DMT DIGEST NO. 4
(June 84)
(8 pp. Text + 11 pp. Figures and Tables)

4A. - Review of DMT Soil Property Measurement Accuracy

As they became available we have collected, and plan to continue collecting -- hopefully with your help, a variety of comparisons between DMT soil engineering property measurements and other independent and possibly superior measures of each property. We hope in this way to assess the probable accuracy of DMT results, to learn under what circumstances we may get poor results, and if needed, to pinpoint where and how to improve the prediction methods.

Table 4A-1 herein represents our first step in the above direction. It lists the overall comparison results we have tabulated to date. Of course, we hope eventually to refine further our knowledge of DMT accuracy by isolating with respect to soil types, geologic conditions, ground modifications employed, etc., but at present our comparison data base does not justify such refinement. Future issues of the DIGEST will update Table 4A-1 and introduce refinements when appropriate.

All the comparisons in Table 4A-1 result from the DMT data accumulation and reduction methods and formulas described by Marchetti in his March 1980, ASCE paper, but substituting the writer's methods and formulas for K_o, OCR and ϕ when $I_D \geq 1.2$ as described in previous DIGEST items 1B, 2B and 3D.

4B. - Dilatometer Exhibit Booth at Geotech III, Paul Bullock

As its first promotional effort for the DMT, GPE Inc. provided a staffed display booth at the Geotech III ASCE meeting in Atlanta over 14-16 May 84. We estimate that a total of 250 people visited the booth, of which about 140 took copies of our new flyer (copy enclosed), and more than 40 have thus far filled out the flyer form to request more detailed information.

As a special attraction in our exhibit booth, we developed a live DMT demonstration in a plastic bucket full of dry, loosely poured fine sand. Altogether the booth staff made 30 demonstration tests at a depth of 7" with 13" of sand in the bucket. Utilizing the HP 41-C calculator, they predicted K_o, ϕ, preconsolidation stress, and M immediately after completing the test and compared the results with known values. Item 4C below presents more details about this unique sand bucket testing.

In addition to such exhibits GPE will begin to advertise the DMT in appropriate magazines and journals. In this way we hope to help spread the recognition and acceptance of the DMT. The recent addition of Paul J. Bullock, a geotechnical engineer with a Masters degree from the Univ. of Florida, to the GPE staff has allowed us to begin these promotional efforts. His availability should also increase our capacity to respond quickly to your questions, additional equipment purchases, or any other DMT-services you may require. Please call Paul to get the quickest response to such matters.

4C. - Sand-bucket Demonstration and Research Tests

Figure 4C-1 shows some annotated photos of the performance of this type of testing. A brief description follows: We used a slightly tapered plastic bucket with an average diameter of about 25 cm, and about 35 cm high. From another bucket of the same size we poured about 30 kg of sand into the empty one to form a very loose sand condition (relative density about 15%). We did all of this with the bucket sitting on a platform spring balance. We then obtained the ΔA calibration reading and, to leave a suction on the membrane, immediately closed the valves when the buzzer stopped. We found this necessary to permit us to read the subsequent A-pressure which remains negative because of the very small lateral stresses at a depth of only 7" in the loose sand. Next we hand-pushed the blade (using a survey rod level to help control plumbness) into the sand to a 7" (0.18 m) depth. The platform balance measured the thrust force required to just reach the this depth. The test proceeded in a normal manner to obtain the A-pressure (negative) and B-pressure except that we used the 2.5 bar range calibration gage to obtain the required accuracy. Finally, we removed the blade and determined the ΔB calibration. All the above took only a few minutes for each demonstration test, after which we reduced the data in the normal manner, on the spot, using an HP 41-C calculator.

Table 4C-1 summarizes the results from the 30 exhibit demonstration tests, as obtained by a total of 3 demonstrators (PJB did about 20, JHS about 7, and another assistant about 3, all using the same blade). This table also includes the "correct" values for the predicted soil properties which were determined from other testing as follows:

· K_o by clamping a suspended blade in the middle of the bucket, pouring sand around the blade, measuring the p_o pressure (corrected A-reading) and then dividing p_o by the known vertical pressure at the mid-height of the membrane. We included careful checks for the possible effect on p_o of the pouring direction with respect to the various sides and edge of the blade and found no effect.

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• The ∅ angle by carefully screening the near-horizontal surface of a loosely poured sample and then tilting the bucket until the slope began to move downhill. We then measured the slope angle at this instant. This should give the plane strain angle for the very loose and very low effective stress conditions.

• We assumed an OCR = 1.0 for this poured sand for which the calculated overburden pressure = 0.025 b at the 7" depth (unit weight known from volume of bucket and weight of sand).

• M by applying a surface gravity load on the sand and measuring its compression by means of a survey rod and level.

Table 4C-1 shows the agreement between the average measured predictions and the "correct" values, together with the variability in the measured values. The table also presents a summary of the similar sand-bucket testing done in our laboratory before the exhibit demonstrations. Although we do not know the precise causes of the variability, most of it probably comes from variations in the sample preparation and in the insertion alignment when attempting to push plumb into only 7" of support sand. We also noted that a minor variation resulted from changing blades (brand new blade compared with well used "veteran" blade). For most of these tests, involving very small and negative A-pressures, we found it convenient to subdivide and mark the early part of the negative gage scale into 0.01 bar divisions.

The reader will note from Table 4C-1 that the sand-bucket demonstration produced good results for the engineering properties of this loose sand even at a depth of only 7" (especially when averaging a number of tests). This type of demonstration requires only a platform balance, a plastic bucket filled with dry sand and the DMT equipment. You may find it useful for your own indoor demonstrations to illustrate the simplicity of the DMT and the quality if the results obtained.

4D. - Comparing DMT with CPT in NC/OC Sand Bucket Tests

Simple sand-bucket testing of the type described above also provided an additional demonstration of the superiority of the DMT vs. the CPT for evaluating modulus after soil structure modification by some form of prestressing history -- in this case simple, one cycle overconsolidation. We obtained the overconsolidation by putting another slightly tapered bucket on top of the very loose sand in the first bucket, placing a metal plate inside of the top bucket, and then carefully standing on the plate for about 15 seconds to provide an OCR of about 6. We measured the resulting sand

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compression by holding a survey rod in the center of the top bucket and reading by survey level.

We prepared the NC and OC = 6 very loose sand-bucket samples by the methods described in section 4C. We performed the DMTs as already described, and the CPTs using the mechanical mantle Dutch cone tip. For the CPTs we pushed the collapsed tip and pushrod acting together and plumb to a depth of about 6.5". Next, we carefully unloaded the friction on the outer pushrod by lifting it slightly (without moving the inner rod) and then clamping it in a table-mounted vise to maintain the unloaded condition. We then pushed on the inner rod and advanced only the cone tip about 0.5" while measuring the thrust put on this inner rod with a sensitive (0.5 lb div.) platform scale. Table 4D-1 presents a summary of the results. Note that it includes the results of one-dimensional compression tests made directly in the bucket using the surcharge and measurement techniques described previously except that we made them during one or more additional reloading cycles beyond the initial NC loading.

The results in Table 4D-1 provide additional data to reinforce the important point first made in DIGEST item 3C, namely that the insertion of the CPT cone has a greater soil structure disturbance effect than the insertion of the DMT blade. The 60° cone during its insertion movement appears to destroy a large portion of the modifications in soil structure that result from the overconsolidation and it therefore measures very little of the related increase in modulus. In contrast, the lower strain penetration of the DMT preserves more of the effects of overconsolidation and it subsequently can measure a greater portion of the modulus increase. According to the average test results reported in Table 4D-1 the actual soil modulus M increased 180%. By comparison, the DMT predicts a modulus increase of 80%, four times the CPT prediction of only a 20% increase.

The previous DIGEST item 3C considered the similar effects of sand structure modification by vibrations while the present data considers only a simple unload-reload cycle. Perhaps with any soil structure modification due to some preconditioning stress history, when compared to the CPT the DMT will more completely detect the resultant modulus increase. From these data it appears that using the CPT to evaluate low-strain modulus changes after ground treatment by vibrations, surcharging, etc. may lead to large overestimates of settlement or deformation unless one can somehow increase the α-factor in $M = \alpha q_c$ to match the treatment.

The enclosed Figure 4D-1 provides additional experimental data to support the above reasoning. According to these experimental strain pattern results from the 3-D insertion of the CPT cone and the DMT blade into dense sand,

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the cone produces shear strains 3 times as great as those of the blade (12% vs. 4%). They are representative of many other shear and volume strain comparisons from experiments performed at the Univ. of Florida. It seems clear that the soil displacement caused by the CPT cone will produce much greater disturbance effects than the displacement caused by the DMT blade.

4E. - No Temperature Effects on ΔA and ΔB Calibrations

The writer has in the past felt some uncertainty about the validity of membrane calibrations made above ground at one temperature and then used in soil at considerably different, usually lower temperature. Also, the frictional heat generated by forcing the blade into the soil, particularly granular soils, might increase blade temperatures. Therefore, to at least roughly check the possible calibration errors due to such temperature effects, the writer performed a series of membrane calibration measurements in a bucket of water with its temperature varied from about 40 to 96° F. The attached Figure 4E-1 presents the results from these experiments. They show no measureable change in ΔA, and only a very small change in ΔB as a result of more than a 50°F change in bucket water (and presumably blade) temperature. It appears that we can safely neglect such temperature effects for all testing except possibly research in very weak materials.

4F. - Better to Measure Vertical Prestress in Horizontal Direction?

One of the questions that often comes up when explaining the DMT and the data reduction methods concerns the seemingly apparent discrepancy when using a horizontal DMT deformation and stress measurement to predict vertical compressibility and preconsolidation stress. A recent paper in the ASCE presents evidence and conclusions that indicate that at least in the soil investigated one should measure the horizontal stress to best estimate the vertical preconsolidation stress. The attached Figure 4F-1 presents the first and last pages from this reference with the relevant conclusion (No. 2) indicated.

4G. - DMT to Estimate Horizontal Subgrade Modulus

Designers sometimes want geotechnical engineers to provide data on the horizontal or vertical subgrade moduli for use in various pile, mat, pipe, etc. support problems. It appears that the DMT may provide the data to permit estimating such moduli. The blade wedges apart the soil about 7 mm in each direction. This induces a lateral stress increase from the initial K_o to the final K_D condition. Dividing the stress change by the 7 mm displacement would

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seem to provide at least an estimate of subgrade modulus. Figure 4G-1 herein illustrates the calculation method suggested, along with an appropriate correction for the blade to prototype size effect.

The writer has used the above calculation method for lateral pile load deformations and it appeared to produce reasonable results. Perhaps other users would like to consider this method which we regard as preliminary and subject to verification or modification as appropriate. After you have some experience with this idea perhaps you can share your thoughts about its value.

4H. - Precaution - Watch for Stress-Magnitude and Preconsolidation Effect in Settlement and Strength Problems

A number of cases have come to our attention recently wherein the users of DMT data made settlement predictions based directly on the DMT M-values without considering the effects of important reductions in modulus when exceeding the preconsolidation stress. The dilatometer measures modulus for the condition of the soil as found at the time of the test. Even if the soil is only lightly overconsolidated it will measure a reload modulus. In some clays, particularly with organics, you can have a factor of 10:1 or more between reload and virgin modulus!

Remember also that the same effect can occur when reconstructing a prior event. Then the effective stress and modulus conditions during a prior loading might have been considerably different than when you performed the DMTs -- with lower prior M if NC conditions prevailed during the loading, and with possibly a higher prior M if recompression conditions prevailed.

Even when considering only normally consolidated conditions throughout an analysis, M_{NC} can vary greatly with the σ_v' magnitude - approx. with $(\sigma_v')^{0.5-1.0}$, where the 0.5 exponent is usually appropriate for sands and silts and 1.0 is used for clays. For highly OC soils we usually take M = constant = M_{DMT} for unloading and reloading.

Note that all the above reasoning holds for undrained shear strength as well as M, with s_u/p constant for the NC condition and s_u proportional to $OCR^{0.8}$ for the OC condition.

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4I. - DMT Can Test Very Weak Clays for Undrained Shear Strength

Figure 4I-1 shows the results of comparative testing for s_u as done by two consulting companies and the University of Florida. The tests were performed at a phosphate mine tailings impoundment in South Florida consisting completely of waste clay materials ("slimes"). This extremely weak calcium montmorillonite clay had an average solids content of only about 25%, a shear strength below that at the liquid limit, and was still consolidating under its own weight. Field vane testing required special large vanes and electric Dutch cone testing required especially sensitive tips. The DMT work used an ordinary blade and membrane but the operator read the gage pressures using the 2.5 b range calibration gage. Note the good agreement between the DMT and other test results, with the DMT on the low side (which may well be more realistic because the vane probably overpredicts s_u in this very high PI clay). Note also that all types of insitu testing required care to support the rods adequately or they would fall to the bottom of the slimes under their own weight.

Several years ago the writer performed a similar set of 2 DMT soundings in a nearby phosphate clay slime pond using a 16 b range gage. The results were similar in magnitude for s_u but without the clearly defined profile -- probably due to the less precise readings possible with the 16 vs. 2.5 b scales. At that time the preconsolidation stress and M value predictions also seemed very reasonable. Similar comparisons are expected in the near future for the site of the Figure 4I-1 data.

4J. - Index of First 4 DIGESTS

For your convenience in looking up information contained in the first 4 issues of the DIGEST, Table 4J-1 presents a summary of the section headings in each of these first 4 DIGESTS.

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4K. - Blade and Membrane Protection Sheath Available

GPE has developed an attractive, heavy duty, leather sheath which will protect the DMT blade and its membrane when not in use. Made from high quality saddle leather, it prevents scratching and denting of the membrane during transportation and handling in the field. The sheath is secured by a convenient snap-on leather strap which is easily removed or replaced in seconds. Handmade by skilled craftsmen, they are now available to previous GPE equipment purchasers at our cost of $30 each.

John H. Schmertmann
Editor

The DMT DIGEST editorial staff invites contributions from its readers detailing test experience and/or helpful observations, for possible inclusion in future issues. Please mail to:

DIGEST EDITOR
GPE, Inc.
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Gainesville, FL 32606

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TABLE 4A-1 - Summary of DMT Results Compared to Assumed Superior[a] Data (from 12 investigation sites)

	K_o	OCR	ϕ ($I_D \geq 1.2$)	s_u ($I_D \leq 0.9$)	M(or settlement[e])
	['Error'	=	$\left(\frac{\text{DMT-Meas.}}{\text{Meas.}}\right)$	100%]	
Ave.	+ 7	+ 1	+1	+ 2	-18
Std. Dev.	22	30		27	33
Max.	+30	+50	+1	+80[d]	+20
Min.	-40	-60	0	-47	-79
No. comparisons	11[b]	17	2[c]	22[d]	22[e]
range in ave. DMT values from all the comparisons	0.3 to 1.6	1 to 15	33 to 37^o	0.007 to 0.80b	2 to 500b

Notes: a. Only used sites, or distinct layers at sites, where we judged that the alternate test results were probably superior (as test embankment) or might be judged superior (as field vane) to the DMT results.

b. But 9 of these from N.G.I. research.

c. We find very limited available superior data for ϕ. Our impression that DMT results over range ϕ_{ps} = 25 to 45^o come out reasonable provided we can make a moderately accurate estimate of net thrust (say +/- 25%). The std. dev. in ϕ probably about 2^o.

d. Omitted one comparison of +180% (UBC, Langley research site) because this comparison falls outside the Chauvenet criteria for validity. Most comparisons vs. field vane.

e. Five of the 22 comparison cases based on comparing measured with M_{DMT}-calculated settlements. Three of the five cases had peat and organic silt/sand as the compressible soils.

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TABLE 4C-1 SUMMARY OF RESULTS FROM POURED-NC TESTS

DILATOMETER SAND-BUCKET DEMONSTRATION TESTS (7" DEPTH)

TEST No.	INPUT (BARS)						OUTPUT (BARS)					
	ΔA	NET THRUST		A	B	ΔB	I_D	K_D	K_0	ϕ°_{PS}	P_C	$M = 1/M_V$
		LBS.	KG.				>1.8		0.49	33°	0.03	8.8 **
AVE. OF 30 DEMOS	0.1314	42.5	19.3	-0.1021	0.531	0.3048	6.22	1.39	0.479	33.2	0.0268	6.22
standard deviation	0.0026	9.48	4.30	0.00495	0.043	0.0025	2.07	0.22	0.075	2.32	0.00577	1.38
coeff. of variation	2.0%	22%		4.8%	8.1%	0.8%	33%	16%	16%	7%	22%	22%
high	0.135	60		-0.090	0.63	0.310	11.3	1.8	0.67	37.1	0.043	9.3
low	0.125	24		-0.115	0.47	0.300	3.6	0.9	0.39	28.5	0.020	4.3
AVE. OF 15 PRELIM.	POURED SAND, NC, SAME AS ABOVE BUT PERFORMED IN LABORATORY PRIOR TO ATLANTA DEMONSTRATION						4.91	1.9	0.52	34.2	0.034	8.9

**BEST VALUES FROM OTHER TESTING (see text)

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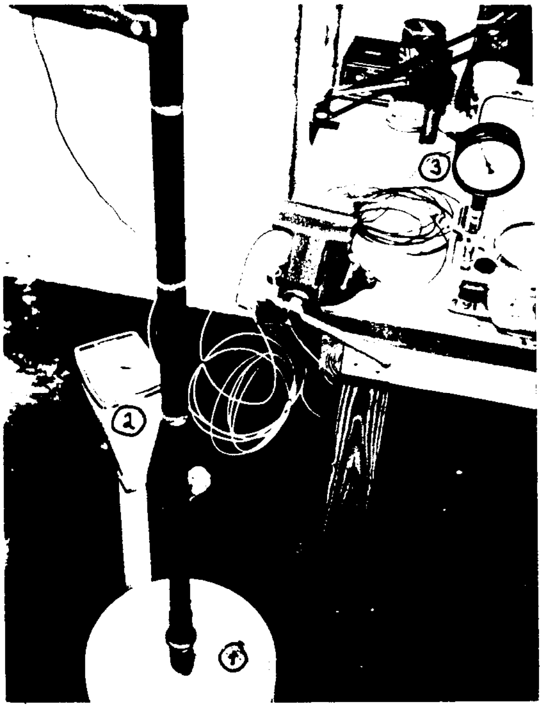
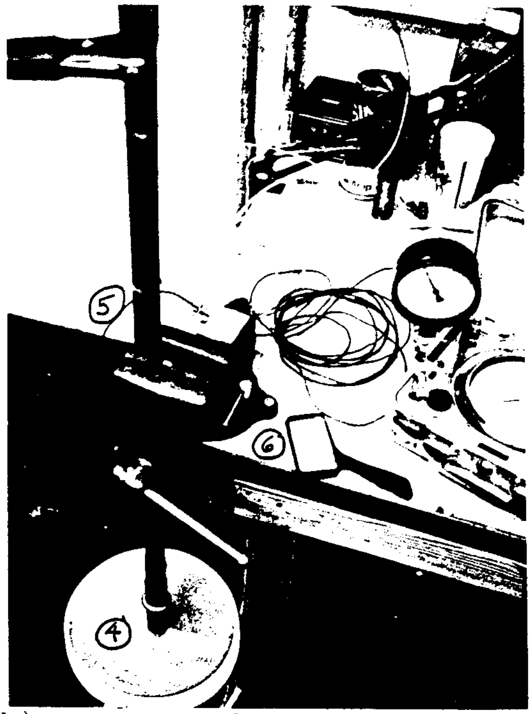
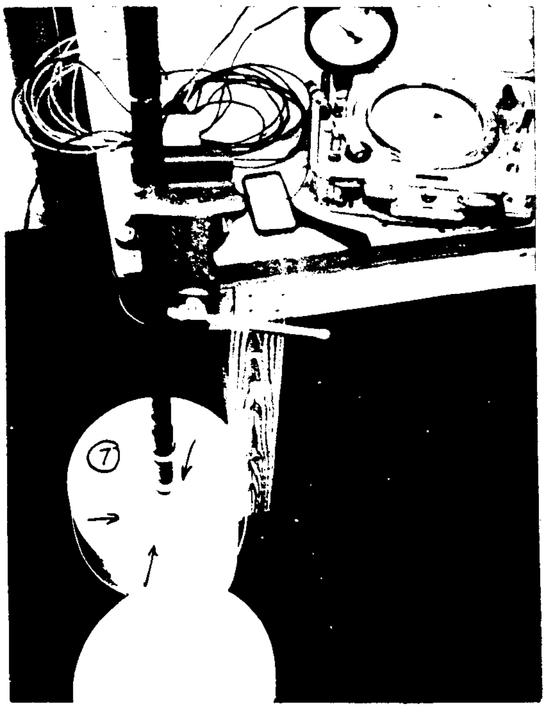


(a) Setup for ordinary DMT, after pushing to 7" depth.
1 - loose, poured NC sand
2 - scale for meas. thrust
3 - 2.5b gage for sensitivity



(b) Test setup for mech. CPT q_c.
4 - cone tip advanced 6"
5 - pushrod clamped to relieve friction and get point only thrust (using scale in (a) not shown)
6 - magn. glass for more acc. gage read



(c) Clamped DMT suspended in sand bucket for poured-around measmt. of actual pre-DMT K_o pressure.
7 - sand poured in various directions w/r blade (arrows) to check effect (none)

(d) Atlanta GEOTECH III exhibit booth, showing:
8 - setup for sand-bucket demo testing
9 - 3x4' posters (4) showing wide variety of DMT data from test sites
10 - automatic slide viewer/changer

FIGURE 4C-1 PHOTOS ILLUSTRATING ASPECTS OF THE SAND-BUCKET DMT TEST DEVELOPED MAY 84

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TABLE 4D-1

EXAMPLE OF PENETROMETER DISTURBANCE INCREASING SETTLEMENT PREDICTION AFTER GROUND TREATMENT:

SIMPLE NC→OCR=6 SAND-BUCKET TESTS

TYPE	NO. TESTS	AVE. CHANGE IN M (BARS)	% CHANGE
1-D COMPRESS	11	NC 9 TO 25 OC	+180
DMT	25	9 TO 16	+ 80
MECH. CPT	10	3 TO 3.5 (M/Q_C= 3)	+ 20

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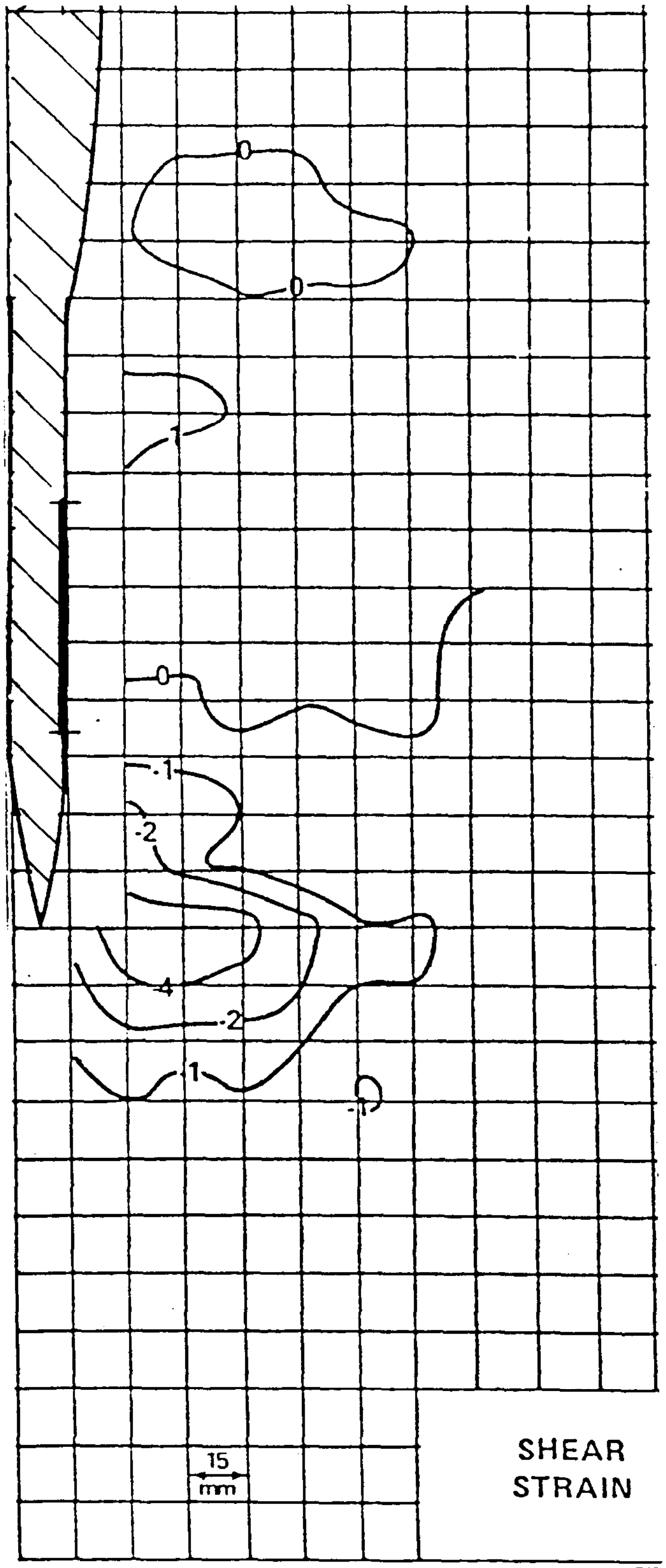
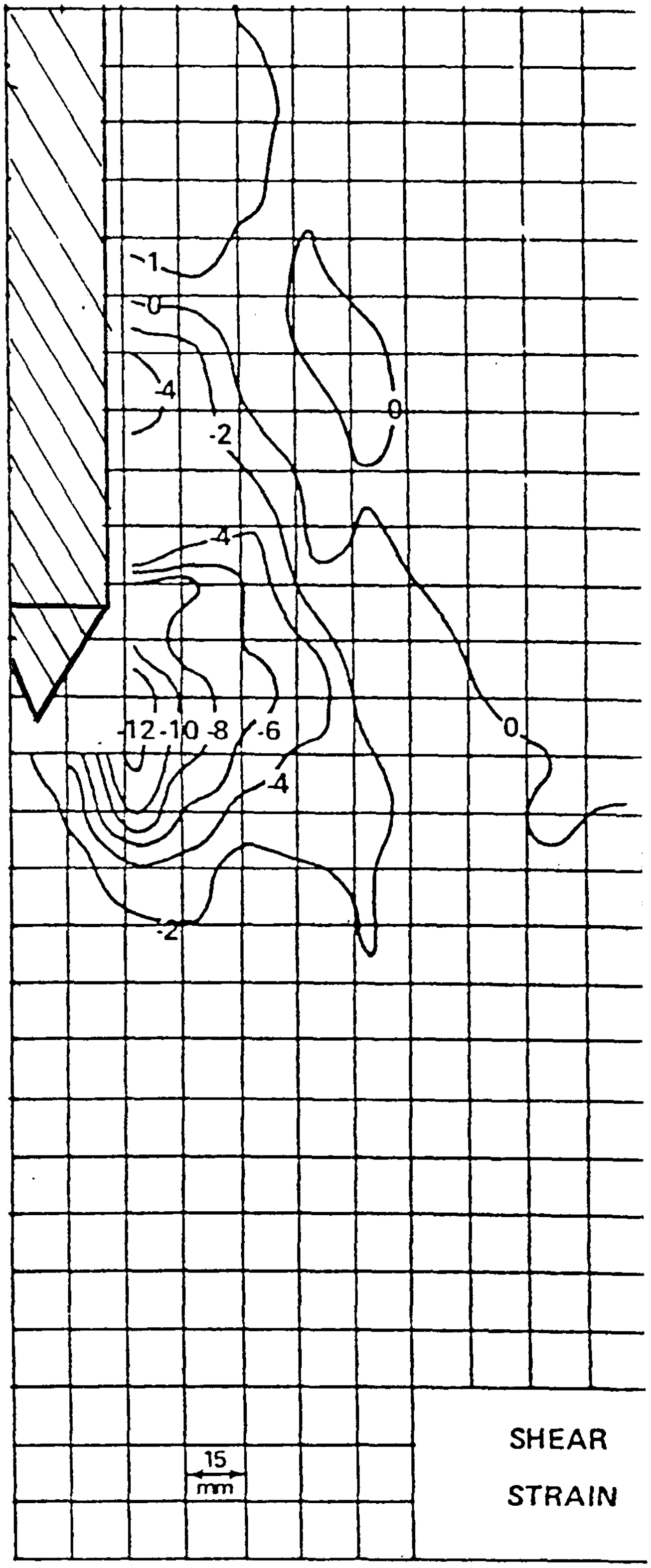
COMPARING CPT AND DMT PENETRATION DISTURBANCE IN SAND

(DATA FROM DAVIDSON & BOGHRAT, PARIS, MAY 83)



Blade - Dense
Shear strains



Cone - Dense
Shear strains

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SCHMERTMANN & CRAPPS, INC. Job No. DMT

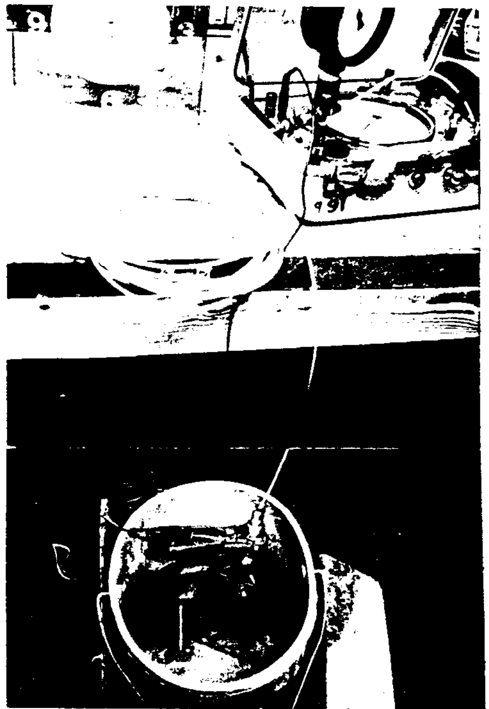
Fig. 4E-1

Problem: Check sensitiv. of ΔA, ΔB to temp.

Work by: JHS date: 14Apr84

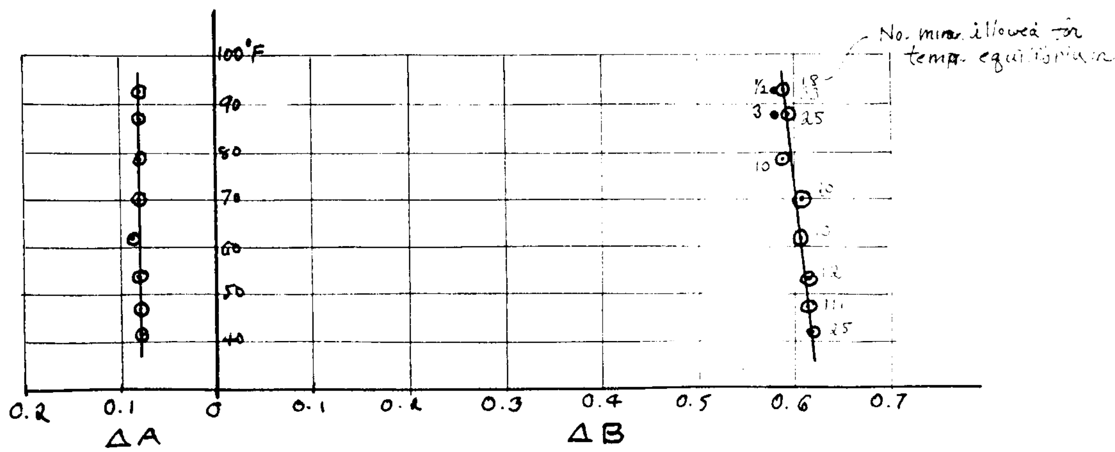
Check by: date:

time	t °F (±½°)	ΔA (± 0.005b)	ΔB	added ice or hot water
1625	70	0.08	0.61	Started with faucet water
35	"	0.085	0.605	
45	"	"	"	
1650	61	"	"	ice
1700	61½	"	"	
1702				ice
07	54	0.08	0.61	
14	"	"	"	
1715				ice
1906	47	0.08	0.61	after dinner
10				ice
30	40	0.075+	0.615	
35	41	0.08	"	
1936	57			hot water added
45	70	0.08	0.59	"
50				"
55	79	0.08	0.59	
2000				hot water added
03	88	0.08	0.585	
12	87	"	0.59	
25	"	"	0.595	
2026				hot wat. added
26½	96½	"	0.58	
44	93	"	0.59	
59	92	"	"	



used bucket with blade #76 immersed in water, with level kept ±½" constant. Temp. read with thermometer with 2°F divs.

Blade #76 used on 11Apr84 for ≤ 50 m soundings,
Start ΔA = 0.14 ΔB = 0.76
end ΔA = 0.09 ΔB = 0.60



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argument that better to measure
in horizontal direction if want vertical
preconsolidation stress (as does DMT)

ASCE JGDiv.

Vol. 110 No. 2 Feb 84

Past Consolidation Stress Estimate in Cretaceous Clay

By Raj P. Khera,[1] M. ASCE and H. Schulz[2]

Abstract: It is shown in this paper that in a highly overconsolidated undisturbed clay, due to natural unloading, most of the strain was recovered in the vertical direction, but not in the horizontal direction. Consolidation tests were performed on both undisturbed and remolded specimens, with the specimens oriented as in conventional tests (V-test) and at right angle (H-test). Estimated precompression stress for V-tests was considered inadequate to define the maximum past consolidation stress. Estimated precompression stress from H-tests was comparatively higher, and gave a more realistic estimate for maximum past consolidation stress. However, when the soil was allowed to swell at a low stress, the H-tests also behaved similar to the V-tests. It is postulated, that, the lesser the degree of strain recovery since the unloading of the soil, the better is the estimate for precompression stress. Electron micrographs showed no preferred particle orientation for undisturbed specimens in the natural state and after loading to 26 tsf (2.6 MPa). For remolded samples, conventional tests yielded accurate values of maximum precompression stress.

Introduction

The widening of the Mittelland Canal, which runs east-west and is located slightly north of Hanover, F.R. Germany, has been in progress for some years. This involves several design and construction operations such as steepening of slopes, use of bulkheads, longer and wider bridges, new docks with greater capacity, etc.

The soils in the vicinity of Hanover are of the upper cretaceous period and are very stiff to hard. The conditions of the deposition of the soils were complex and are not well understood. The region has been through several glacial periods such as Elster, Saale, Weichsel (5). There have been upward movements of a salt dome located about two miles (3 km) north-west of the site, but there is no evidence of any tectonic movement in the area investigated. Though the movement of ground water is confined within the joints, the general ground water level has not been established as yet. For a brief discussion of the geology of this area, see Khera and Schulz (7). Along this region of the Mittelland Canal, failures of slopes and bulkheads have occurred. For correcting the existing problems and for future design of safe and economical structures, a program was initiated at the Bundesansatalt für Wasserbau (BAW) for a detailed examination of the geotechnical properties of the clay from an area east of Hanover, called Anderten clay in this article.

The study presented in this paper pertains to the consolidation behavior and fabric of undisturbed and laboratory prepared specimens.

FIGURE 4F-1 (2 pp)

[1]Prof. of Civ. Engrg., New Jersey Institute of Technology, Newark, N.J.
[2]Dir., Soil Mech. and Foundation Engrg., Bundesanstalt Für Wasserbau, Karlsruhe, F.R. Germany.

Note.—Discussion open until July 1, 1984. To extend the closing date one month, a written request must be filed with the ASCE Manager of Technical and Professional Publications. The manuscript for this paper was submitted for review and possible publication on March 17, 1983. This paper is part of the *Journal of Geotechnical Engineering*, Vol. 110, No. 2, February, 1984. ©ASCE, ISSN 0733-9410/84/0002-0189/$01.00. Paper No. 18572.

DMT DIGEST #4

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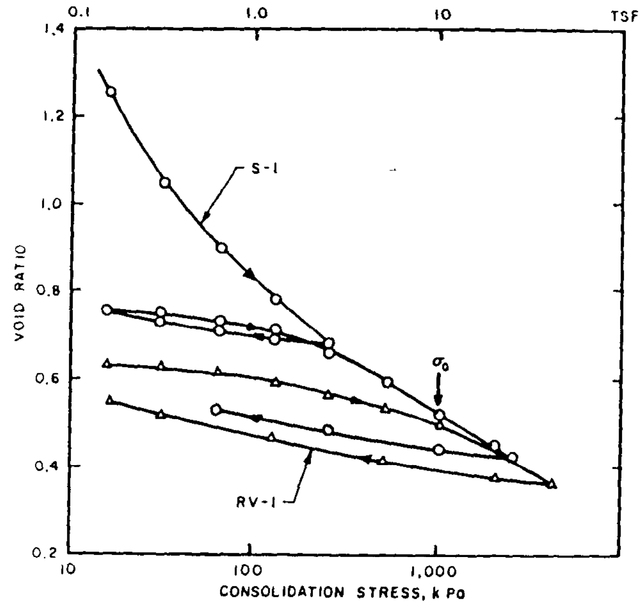

FIG. 8.—Odometer Curves for Laboratory Prepared Specimens

this point, the RV-test showed a negative strain of 3.2% and RH-test a negative strain of 0.7%. This is contrary to the response of the undisturbed specimens, in which the negative strain for H-6.9 was larger than for V-6.9. Though the undisturbed samples and the remolded samples were both overconsolidated, their contrary response may be due to the difference in age, environment, soil fabric, and other events that have occurred in the history of the former, but not the latter.

The results of the RV-1 test in Fig. 8 indicate the precompression stress to be 10 tsf (1 MPa). This was, indeed, the maximum stress used during remolding. At about the same stress, the curve comes very close to the curve for slurry S-1. Beyond 10 tsf (1 MPa), the two curves follow each other very closely. Thus, in the remolded state, the maximum reconsolidation stress can be determined reliably by conventional or V-tests. This was not true for undisturbed soil.

At 20 tsf (2 MPa), the strain for RV-1 and RH-1 tests were 11.2% and 15.1%, respectively. When compared with those shown in Table 1 for undisturbed soil, they are in the reverse order but consistent with trends observed by other investigators. During triaxial consolidation of remolded test specimens, both axial and radial strains were measured (6). Their results indicated a directionally dependent strain behavior similar to that found here. Though the soil they used was different, the method of sample preparation, which has a major influence on soil behavior, was the same.

Conclusions

On the basis of the investigation of Anderten clay, the following conclusions are derived.

1. The undisturbed overconsolidated soil has greater unrecovered strain in the lateral direction than in the vertical direction. The more the unrecovered strain, the better a soil is able to recall its stress history.
2. **A more realistic estimate of the precompression stress is obtained when the direction of the applied stress during** the odometer test **coincides with that of the higher unrecovered strain.**
3. If a highly overconsolidated soil is allowed to recover part or all of the unreleased strain while in contact with water, its ability to recall the stress history is obliterated and a lower value of precompression stress is obtained.
4. It is not possible to understand or predict the behavior of the undisturbed soil from the tests on remolded soil.

Acknowledgment

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Appendix I.—References

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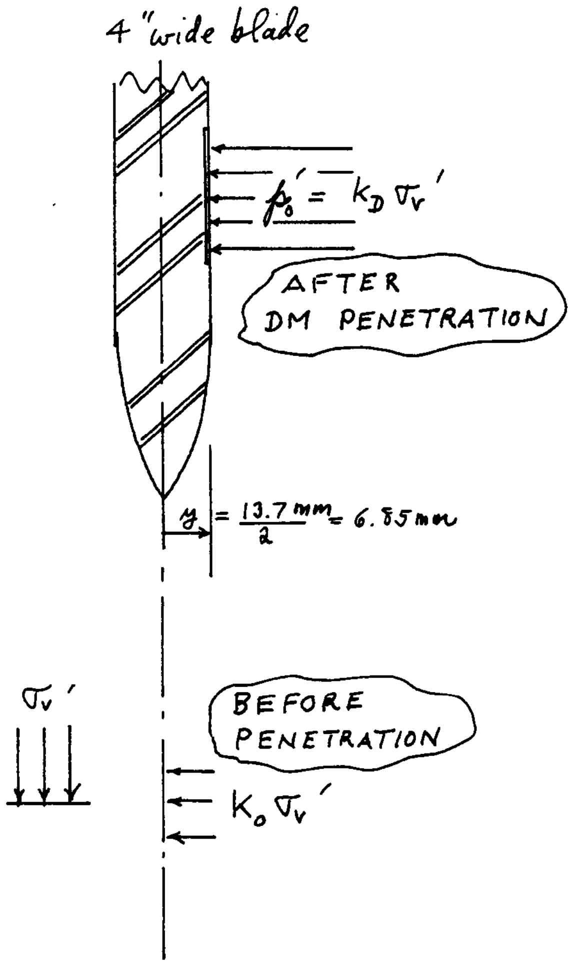
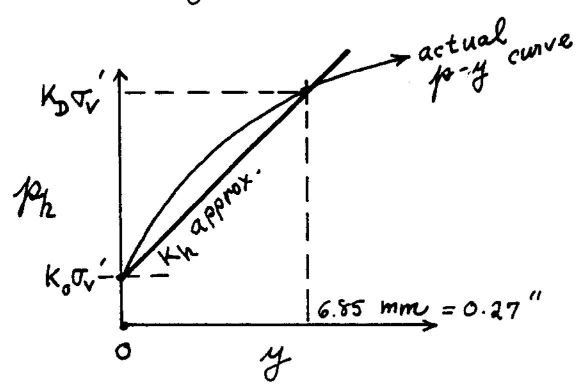
BACK



k_h for subgrade theory

$$= \frac{\Delta p_h}{\Delta y} \quad \left(\frac{F/L^2}{L} = \frac{F}{L^3}\right)$$



then:

$$\boxed{k_{h,\,B=4''} = \frac{(K_D - K_0)\,\sigma_v'}{6.85\text{ mm}}}$$

$\left.\begin{matrix} K_D \\ K_0 \end{matrix}\right\}$ from Dilatometer test

σ_v' calculated

convert to units desired

Correct for size (width = B')

reference width B = 1.0 ft., estimate $k_{h,(B=1')} = 0.5\, k_{h\,B=4''}$

for widths B > 1 ft use terzaghi eqn. $k = k_1 \left(\frac{B+1}{2B}\right)^2$

thus:

$$\boxed{k_{h_B} = 0.5\left(\frac{B+1}{2B}\right)^2 \frac{(K_D - K_0)\,\sigma_v'}{6.85\text{ mm}}}$$

For vertical direction, k_v

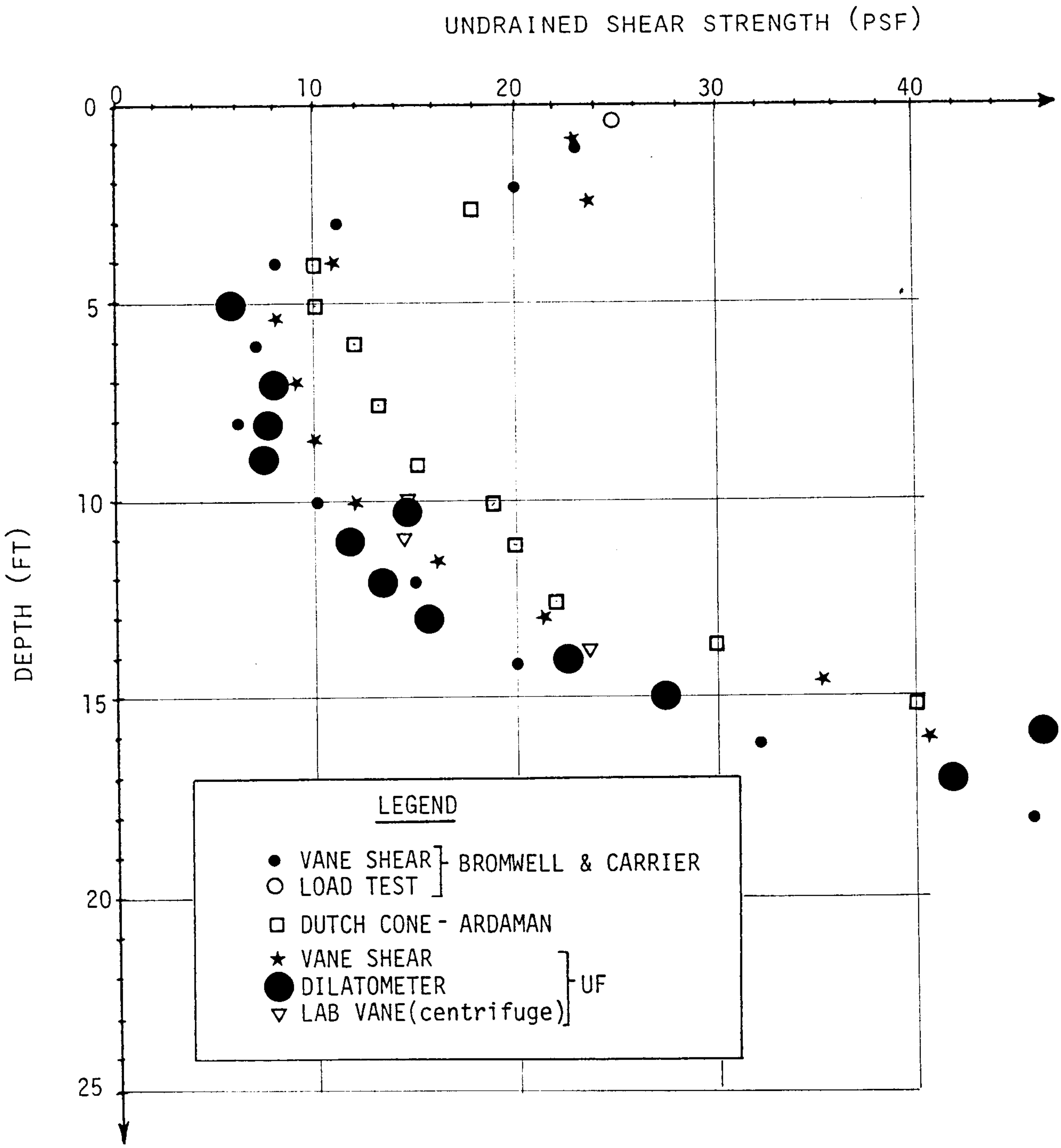
assume $k \sim \sigma'$

then:

$$\boxed{k_v = \frac{k_h}{K_0}}$$

BACK

FIGURE 41-1 COMPARATIVE UNDRAINED SHEAR STRENGTH RESULTS FROM CLAY SLIMES IN A FLORIDA PHOSPHATE MINE TAILINGS POND
(as compiled by Dr. D. Bloomquist, U. Fla.)



BACK

TABLE 4J-1 - INDEX OF FIRST 4 DIGESTS

DIGEST No. 1 (APR 83)

1A. New DIGEST Series
1B. Change Calculation for K_o, OCR (and therefore p_c and ϕ in Sands)
1C. Driving Blade Alert
1D. Crushing Soil Alert
1E. Edmonton Conference and Orlando Workshop
1F. Total Thrust Log Useful
1G. DMT Video Tapes Available

DIGEST No. 2 (JUL 83)

2A. Site-specific q_c-M correlations
2B. Towards a Common Presentation of ϕ_{ps} from DMTs
2C. Changes in Computer Program
2D. Increased Static Thrust Reaction When Using Drillrigs
2E. DMT Conference Proceedings Available

DIGEST No. 3 (FEB 84)

3A. Data Reduction in Basic Language
3B. Possible Special Usefulness in Peat Soils
3C. M_{DMT}/q_c Ratio in Sands Depends on Stress History and Method of Compaction
3D. Speeding Up The Calculation of K_o and OCR in Sands
3E. Graph for Estimating ϕ_{ps} at any Stress Level from ϕ_{ps}
3F. Compacted Sand Alert
3G. Very Loose Sand Alert, Pushed and Driven DMTs
3H. Adaptor Slot Can Cut Cable
3I. 2E Revisited -- Conference Proceedings Available

DIGEST No. 4 (JUN 84)

4A. Review of DMT Soil Property Measurement Accuracy
4B. Dilatometer Exhibit Booth at Geotech III, Paul Bullock
4C. Sand-bucket Demonstration and Research Tests
4D. Comparing DMT with CPT in NC/OCR Sand Bucket Tests
4E. No Temperature Effects on ΔA and ΔB Calibrations
4F. Better to Measure Vertical Prestress in Horizontal Direction?
4G. DMT to Estimate Horizontal Subgrade Modulus
4H. Precaution - Watch for Stress-Magnitude and Preconsolidation Effect in Settlement and Strength Problems
4I. DMT can Test Very Weak Clays for Undrained Shear Strength
4J. Index of First 4 DIGESTS
4K. Blade and Membrane Protection Sheath Available

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