



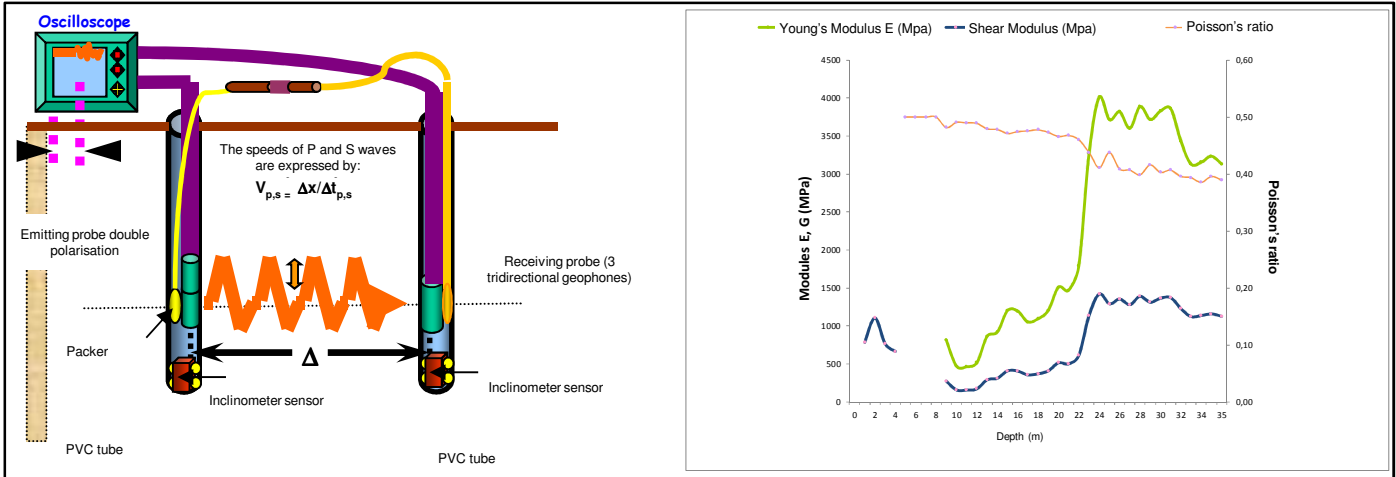
SOLDATA
GEOPHYSIC

CROSS-HOLE SEISMIC

with Down-Hole and Up-Hole variations



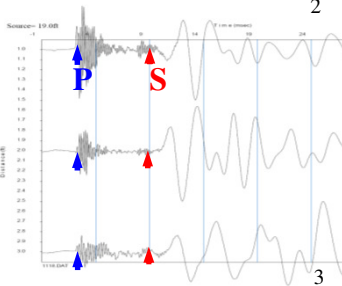
ASTM Standard D4428
AGAP sheet 92.1 SIS 24 and 92.1 SIS 23



The cross-hole method measures the propagation time of seismic waves between a transmitter borehole and a receiver borehole, and deduces from compression waves (P-waves) and shear waves (S-waves), the mechanical properties of the soil - Poisson's ratio (ν), Young's modulus (E) and shear modulus (G).

Applications

- Determination of geodynamic characteristics of the subsoil
- Estimation of seismic risk according to Eurocode 8
- Measurement of attenuation parameters of the ground



The principle of the method consists of emitting a shock which generates shear waves. The compression wave signals (P) and shear wave signals (S) are received using a tri-directional geophone sensor located at different depths in a borehole.

Cross-hole and distance measurements are taken every meter, along a horizontal path. The depths are measured relative to ground level next to the borehole. For each level the measurements are taken according to the two polarisations (shock towards the top and towards the bottom) to more easily identify the S wave. The shear wave is usually clearly visible when its propagation speed is low (characteristic of low frequency behaviour).

A variation of the cross-hole method is the down-hole method where the shock is emitted at the surface and the receiving sensors are moved vertically within the receiving borehole. With the up-hole method, the receiving sensor is at the surface and the shock is generated in the borehole.

The interpretation consists of pinpointing the velocities of the P and S waves and then determining a velocity-depth and a velocity-module graph.

At the end of the study, the geodynamic parameters can be provided: compression wave velocity (V_p), shear wave velocity (V_s), the Poisson's ratio (ν), the shear modulus and Young's modulus (E and G).



Legend

1. Principle of the method and example of results
2. Implementation
3. Example of cross-hole signals

Key figures

- Maximum depth of investigation for cross-hole test: approx. 150m

- For down-hole and up-hole tests, depths of investigation are between 30m and 70m

SDG Equipment

- Inclinometer sensor / distance sensor
- Low frequency tridirectional drilling probes (4.5 to 15Hz)
- Laboratory and high resolution seismic spectrum analyser