

### **Subjects**



- introduction MW
- introduction APB
- introduction CPT
- portfolio APB
- onshore CPT equipment
- near shore CPT equipment
- offshore CPT equipment
- 🖰 data acquisition, developments
- digital data acquisition, the base
- digital data acquisition, click-on concept
- digital data acquisition, available click-on modules
- summary



#### **Introduction MW**



- Mark Woollard
- **1969**
- married, 2 kids (10 & 8 yrs old)
- MSc. Civil EngineeringDelft University of Technology
- MBA Rotterdam School of Management
- 10 yrs Global International Construction Industry
- 4 yrs Global Water Treatment Industry
- 2 yrs European Bicycle Industry
- 2,5 yrs at A.P. van den Berg2 yrs Business Development Director0,5 yrs Commercial Director



#### **Introduction APB**



- 1968 of founded in 1968
- family owned
- number of employees: 50
- active wordwide: 85% export (2012)
  - onshore 70% export
  - offshore 100% export
- 10 % of turn over in Research & Development
- 25 Patents
- market leading in onshore CPT equipment
- world market leader in offshore CPT equipment





### **Introduction APB**

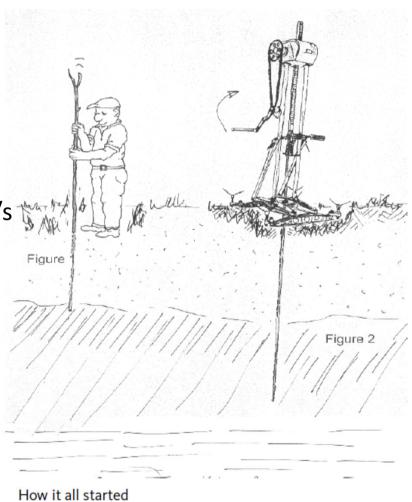






#### **History of Cone Penetration Testing**

- static CPT
- measurement of the penetration resistance on a cone, pushed into the ground by a constant speed of 2 cm/s
- first used in the 1930's in Holland (Barentsen cone)
- first electrical cone was used in 1948
- first piezocone in 1974
- A.P. van den Berg was involved with development of first CPT machines





#### **CPT** parameters

- cone tip resistance (q<sub>c</sub>)
- local friction (f<sub>s</sub>)
- $\bigcirc$  cone inclination  $(I_{x/y})$
- pore water pressure (U)



Optional; important to better evaluate shear strength, deformation and consolidation characteristics.

These are the direct parameters of which other parameters can be calculated from. For instance the friction ratio  $f_s/q_c$  for soil classification.



#### Worldwide application

- 50 % of the total CPT is done in Holland
- other 50 % in the rest of the world
- CPT is increasingly applied in the world because of the advantages over more traditional methods





#### **Advantages CPT**

- continuous data generation; every 0,4 cm
- high productivity with high quality / reliable output
- multiple parameters in 1 test
- low cost operations
- real-time results, so immediately available
- complete scan of the soil is obtained, so further investigations can be planned more economically



### **Portfolio APB**



Onshore CPT equipment





Offshore CPT equipment

Near shore CPT equipment





Digital data acquisition

# **Onshore CPT equipment;** small











# **Onshore CPT equipment;** medium









# Onshore CPT equipment; big





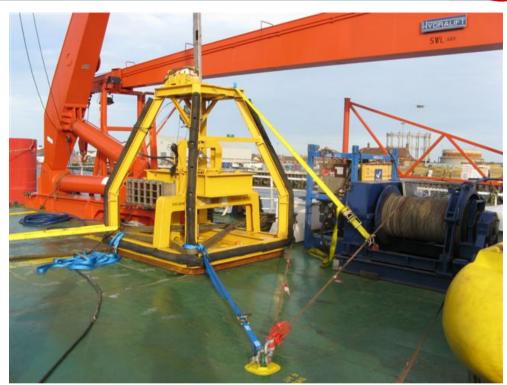






# Offshore CPT equipment; seabed system









# Offshore CPT equipment; wireline system







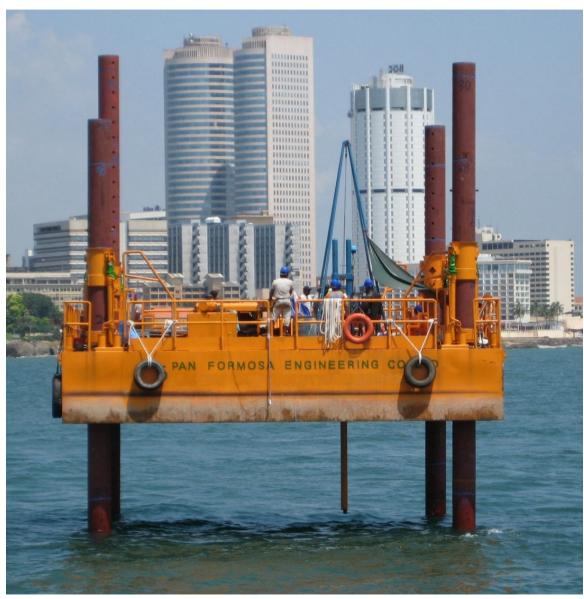


### **Near-shore Equipment**









## Data acquisition: developments



First mechanical, then analogue, now digital.

Why digital now?

### Compared to analogue cones, the Icone (digital) is:

- mechanically 40% stronger
- more accurate & reliable;
  - joint calibration of cone & measuring system
  - digital measurements are always correct
- the influence of cables & connectors on the measured data is history
- easier to maintain; less dirt & user friendly assembly
- calibration data is stored in the cone itself
- no limits to the amount of data transfer





#### Digital cone + data logger + wire(less) data transfer + software

#### Icone: digital CPT cone

- built-in AD-conversion & micro controller
- Calibration class 1 (possible)
- resolution 24 bits
- cone tip area 10 or 15 cm<sup>2</sup> (5 cm<sup>2</sup> under development)
- optional memo function 16 Mbit (circa 8 hrs. CPT operations)
- $\bigcirc$  standard parameters q<sub>c</sub>, f<sub>s</sub>, U, I<sub>x/y</sub>
- entirely digital path to the data logger
- pressure compensated Icone specially for deep water



#### Digital cone + data logger + wire(less) data transfer + software

#### Icontrol: digital data logger

- placed near a computer on which the data is recorded
- combines depth information with the CPT data
- provides power to the Icone
- applicable for on- and offshore





#### Digital cone + data logger + wire(less) data transfer + software

#### Optocone: wireless data transfer

- CPT rods provided with a light transducer
- measuring signals converted into light signals
- optical adapter takes care of registration, digitalization, conversion & transmission
- signals in the camera combined with depth registration data in the Icontrol
- composed signal transmitted to a computer





#### Digital cone + data logger + wire(less) data transfer + software

Software: GOnsite!

For realtime data registration on location.



# Digital data acquisition: click-on concept



## The Icone is easily extendable with click-on modules to measure other parameters.

- in the digital system is room for additional parameters
- without changing cable or control box/data logger
- a click-on module is automatically recognized by the data logger
- available modules: Seismic,Conductivity, Magneto & Vane



# Digital data acquisition: click-on concept



#### What is so useful to the click-on concept?

- the requirement for different parameters from in-situ soil investigation is increasing
- several parameters can be measured with one measuring system
- no time and information are lost when switching between systems
- Ć simultaneous CPT and other research (e.g. magnetic field research) is possible





#### **Seismic**

Determine the stability of the ground, by the propagation speed of sound.

#### What is measured?

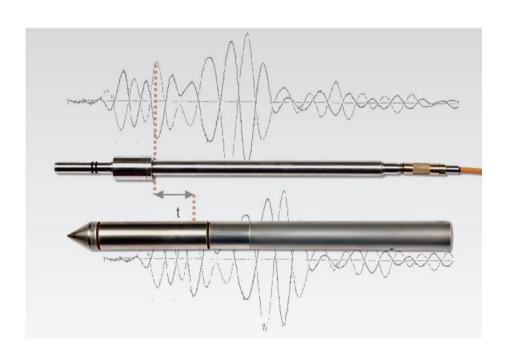
- triaxial seismic module: shear wave left, shear wave right and compression wave
- small strain shear modulusconstrained modulus
- elasticity modulus
- poisson's ratio





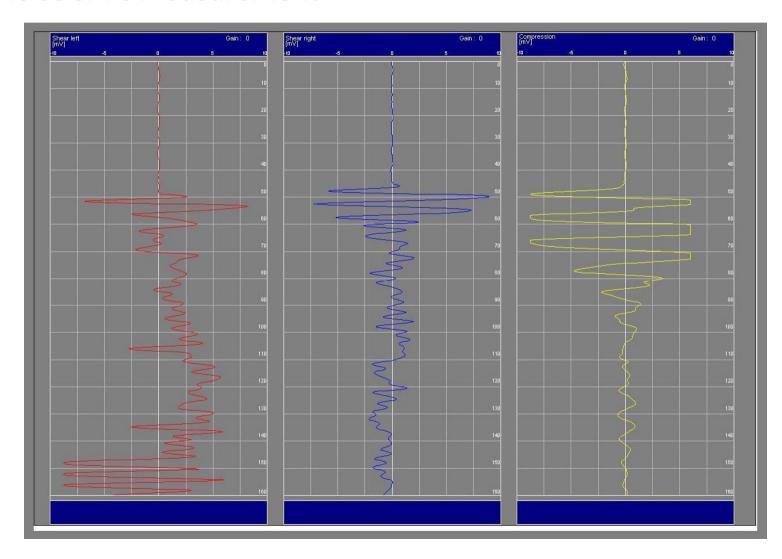
#### **Options Seismic Module**

- easy to upgrade to test two depths simultaneously
- easy to stack modules on top of each other in CPT string





#### Outcome seismic measurement





#### **Conductivity**

Detect any soil contaminate that has a typical electrical conductivity higher than that of water.

### Possible reasons to do conductivity research

- measuring the density
- tracking of saltwatercarrying layers
- environmental investigation





#### Icone Vane

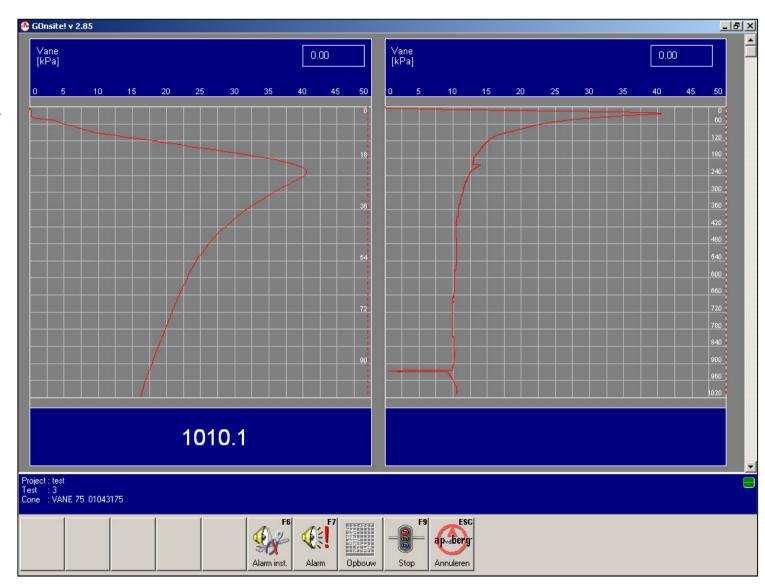
Determine the strength of the undisturbed and disturbed soil. Also suitable for soil investigation in very soft soils.







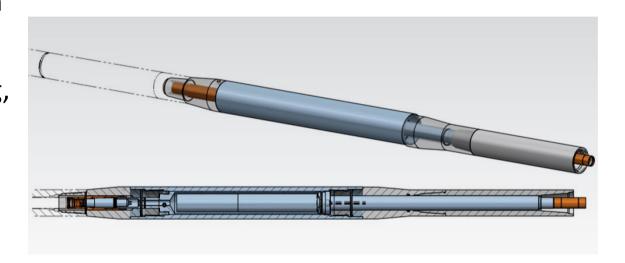
Outcome Vane measurement





#### Magneto

- 3-dimensional detection of the magnetic field
- detection of sheet piling, ground anchors and unexploded explosives
- it measures up to 1,5 meters around the cone



### **Summary**



- the requirement for different parameters is increasing
- ♠ A.P. van den Berg responds to this trend with development of userfriendly click-on modules for the Icone
- the Icone (digital cone) is stronger, more accurate & reliable, easier to maintain and offers endless possibilities
- we can not avoid: digital data acquisition will become the new standard
- $\bigcirc$  for measuring the standard parameters q<sub>c</sub>, f<sub>s</sub>, U, I<sub>x/y</sub>
- nd more, such as seismic, conductivity, magneto and vane
- for both onshore and offshore CPT