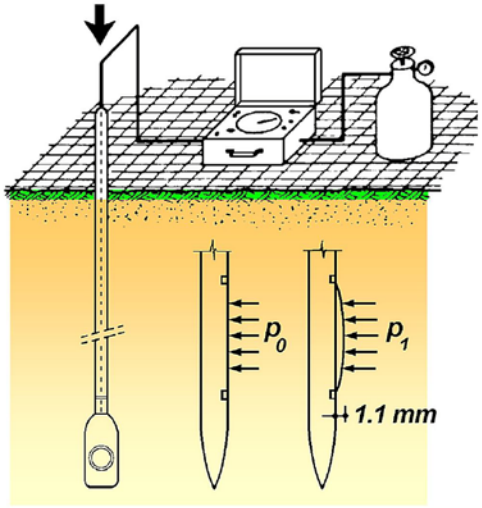
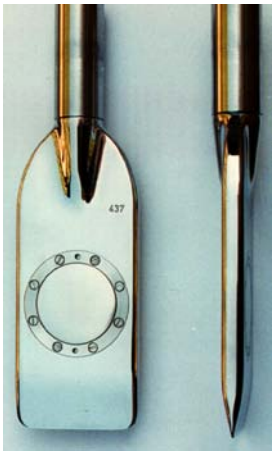
SEISMIC DILATOMETER (SDMT)

SETTLEMENTS, LIQUEFIABILITY, Parameters **M** and **Cu**,
Vs Shear Wave Velocity, **G-Gamma** Curves

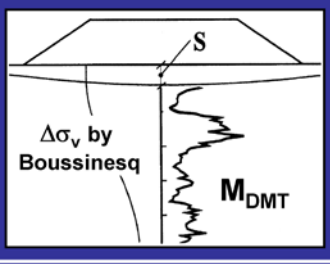
FLAT DILATOMETER (DMT)



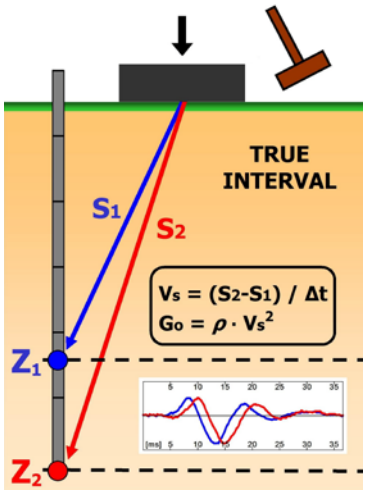


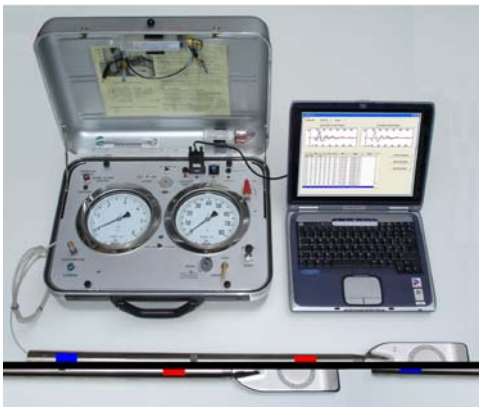
SETTLEMENT CALCULATION

$$S = \sum \frac{\Delta\sigma_v}{M_{DMT}} \Delta z$$



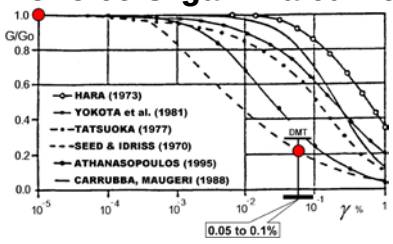
SEISMIC DILATOMETER (SDMT)





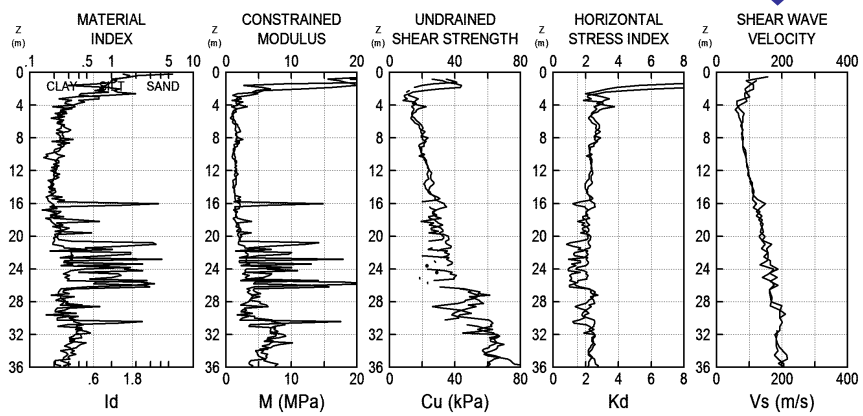
$$V_{S30} = \frac{30}{\sum_{i=1}^{N} \frac{h_i}{V_i}}$$

Choice G-gamma curve



RESULTS

Repeatibility of Vs 1-2%



Obtained Parameters

Symbol	Description
M	Constrained modulus (at σ'_{vo})
Cu	Undrained shear strength
Id	Material Index
Vs	Shear wave velocity
Go	Low strain shear modulus
Ed	Dilatometer modulus
Kd	Horizontal Stress Index
Gamma	Natural unit weight
Ko (clay)	Earth pressure coefficient at rest
OCR (clay)	Overconsolidation ratio
Phi (sand)	Friction angle (conservative)

FLAT DILATOMETER (DMT)

DMT determines in a **quick, precise, simple and economical** way various important parameters used in geotechnical design. The results are highly repeatable and independent from the operator.

The blade is advanced in the soil by pushing the rods with penetrometers or drill rigs, or a variety of field machines. In this way **boreholes** and **sample disturbance** are **avoided**. The measurements are carried out **directly on the in situ soil**.

The results are immediately available in a report format, containing graphs and tabular outputs.

The DMT is used in **50 countries**. It is standardized in the **ASTM** (USA) norms and in the **Eurocode**.

The equipment and test procedure are described in detail in the Report ISSMGE Committee **TC16** (2001), downloadable from the website.

APPLICATIONS

- Settlements prediction
- Operative modulus M
- Undrained shear strength Cu
- Soil Type (sand, silt, clay)
- Compaction control
- Detection of slip surfaces in slopes
- P-y curves for laterally loaded piles
- Liquefaction potential
- Coefficient of consolidation and permeability (clays)
- ϕ in sands
- OCR and Ko in clays
- Subgrade reaction modulus for diaphragm walls
- Choice of Input parameters for Plaxis
- Subgrade reaction modulus for pavements

Settlement predictions

The DMT provides estimates of operative **moduli** and **settlements** of **superior accuracy**, initially documented by Schmertmann 1986, Lacasse 1986, Sallfors 1988, Leonards 1988, Hayes 1990, subsequently by a summary of numerous case histories by Monaco et al. "DMT-predicted vs observed settlements" in the Proceedings of "Washington DMT 2006" Conference.

The superior accuracy of the DMT **settlement** prediction is due to the **lower distortions** caused by the blade penetration compared with the distortions caused by conical tips, to the fact that the modulus Mdmt is derived by a "**miniload test**" rather than by the penetrometric resistance at rupture, to the availability of the "Stress History Index" **Kd**, strongly related to **OCR**. Thanks to Kd, **estimating the moduli**, notoriously highly dependent from **stress history**, is **univocal**, avoiding arbitrary factors as in the case of penetrometric tests.

SEISMIC DILATOMETER (SDMT)

SDMT is the combination of the standard Flat Dilatometer (DMT) with a seismic module. Such module is a probe outfitted with two sensors, spaced 0.5 m, for measuring the shear wave velocity Vs. From Vs one can determine the small strain shear modulus Go.

APPLICATIONS of SDMT

The **modern norms** increasingly require seismic analysis, for which the basic parameter is Vs. SDMT provides **profiles of Vs** in a **quick, precise, simple and economical** way. Repeatability of Vs 1-2 %.

For complete seismic analysis it is necessary, besides Vs (or Go obtainable from Vs), the complete G-Gamma decay curve. At the moment SDMT is the only in situ test, besides the self boring pressuremeter, providing the ***low strain* Go** and the ***working strain* M**, hence **two points** in the **G-Gamma curve**. The availability of two points helps in the choice of the proper G-Gamma curve, unlike tests determing only Go.

SDMT provides, besides Vs, all the information obtained by the traditional DMT.

Liquefaction potential. SDMT provides at each depth **two independent estimates of the liquefaction resistance,** one derived from **Vs**, the other from **Kd**. Kd is sensitive to factors almost *unfelt* by other tests, in particular ***aging***, a factor that may increase the liquefaction resistance even by 60% in loose sands (see Leon et al. Jnl ASCE GGE March 2006, evaluating the seismic risk under existing nuclear reactors in South Carolina).

Seismic codes. According to Eurocode 8 all new contructions should be preceded by an analysis of the local seismic response, requiring **Vs** from ground surface to 30 m depth.

Use of SDMT. Used worldwide, often in important projects, among others the Barriers for protecting Venice (Italy), Barcelona harbour and airport, the New Shuttle Crawlerway at Nasa Cape Kennedy, the San Andreas Fault area in California, Marina Pez Vela project in Quepos Costa Rica, big Power Plants, high speed Railways and Metro, various Harbours Nearshore, numerous research projects by Universities etc..

References.

-**TC16 (2001)** "The DMT in Soil Investigations", A Report by the ISSMGE Committee TC16, 41 pp.

-**Washington DMT 2006. 2nd** International Conference on the Flat Dilatometer (**DMT**). 50 papers describing experiences worldwide – see website.

-**Seismic Dilatometer**. Additional information at website.

EUROCODE 7 Part 2 (2007)	**ASTM- Standard D6635 (2007)**	**ISSMGE – TC16 Report (2001)**

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