

OBSERVED vs DMT-PREDICTED SETTLEMENTS

Lacasse & Lunne (1986) "Dilatometer Tests in Sand". Proc. In Situ '86 ASCE Spec. Conf. Virginia Tech, Blacksburg.. Authors report *"very good agreement between DMT-predicted and measured settlements under a silos at a sandy site"*

Leonards (1988) *"It has been argued (Leonards 1985) that, at the present time, the Marchetti dilatometer is the most generally applicable practical tool for sensing soil compressibility"*

Mayne (2004) *"Over two decades of calibration between the DMT and measured foundation performance records have shown its value & reliability in settlements computation"*.

Crapps (2001)...very loyal *users that prefer DMT data over any other soils data to estimate settlements. A user with Law Engineering in Atlanta told me yesterday that the settlements are "always right on (meaning close to) the predictions from DMT data when they have the opportunity to make settlement measurements"*.

KCI Technologies, Md, Usa (2000): *"By DMT a more cost effective design can result compared to using the SPT alone, producing savings in construction cost"*.

Sawada S. and Sugawara N. (1995) "Evaluation of densification of loose sand by SBP and DMT", Proc. 4th Int. Symp. On Pressuremeter, Sherbrooke, Canada. *"SBP and DMT are valuable tools for estimating soil parameters on sandy soil and effectiveness of the treatment. But SBP is much time-consuming and expensive"*.

Tice & Knott (2000) "Cape Hatteras Light Station Relocation" - ASCE Outstanding Civil Engineering achievement for 2000, Geo-Strata Oct. *"Good agreement was observed between DMT-predicted and measured settlements at the sandy site under Cape Hatteras Light Station"*

Steiner W. (1994) "Settlement Behaviour of an Avalanche Protection Gallery Founded on Loose Sandy Silt", Settlement '94 ASCE Conf. at Texas A&M, [An earthfill on a loose **sandy-silt** produced settlements substantially higher than anticipated based on conventional soil borings. DMT were then performed. *"The DMT-predicted settlements agreed well with observed settlements"*].

Mayne (2001) "Settlements predicted by SPT and DMT vs settlement measured of a 13-story Dormitory Building for Georgia State University in Atlanta", [Prof. Mayne compares settlements predicted by SPT and DMT vs measured. "The measured settlement was 9.8 inches. SPT had predicted 1 inch (in this case 1 order of magnitude lower). *"DMT + theory of elasticity gave essentially the correct answer"*].

Woodward & McIntosh (1993) "Case history : Shallow Foundation Settlement Prediction Using the Marchetti Dilatometer", ASCE Annual Florida Sec. Meeting - **Sandy site.** *"Use of modulus from DMT permitted considerable savings vs using data from SPT. SPT, for this project, underpredicted the modulus"*.

Geopac (1992) "Comparisons of settlements predicted by PMT and DMT in a silty-sandy soil in Quebec" *...settlements predicted by PMT and DMT were very similar, but cost and time for DMT were a fraction of PMT"*

Failmezger & Ziegler(1999) "Behavioral Characteristics of Residual Soils. SPT?- A Better Approach to Site Characterization of Residual Soils using other In-Situ Tests" **Blacksburg Bypass : SPT predicted 100 mm settlements, while DMT predicted 27 mm leading to change in design and large savings"**. *Generally SPT overpredicts settlements (in one case by factor 10)"*.

Mayne (2009) *"Soil boring, lab testing SPT PMT VST crosshole.. taken together, all are suitable... yet at considerable cost in time and money... In this fast paced world... SCPT and SDMT should serve as the basis... in routine site investigation practices..."*

Applicability of Oedometer SPT CPT PMT DMT to predict settlements of shallow foundations.

Oedometer ...testing is time-consuming and is typically performed at depth intervals exceeding 3 m... Sampling and handling disturbance may also significantly reduce the accuracy of the results... In general, the authors believe that in-situ testing provides more information, more quickly, with less cost.

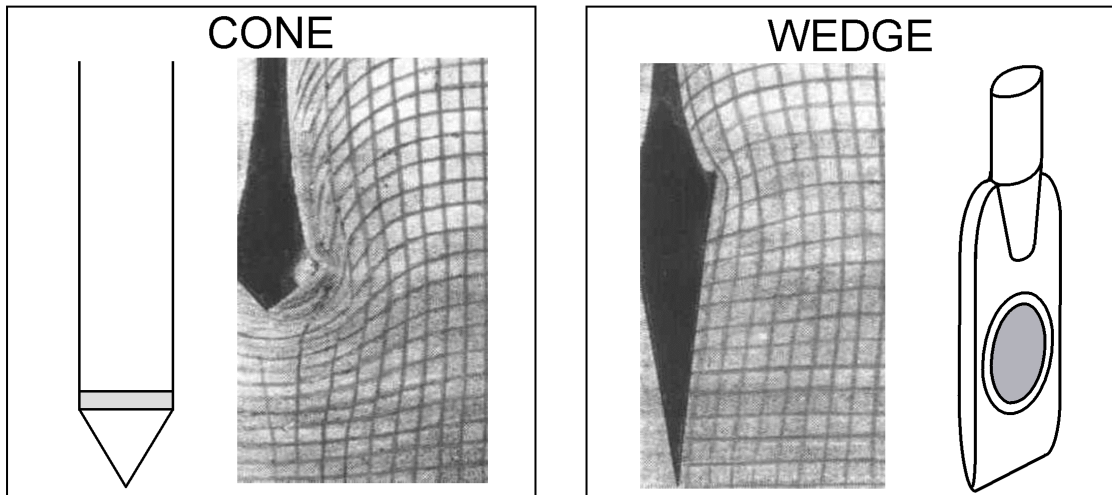
Standard Penetration Test (SPT) ...The hammer type, a critical factor for the energy, is often omitted from the boring log... If the geotechnical engineer does not know the energy used to drive the sampler, this significantly reduces the accuracy of any N-value interpretation... SPT is a dynamic penetration test and strains the soil to failure... To determine the soil deformation modulus from the SPT N-value requires extrapolation from a failure strain to an intermediate strain, another source of error... N-value correlations for the static deformation modulus are very poor or invalid... ...Even the best case scenario for the SPT, is much too inaccurate to predict settlement.

Cone penetrometer tests (CPT)... Like the SPT, the test strains the soil to failure... The engineer must extrapolate to a deformation modulus at an intermediate strain level... Typically, modulus values are determined from CPT using the equation:

$$M = (\alpha) (q_T)$$

Without knowing which *alpha* value to use, the engineer cannot accurately predict settlement.

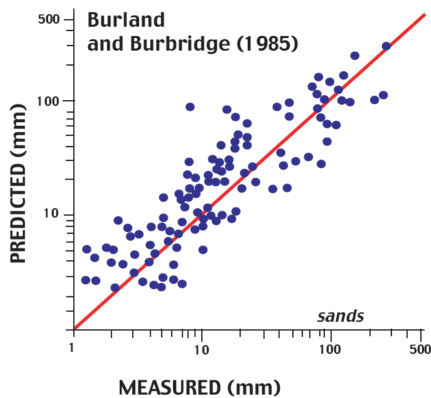
Dilatometer tests (DMT)... the dilatometer is a static deformation test that strains the soil to intermediate strains. It is also a good predictor of settlement. Tests are generally performed at depth intervals of 0.20 m. Tests typically take about 1 minute to perform and there is sufficient data for risk assessment of settlement with DMT. The dilatometer test is therefore the best choice of in-situ tests for settlement prediction of shallow foundations.



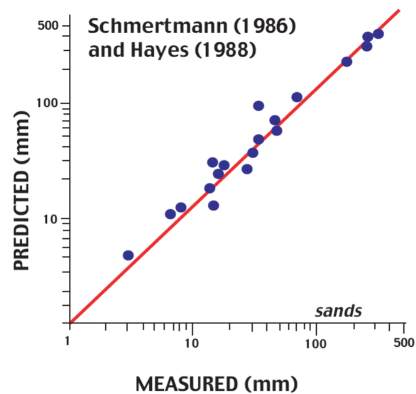
Distortions caused by penetration of cones and wedges in real clay.
Baligh & Scott (Nov. 1975) "Quasi-Static Deep Penetration in Clay", Jnl. ASCE Geot. Eng. Div.

SETTLEMENTS

SPT predicted Settlements



DMT predicted Settlements

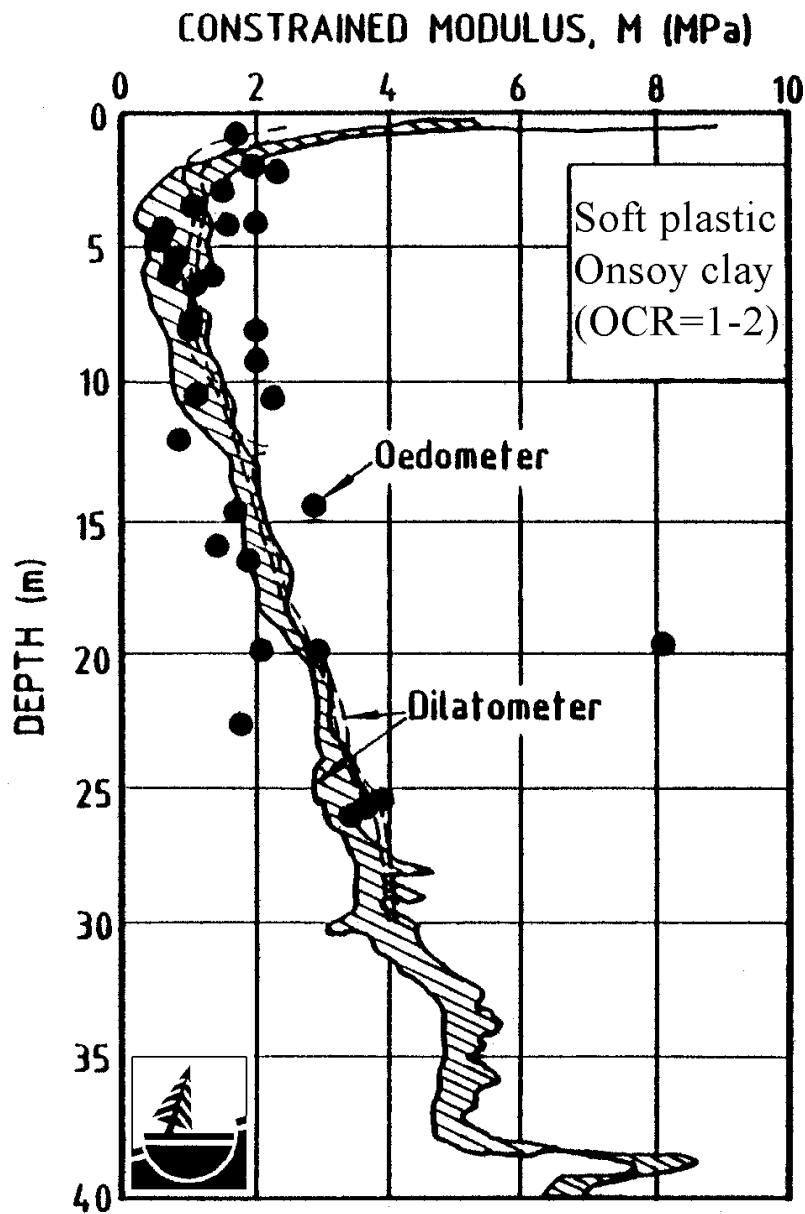


Higher accuracy of DMT believed due to:

1. DMT contains information on Stress History
2. Wedge shaped tips deform less than conical tips
3. Modulus obtained by loading the soil (mini-load test) is more closely related to Modulus than Penetration Resistance

MODULI by DMT vs MODULI by other methods

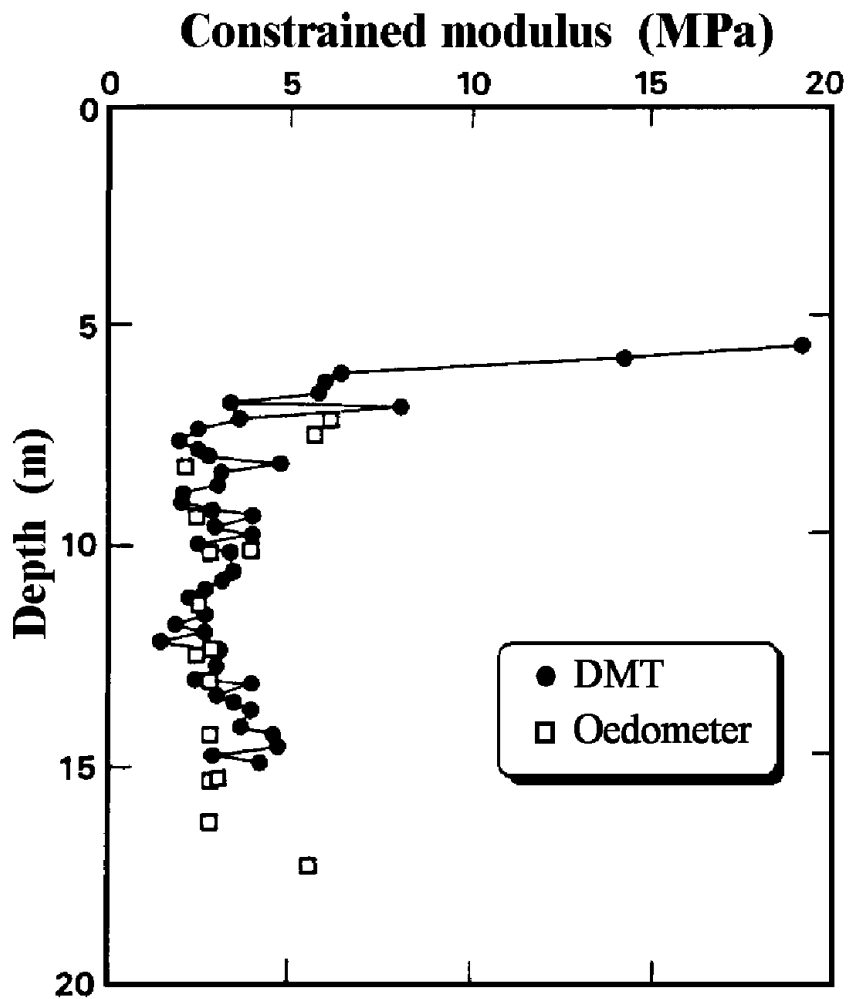
M in ONSOY Clay (NORWAY)



Norwegian Geotechnical Institute (1986).
"In Situ Site Investigation Techniques
and interpretation for offshore practice"
Report 40019-28 by S. Lacasse, Fig. 16a, 8 Sept 86

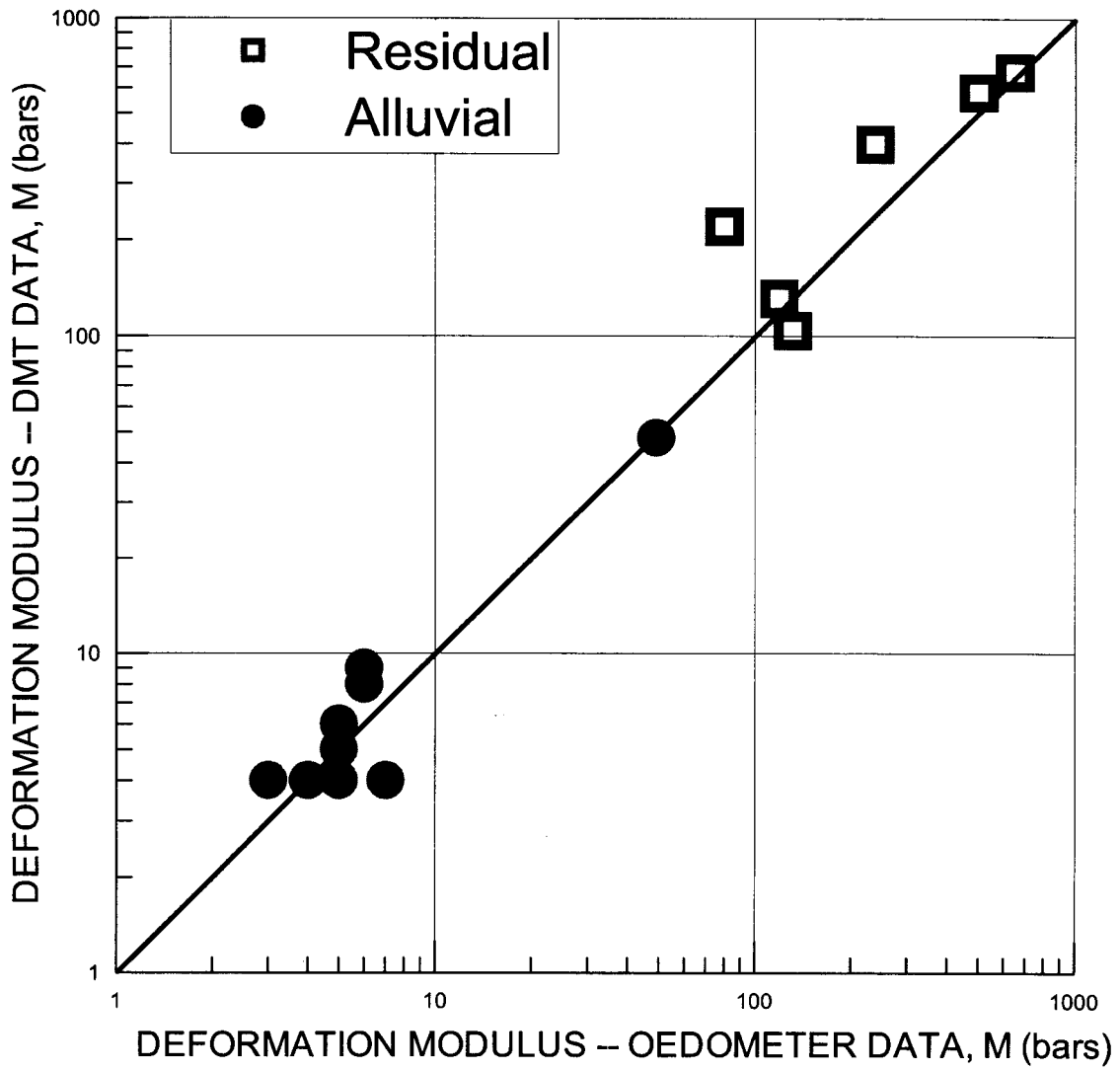
M in Tokyo Bay Clay

Geotechnical Research Center
Kiso-Jiban Consultants Co., Tokyo



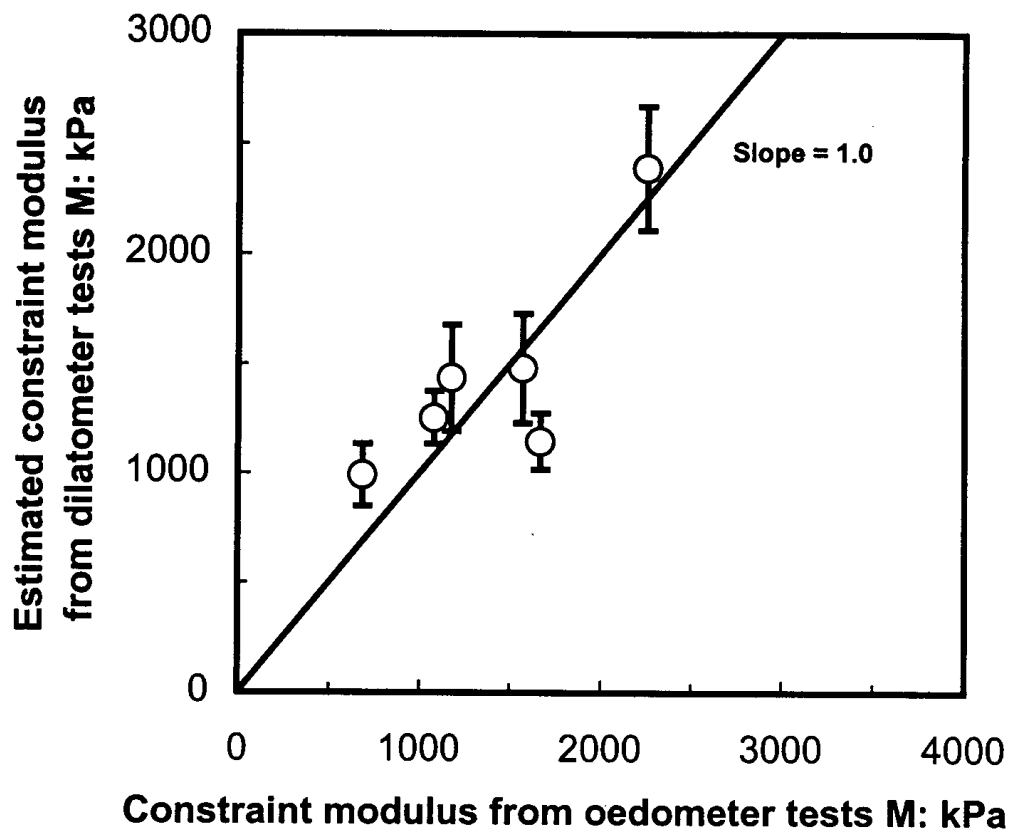
Iwasaki, K Tsuchiya H., Sakai Y., Yamamoto Y. (1991) "Applicability of the Marchetti Dilatometer Test to Soft Ground in Japan", GEOCOAST '91, Sept. 1991, Yokohama 1/6

M in Sites in Virginia, U.S.A.



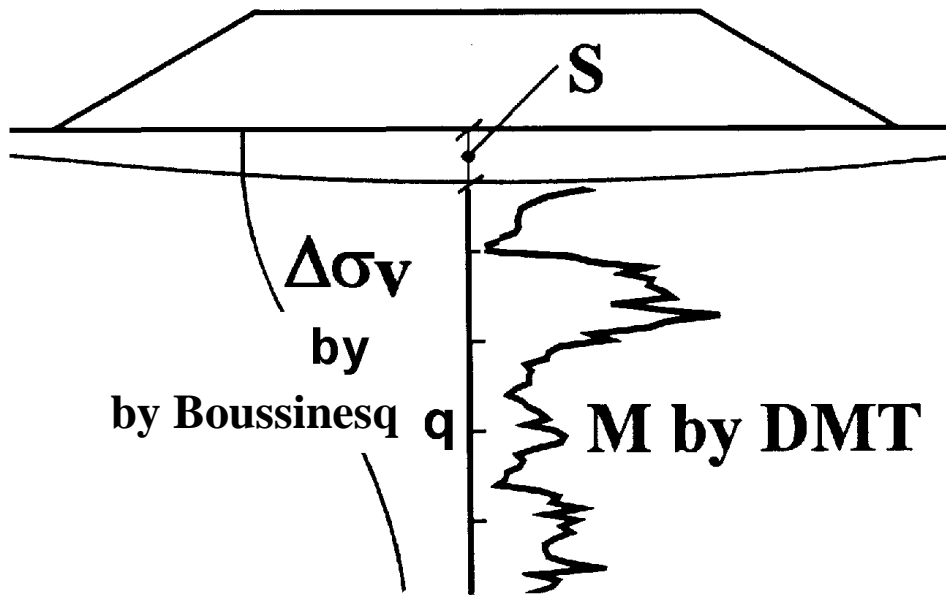
Failmezger, 1999

M in Bangkok Clay



Seah and Rasheed – unpublished results

APPLICATION DMT N° 1 – SETTLEMENTS



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

or 3-D with $E \approx 0.8 M$ (obtain similar prediction)
Poulos : important is Modulus, not Formula !

DMT-calculated vs observed SETTLEMENTS

SCHMERTMANN, 1986 - 16 CASE-HISTORY

Proc. In Situ '86 ASCE Spec. Conf. VIP, Blacksburg, p.303.

No	Location	Structure	Compressible soil	Settlement (mm)			Ratio DMT/meas.
				DMT	**	meas	
1	Tampa	Bridge pier	HOC Clay	*25	b,d	15	1.67
2	Jacksonville	Power Plant	Compacted sand	*15	b,o	14	1.07 (ave.3)
3	Lynn Haven	Factory	Peaty sd.	188	a	185	1.02
4	British Columbia	Test embankment	Peat org. sd.	2030	a	2850	0.71
5a	Fredricton	Surcharge 3' plate building	Sand	*11	a	15	0.73
b			Sand	*22	a	28	0.79
c			Quick cl. Silt	*78	a	35	2.23
6a	Ontario	Road embankment building	Peat	*300	a,o	275	1.09
b			Peat	*262	a,o	270	0.97
7	Miami	4' plate	Peat	93	b	71	1.31
8a	Peterborough	Apt. bldg	Sd. & si.	*58	a, o	48	1.21
b		Factory		*20	a, o	17	1.18
9	"	Water tank	Si. clay	*30	b,o	31	0.97
10a	Linkoping	2x3 m plate	Si. sand	*9	a,o	6.7	1.34
b		1.1x1.3m plate	Si. sand	*4	a,o	3	1.33
11	Sunne	House	Silt & sand	*10	b,o	8	1.25

30%
-50%

CALCULATED/OBSERVED AVE : 1.18