

the mold. However, this procedure helps to determine the expected density before the real sample is made.

For pluviation of the sand in a bigger chamber, a funnel with a small hole probably will not produce a satisfactory uniform sample. A funnel illustrated in Fig. 6.1 is recommended.

Due to space needed for wiring and attaching strain gages and thickness of wall required to overcome bending, the electrical cone suggested for further research should have a diameter of 0.825 in. The recommended geometry is illustrated in Fig. 6.2. with smaller connecting rod to provide displacement relief of the soil during penetration.

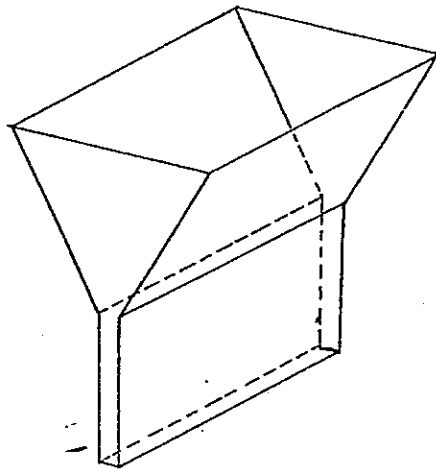


FIG. 6.1. SUGGESTED FUNNEL

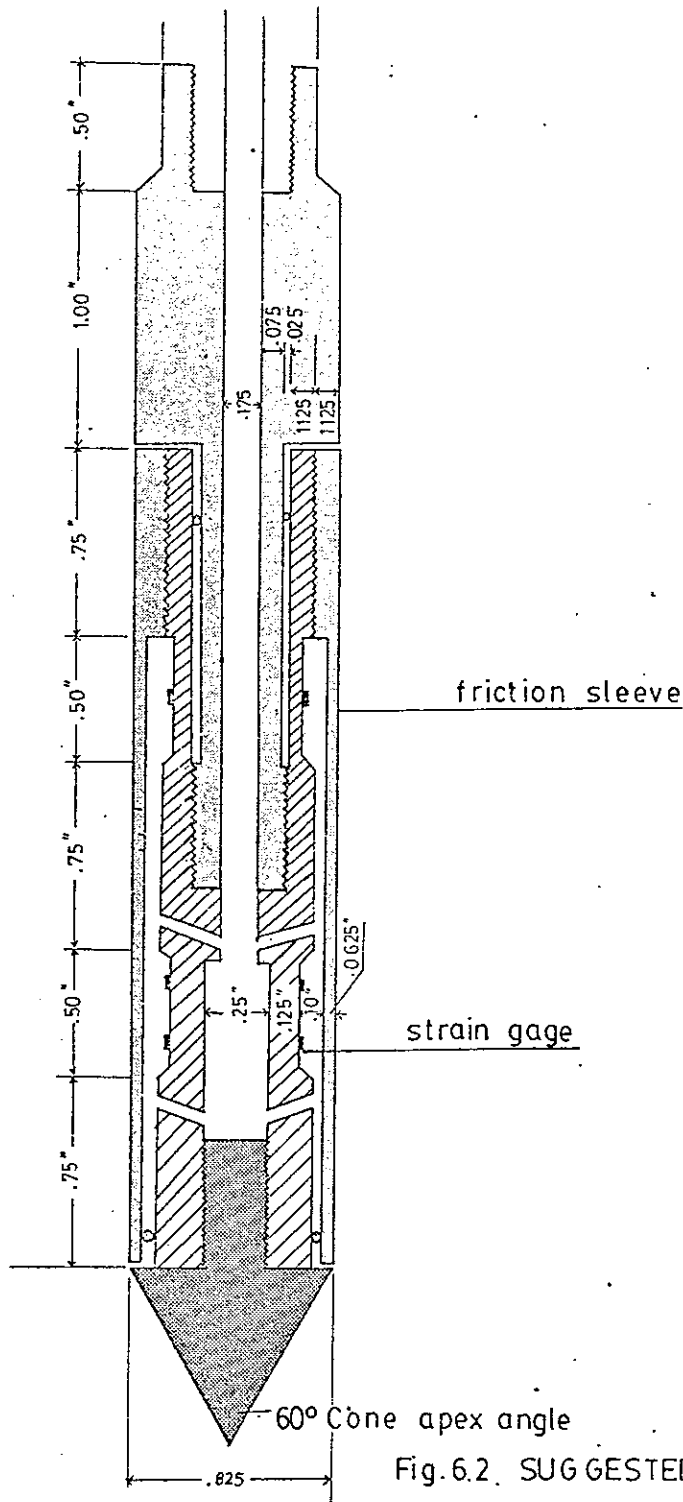


Fig.6.2. SUGGESTED ELECTRICAL CONE.

## LIST OF REFERENCES

- Adestam, L., 'Portable Geotechnical Field Equipment', Proceedings of the X International Conference on Soil Mechanics and Soil Foundation Engineering, Stockholm, 1981.
- ASTM, 'Tentative Method for Deep, Quasi Static, Cone and Friction Cone, Penetration Test of Soil', ASTM Designation : D 3441 - 75T.
- Al-perstein, R., Leifer, S.A., 'Site Investigation with Static Cone Penetration', Journal of Soil Mechanics and Foundation Division, ASCE, Vol. SM5, May 1976, pp. 539-558.
- Baligh, M.M., Vivatrat, V., Ladd, C.C., 'Cone Penetration in Soil Profiling', Journal of The Geotechnical Engineering Division, ASCE, Vol. 106, No. GT4., April 1980, pp.447-461
- Baligh, M.M., Azzouz, A.S., Wissa, A.Z.E., Martin, R.T. and Morrison, M.J., 'The Piezocone Penetrometer', pp.247-263. \*)
- Baligh, M.M., Azzouz, A.S., Martin, R.T., 'Cone Penetration Tests Offshore the Venezuelan Coast', Report no. MITSG 80-21, Massachusetts Institute of Technology, Cambridge, Massachusetts, Dec. 1980.
- Bachelier, M., Perez, L., 'Contribution to the study of Soil Compressibility by means of a Cone Penetrometer', Proceedings Sixth ICSMFE, Montreal, Vol. 2, pp. 3 - 7.
- Begemann, H., 'General Report on Penetration Testing in Central and Western Europe', Vol.2, pt.1, pp.27-39. \*\*)
- Campanella, R.G., Robertson, P.K., 'Applied Cone Research', pp. 343-362. \*)
- Chapman, G.A., Donald, I.B., 'Interpretation of Static Penetration Test in Sands', Proceeding of X International Conference of Soil Mechanics and Foundation Engineering, Stockholm, 1981.
- Chapman, G.A., 'A Calibration Chamber for Field Test Equipment', Vol.2, pt.2, pp.59-65. \*\*)
- De Beer, E., Dahlberg, 'Interpretation of Result of Static Penetration Tests', Group Discussion, Vol.2, pt.1, pp.66-72. \*\*)

Desai, M.D., Jain, G.R.S., Swami Saran, Jain, P.K., 'Penetration Testing in India, Vol.1, pp. 167-184. \*\*)

Douglas, B.J., Olsen, R.S., 'Soil Classification Using Electric Cone Penetrometer', pp.209-227. \*)

Durgunoglu, H.T., Mitchell, J.K., 'Influence of Penetrometer Characteristic on Static Penetration Resistance', vol.2, pt.2, pp. 131-139. \*\*)

Durgunoglu, H.T., Mitchell, J.K., 'Static Penetration Resistance of Soils : I Analysis', pp. 151-171. \*)

Durgunoglu, H.T., Mitchell, J.K., 'Static Penetration Resistance of Soils : II Evaluation of Theory and Implications for Practice', pp.173-189.

Folque, J., 'Penetration Testing in Portugal', Vol.1, pp. 105-106. \*\*)

Gibbs, H.J., and Holtz, W.H., 'Research on Determining the Density of Sands by Spoon Penetration Testing', Proceedings 4th ICSMFE, London, 1957, Vol. 1, pp. 35 - 39.

Gualtiero, B., Roberto, B., Vito, G., Michele, J., Erio, P., 'Cone Resistance in Dry N.C. and O.C., Sands, pp. 145-177. \*)

Heijnen, W.J., 'Penetration Testing in Netherlands', vol. 1, pp. 79-83. \*)

Horvitz, G.E., Stettler, D.R., Crowser, J.C., 'Comparison of Predicted and Observed Pile Capacity', pp. 413-433. \*)

Holtz, W.G., 'The Relative Density Approach - Uses, Testing Requirements, Reliability and Shortcomings', ASTM Special Technical Publication no. 523, edited by Selig, E.T., and Ladd, R.S., 1972.

Janbu, N., Senneset, K., 'Effective Stress Interpretation of Insitu Static Penetration Tests', Vol.2, pt.2, pp. 181-193. \*\*)

John, S.B.P., 'Insitu Measurement of Soil Properties', Report no. FHWA/CA/TL-80/13, Federal Highway Administration, U.S. Department of Transportation, Sept. 1980.

John, S.B.P., 'Insitu Testing Procedure', Report no. FHWA/CA/TL-80/29, Federal Highway Administration, U.S. Department of Transportation, Sept. 1980.

Kamata, M., 'A New Continuous Cone Penetration Test Method with a Deep Sounding Vehicle', Vol. 2, pt. 2, pp. 209-213. \*\*)

Ko, H.Y., Scott, R.F., 'Deformation of Sand in Shear', Journal of the Soil Mechanics and Foundation Division, ASCE, Proc. Paper no. 5470, no. SM5, Sept. 1967.

Ladd, C.C., Foot, R., Ishihara, K., Schlosser, F., Poulos H.G., 'Stress Deformation and Strength Characteristics', Proceedings of the IX International Conference on Soil Mechanics and Foundation Engineering, Tokyo 1977.

Lee, K.L., Seed, H.B., Dunlop, P., 'Effect of Moisture on The Strength of Clean Sand', Journal of Soil Mechanics and Foundation Division, ASCE, no. SM6, Nov 1967, pp. 17-40.

Lee, K.L., 'Comparison of Plane Strain and Triaxial Test on Sands', Journal of Soil Mechanics and Foundation Division, ASCE, no. SM3, proc. paper no. 7276, May 1970.

Lee, K.L., Seed, H.B., 'Drained Strength Characteristics of Sands', Journal of Soil Mechanics and Foundation Division, ASCE, no. SM6, proc. paper no. 5561, Nov. 1967.

Lousberg, M., Calembert, L., et. al. 'Penetration Test in Belgium', Vol. 1, pp. 8-17. \*\*)

Lunne, T., and Kleven, A., 'Role of CPT in The North Sea Foundation Engineering', Norwegian Geotechnical Institute Publication no. 139, Oslo, 1982.

Mahmood, A., Mitchell, J.K., and Lindblom, U., 'Effects of Sample Preparation Method on Grain Arrangement and Compressibility in Sand', ASTM, STP-599, 1975.

Malyshev, M.V., Lavison, A.A., 'Certain Results Obtained in Cone Penetration of a Sand Base', Vol. 2, pt. 2, pp. 237-239. \*\*)

Melzer, K.J., 'Relative Density - Three Examples of Its Use in Research and Practice', ASTM Special Technical Pu

blication 523, edited by Selig, E.T., and Ladd, R.S., 1972.

Meyerhoff, G.G., 'General Report on Penetration Testing Outside Europe', Vol.2, pt.1, pp. 40-48. \*\*)

Mitchell, J.K., Lunne, T.A., 'Cone Resistance as Measure of Sand Strength', Journal of The Geotechnical Engineering Division, ASCE, no. GT7, proc. paper no. 13901, July 1978, pp. 995 - 1012.

Mitchell, J.K., Gardner, W.S., 'In-situ Measurement of Volume Change Characteristics', State of the Art paper, Proc. ASCE Specialty Conference of In-situ Measurement of Soil Properties', Raleigh, Vol. 2, pp. 279 - 345.

Muromachi, T., 'Cone Penetration Testing in Japan', vol. 1, pp. 49-75. \*\*)

Parez, L.A., 'Static Penetrometer : The Important of Skin Friction Associated with The Point Resistance', Vol. 2, pt.2, pp. 293 - 299. \*\*)

Parkin, A.K., and Lunne, T., 'Boundary Effects in The Laboratory Calibration of a Cone Penetration in Sand', Norwegian Geotechnical Institute Publication no. 138, 1982.

Puech, A., Biarez, J., Cassan, M., Toutoungi, A., 'Contribution to The Study of Static and Dynamic Penetrometer', Vol.2, pt.2, pp.307-312.

Ricceri, G., Previatello, P., Colleselli, F., 'Relationships Between Static Penetration Test Results and Mechanical Properties of Soils', Vol.2, pt.2, pp. 313. \*\*)

Rohani, B., Baladi, G.Y., 'Correlation of Cone Index with Soil Properties', pp. 128-144. \*)

Ruiter, J., 'Electric Penetrometer for Site Investigations', Journal of Soil Mechanics and Foundation Division, ASCE, Vol 97, No. SM2, proc. paper no. 7907, Febr. 1971, pp. 457-472.

Ruiter, J., 'Current Penetrometer Practice', pp.247-263. \*)

Sanglerat, G., 'The Penetrometer and Soil Exploration', Elsevier Publishing Company, 1972.

Seed, H.B., Lee, K.L., 'Undrained Strength Characteristics of Cohesionless Soils', Journal of Soil Mechanics and Foundation Division, ASCE, no. SM6, proc. paper. no. 5618, Nov. 1967, pp. 333-359.

Schmertmann, J.H., 'Measurement of Insitu Shear Strength' Proceedings of ASCE Specialty Conference of Geotechnical Division, Raleigh, North Carolina, 1975.

Schmertmann, J.H., 'Guidelines for Cone Penetration Test, Performance and Design', Federal Highway Administration, U.S. Department of Transportation, July 1978.

Schmertmann, J.H., 'Penetration Testing in U.S.A.', Vol. 1, pp. 217-218. \*\*)

Schmertmann, J.H., 'Suggested Method for Deep Static Cone Penetration Tests', Vol.2, pt.1, pp.255-257. \*\*)

Schmertmann, J.H., 'Penetration Pore Pressure Effects on Quasi Static Cone Bearing, qc', Vol.2, pt.2, pp. 345-351 \*\*)

Shields, D.H., 'Should ASTM adopt the European Standard CPT?', pp.383-393 \*)

Schultze, E., 'Examples of Evaluating the Results from Sounding Tests', Vol.2, pt.2, pp. 353-356. \*\*)

Silver, M.L., 'Laboratory Triaxial Testing Procedures to determine the cyclic strength of soils', Nuclear Regulatory Commission, Washington, D.C., Div. of Reactor Safety Research, June 1977.

Tang, W.H., 'Probabilistic Evaluation of Penetration Resistance', Norwegian Geotechnical Institute, Publication no. 131, Oslo, 1980.

Tavenas, F.A., 'Difficulties in The Use of Relative Density as a Soil Parameter', ASTM Special Technical Publication 523, Edited by Selig, E.T., and Ladd, R.S.

Trofimenkov, 'Penetration Testing in USSR', Vol.1, pp.147-154. \*\*)

Veismanis, A., 'Laboratory Investigation of Electrical Friction Cone Penetrometer in Sand', Vol. 2, pt.2, pp.407



-419. \*\*)

Vesic, A., 'Bearing Capacity of Deep Foundation in Sand' National Academy of Sciences, Highway Research Record 39 pp. 112-153, 1963.

Villet, W.C.B., Mitchell, J.K., 'Cone Resistance, Relative Density and Friction Angle', pp.178-208. \*)

Waitkus, R.A., Burgin, C.R., Smith, R.E., 'Sensing Systems for Measuring Mechanical Properties in Ground Masses : Volume 5, Subtitle : Dutch Cone Penetrometer Tests - Case Histories', Report no. FHWA/RD-81/113, Federal Highway Administration, U.S. Department of Transportation Dec. 1981.

Yong, R.N., 'Chen, C.K., 'Cone Penetration of Granular and Cohesive Soils', Journal of The Engineering Mechanics Division, ASCE, No. EM2, proc. paper 12081, April 1976, pp. 345-363.

Zolkov, E., 'The Nature of a Sand Deposit and The Settlements of Shallow Foundations', Vol.2, pt.2, pp.421-431\*\*)

\*) Norris, G.M., and Holtz, R.D., 'Cone Penetration Testing and Experience', Proceedings of a Session Sponsored by the Geotechnical Engineering Division at the ASCE National Convention, St. Louis, Missouri, Oct. 1981.

\*\*\*) Proceedings of The European Symposium on Penetration Testing (ESOPT), Stockholm, June 1974.