

CHOICE OF INSERTION RIG and RODS FOR DMT TESTING IN HARD/ CEMENTED SOILS

CHOICE OF THE INSERTION RIG

Heavy truck mounted penetrometers : are incomparably more efficient than drilling rigs. Moreover the soil provides lateral support to the rods (which is not the case in a borehole).

Drilling rigs or light rigs : are almost always inadequate in **hard soils** and often generate problems. However they may be useful in soils containing occasional boulders or hard layers. In this case the obstacle - destroying - capability is useful and permits to continue the test past the obstacle.

If the insertion is done with SPT rigs at the bottom of the hole :

- 1) Since such rigs have typically a pushing capacity of only 2 tons, **refusal is found very soon** (often at 1-2 ms depth). Hence these rigs are inadequate in hard soils.
- 2) Moreover with many SPT rigs :
 - There is no collar near ground surface, i.e. **no ground surface side-guidance of the rods**
 - Often there is a **hinge-type connection in the rods just below the pushing head**, which permits excessive freedom and **oscillations** of the rods inside the hole.
 - The distance between the pushing head of the rig and the bottom of the hole is several meter, hence the **free/ buckling length of the rods is high**. In some cases the loaded rods have been observed to assume a "Z" shape.
 - **Oscillations of the rods cause wrong results** in case of short penetration (short laterally supported rod length in the soil) : It was occasionally observed, in hard layers, that the "Z" shape of the rods suddenly reverted to the opposite side. This is one of the few cases in which the DMT readings may be instrumentally incorrect. In fact oscillation of the rods causes oscillation of the blade, and the membrane is pushed without control close to/ far from the soil.
(As a rule, the rods above the blade must **not move laterally** during pushing. Such situation occurs in general naturally, because the soil above the blade restrains the rods against lateral movement).

STRONGER PUSH RODS

A number of 20-24 tons CPT trucks are now equipped with a set of rods much stronger than the common 36 mm CPT rods. Such stronger rods are typically 45-50 mm in diameter, 1 m long, thick wall, same steel grade as CPT rods (yield strength > 10000 bar).

Such rods were a consequence of the recognition that, in case of heavy trucks, the rods were "the weakest element in the chain". In fact the operators of such trucks often stopped the test at 10 or 15 tons just for fear of breaking the 36 mm rods.

The stronger rods have several distinct advantages :

- Better lateral stability against buckling in the first few meters in case of soft soil
- Better lateral stability when the rods are pushed inside an empty borehole
- Possibility of using completely the push capacity of the truck and the high strength of the current DMT blades (working push capacity approximately 30 tons)
- Capability of penetrating through cemented layers
- Reduced risk of deviation from the verticality in deep tests.
- Drastically reduced risk of losing the rods

SOME FEEDBACK FROM FIRMS USING SUCH "STRONG" RODS:

Ing. Goretto of Soiltest - Arezzo (Italy):

"working with 50 mm rods is a different universe...such rods are indestructible...I would never go to a dense sand with the 36 mm rods"

Dr. Hamza of Hamza Associates Cairo (Egypt):

"[the strong] rods were a good improvement...and I would now recommend them in place of the standard rods in all cases".

(A suggestion by Dr. Hamza : the friction reducer - if one wants to use it - should be applied to a special short rod segment, not to a one meter rod)

MANUFACTURERS OF "STRONG" RODS for DMT

"Strong" rods for DMT are especially made by Pagani (<http://www.pagani-geotechnical.com>), Italy (50 mm OD) or are usually in stock at Van den Berg, (www.apvdberg.nl) Netherlands (45 mm OD). The 45 mm rods are routinely used by CPT firms working with 15 sqcm tips. Such 45 mm rods have been found to be perfectly adequate as "strong" rods for DMT. Moreover their cost is less than especially made rods. Van den Berg supplies such rods at 147 Duth Guilders/per meter and the adaptor between DMT blade and such rods at 200 Dutch guilders (1997 prices)