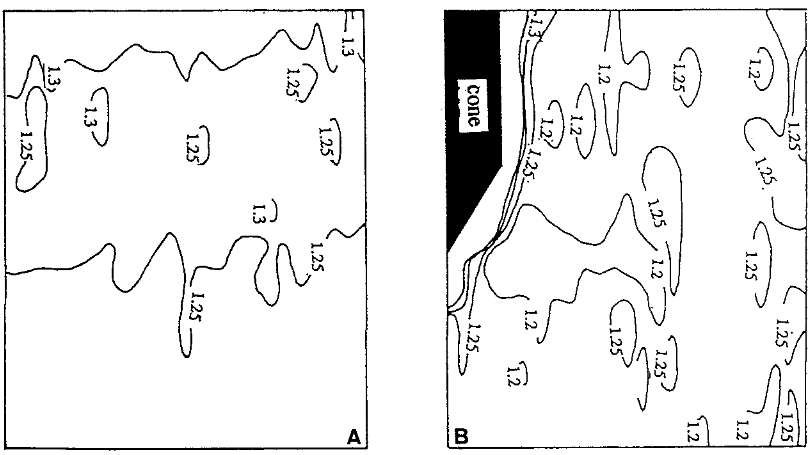

Fig. 4: A. Initial density distribution inside the chamber (initial density=1.253 g.cm^{-3} ; Dr = 55%); B. density distribution after 10cm penetration.