

Cone Pressuremeter

The Fugro Cone Pressuremeter provides a reliable measurement of the in-situ strength and load-deformation behaviour of the soil. These data can be used to derive soil parameters, such as undrained shear strength, shear modulus, effective horizontal stress and relative density. Conventional pressuremeter testing requires drilling a borehole and hence creates problems with respect to soil disturbance, or requires the use of carefully applied self boring techniques. The combination of the operational benefits of cone penetration testing (CPT) with pressuremeter testing provides soil information in an efficient and operator independent way.

DEVELOPMENT

Most of the hesitation towards the use of pressuremeter encountered with contractors and consultants is based on the delicate and fragile nature of the equipment, the frequently cumbersome execution of the tests by various installation methods in boreholes, and the subsequent high costs. To overcome drawbacks of the existing equipment, development of the Fugro Cone Pressuremeter (CPM) was started in the mid-eighties without drilling boreholes. The main reasons leading to the development of the CPM are:

- the tool can be installed using routine CPT equipment and associated personnel
- installation of the probe and execution of the test are fully operator independent which ensures repeatable test results
- the inclusion of a piezo-cone penetrometer in the CPM enables clear identification of the soil for subsequent CPM testing
- theoretical analysis and test data indicate that reliable soil parameters can be obtained, despite the effect of initial disturbance

TEST PROCEDURE

The new tool is part of Fugro's modular CPT system, allowing any 15 cm² penetrometer to be fitted. Figure 1 shows the operational set-up for the probe. In advance of the field work the CPM system is calibrated to establish the membrane resistance and the system compliance. The probe is advanced to the desired test level through full displacement of the ground using a CPT rig. The CPM tests are performed by inflating the membrane to a maximum of 1.5 times the original diameter in a strain controlled manner at a volumetric strain rate of about 12.5 % /min. At various inflation levels unloading/reloading cycles are performed. The test is fully computer controlled. All measurements are recorded on magnetic media to facilitate

quick and easy data processing. Specially developed reporting software is available to ensure quick reporting.

DATA INTERPRETATION

Various methods are available to analyze the results of a CPM test. During the analysis of data corrections are applied to account for membrane resistance and system compliance. Standard analysis in sand tests includes determination of shear moduli from unload/reload loops and limit pressure. Through empirical correlations relative density and in-situ horizontal stress can be estimated. By applying cavity expansion theory to the unloading curve the shape of the curve is used to determine the undrained shear strength and shear modulus (Houlsby and Withers, 1988). Conventional Menard Pressuremeter analysis can also be applied to CPM testing (Baguelin et al., 1979).

APPLICATIONS

The design of the CPM enables application of the probe in onshore mode using a CPT truck, and in a nearshore mode using an onshore operated rig from jack-up barges or a seabed operated system from vessels. Furthermore, the CPM can be utilized offshore using Fugro's wheeldrive SEACALF.

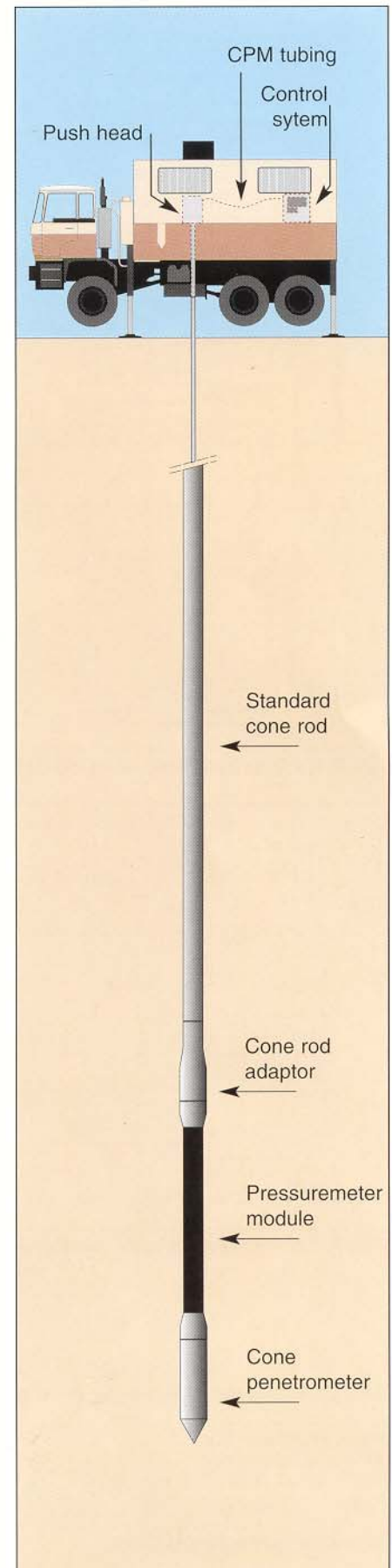
CPM SPECIFICATION

Components:

- Pressure developer (PD)
- CPM tubing
- Cone Pressuremeter (CPM)
- Measuring and control system

Overall CPM length	: 1.35 m
Cell membrane type	: mono
Maximum string length	: 75 m
Maximum inflation pressure	: 8 MPa
Initial volume	: 660 ml
Maximum volumetric strain	: 125 %
Strain rate / minute	: 12.5 %
L/D Ratio	: 10:1

Fig. 1. Schematic diagram of CPM deployed from CPT truck



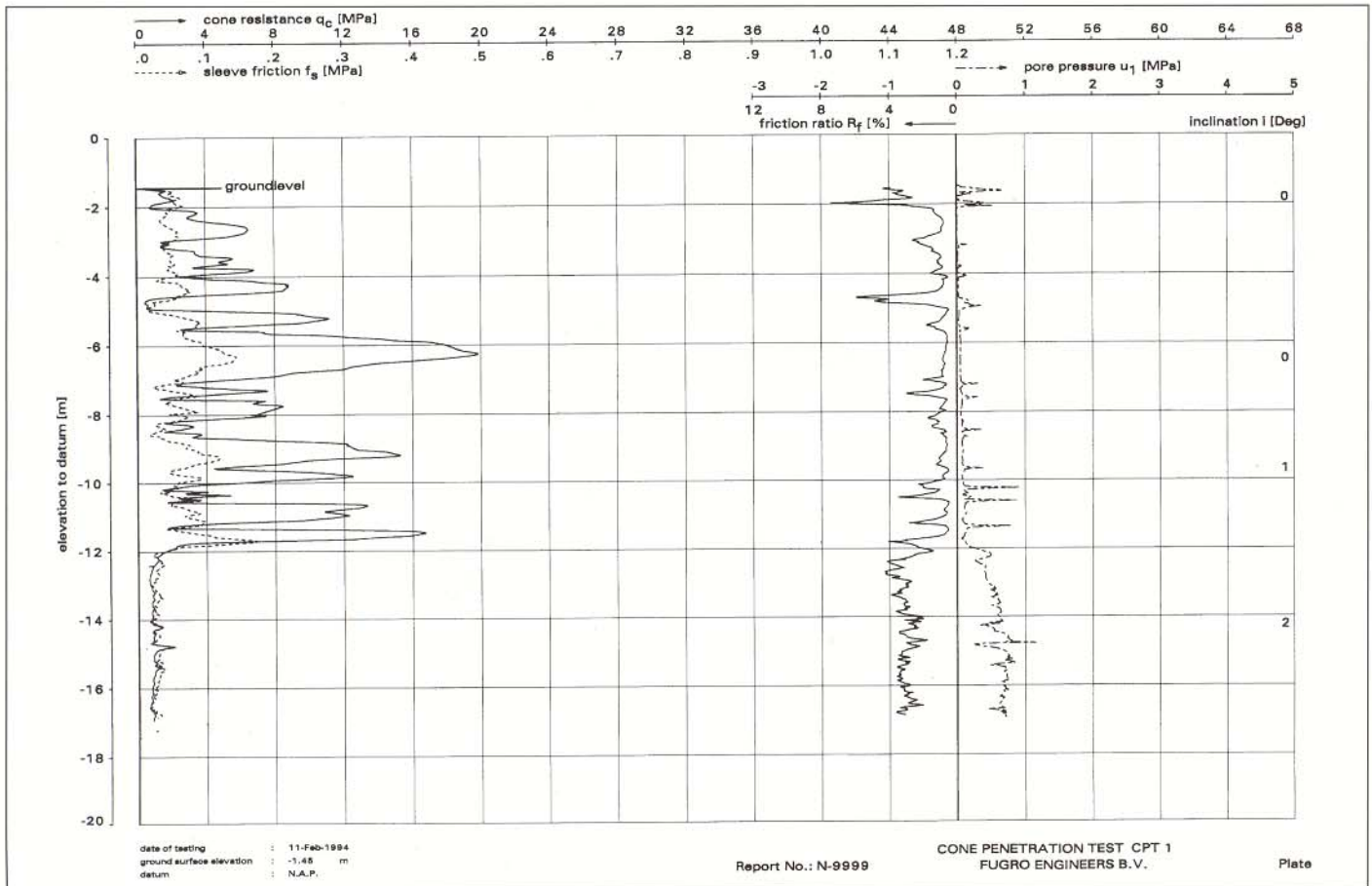


Fig. 2. Results obtained using the Cone Pressuremeter equipped with piezo-cone penetrometer at an onshore site

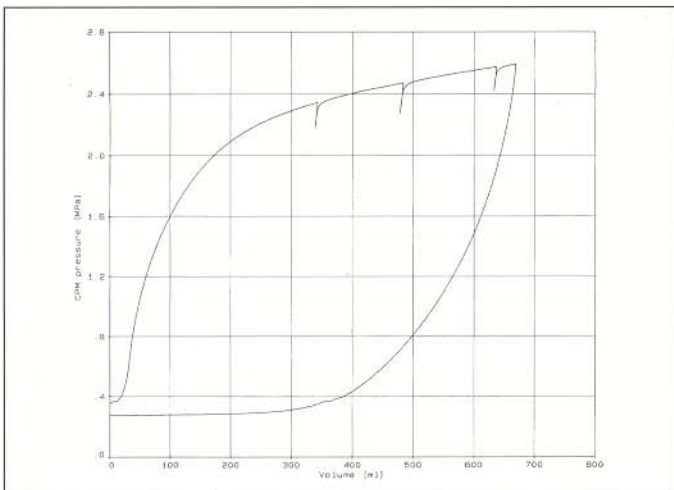


Fig. 3. Cone Pressuremeter test results



Fig. 4. Cone Pressuremeter equipment spread

The specification of the equipment in this data sheet may be subject to modifications without prior notice

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