with comparatively small samples is unsatisfactory.

When larger specimens are used, difficulties are encountered due to side friction in the consolidation box, but it appears that for a rough evaluation, corrections can be made from estimates of the reduction in pressure due to friction, and the assumption that the consolidation is due to the average of the pressure at the top of the specimen and the resultant pressure at the bottom. It is impossible to eliminate friction in the normal type of consolidation box, and the use of the triaxial compression type of machine with a device such as that used by the author appears likely to provide a solution of the difficulty.

The investigations described were regarded as exploratory and were made on one type of remoulded soil and one shape of gravel. Further investigations are necessary to determine the effect of the shape of the solid particles, effect of remoulding, and other properties before any definite conclusions on the general effect of the presence of stones and other coarse particles on the consolidation can be reached. This further research is dependent, however, on the final development of a suitable form of test for the large samples necessary.

ACKNOWLEDGMENT.

The Author is indebted to the Directors of Messrs. G. Wimpey and Co. Ltd., for permission to publish the data contained in the Paper.

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SUB-SECTION II d

TRIAXIAL TESTS

II d 1 CORRELATION BETWEEN THE RESULTS OF CELL-TESTS AND COMPRESSION TESTS

E. DE BEER
Ghent (Belgium).

INTRODUCTION.

In the cell-tests performed at Delft and Ghent the sample is subjected to a certain number of vertical loads, and for each of these loads the minimum lateral pressure, necessary to still maintain the sample in equilibrium, is determined. When quick cell-tests are performed on clays, the obtained envelope of Mohr consists of two straight lines intersecting in the so called "singular point" of the diagram of Mohr. When the sample is given opportunity to consolidate under the last applied load, the necessary minimum pressure is decreasing with time. The circle obtained after consolidation is complete, is tangent to the first straight line of the envelope. The first line gives the cohesion c by its ordinate at the origin, and the angle of internal friction φ by its inclination. The second straight line gives the so called apparent cohesion c' and apparant angle of friction φ'. The ordinate W_c of the singular point should be the shearing-resistance of the material in its natural state in the ground, while the circle tangent to the two straight lines should give the natural vertical effective pressure σ_t.

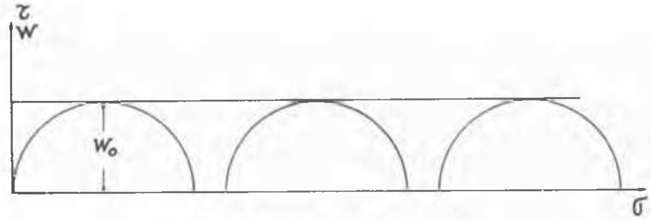
For several clays the quick-test may not be performed too quickly. Indeed, because of phenomena at the surface of the very small clay-particles, the shearing-resistance of these clays under an instantaneously applied load can be larger than that existing under a remaining load. The velocity of performing the cell-test must be so, that the maximum value of the minimum lateral pressure, necessary to maintain the equilibrium under a given vertical load, can be measured, after what a new increase of the vertical load shall be applied as quickly as possible. In this way the normal cell-diagrams dealt with in this report have been obtained.

In the U.S.A. and in several other countries the shearing-resistance is computed from compression-tests. If q is the crushing strength of a sample, it is admitted that the shearing-resistance of the sample in its natural state in the ground W_o is given by

$$W_o = \frac{q \cos.\varphi}{2} \qquad (1)$$

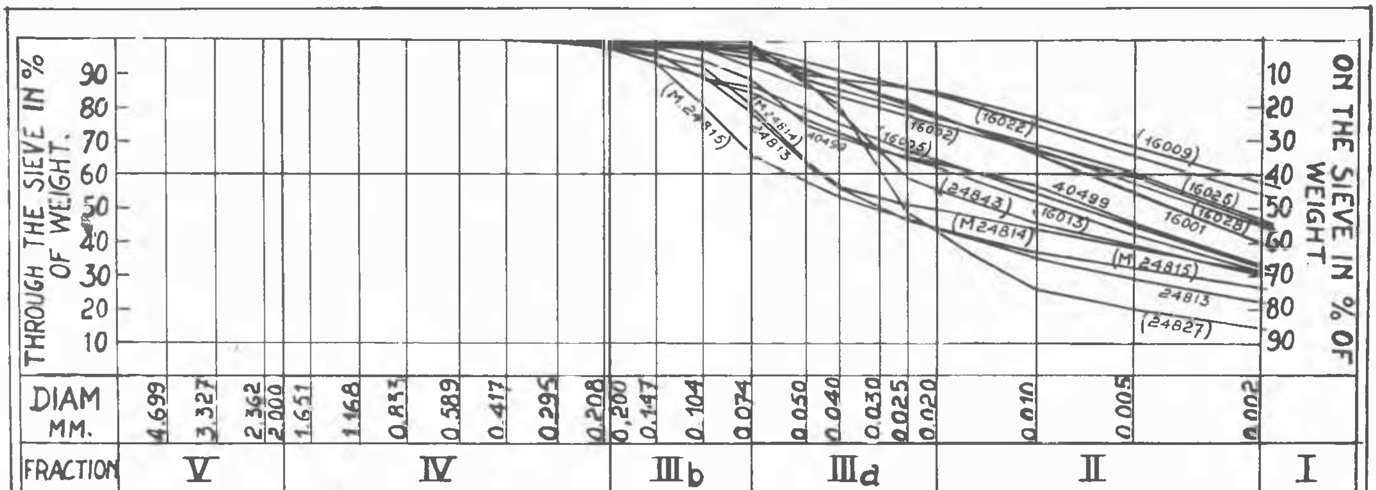
In the same countries the shearing-resistance is also computed from triaxial compression tests. In the quick tests the sample enclosed in a rubberbag, is subjected to an overall pressure; after what the vertical stress is increased till rupture. The overall pressure seems to have no influence on the shearing-resistance. When the test is repeated on different parts of the same sample, circles with the same radius W_0 are obtained (fig.1). The quick triaxial tests should give the same results as the ordinary compression tests.

In order to compare the results of the cell-tests and of the ordinary compression tests, at our laboratory at Ghent a certain number of samples were subjected to both tests.



Quick triaxial test

FIG.1



N° OF THE SAMPLE	ORIGIN	DEPTH UNDERNEATH SOIL SURFACE	GRANULOMETRIC SIZE FRACTION IV	IIIb	IIIa	II	I	LIMITS OF ATTERBERG LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	ORGANIC CONTENT	CHALK CONTENT	VOLUME WEIGHT	DRY WEIGHT	WATER CONTENT	PERCENTAGE OF VOIDS	PENETRATION VALUE
		M.	%	%	%	%	%	%	%		%	%	T/M³	T/M³	%	%	KG/CM²
24 827	GAVERE	17,50		(1)	(56)	(28)	(15)	(66,4)	(22,9)	(43.5)	–	(14,5)	(1,885)	(1,455)	(29,4)	(45,0)	15 à 17 (20,4)
24.843	"	20,50		(1)	(25)	(43)	(31)	(123,0)	(26,7)	(96,3)	–	(8,9)	(1,870)	(1,370)	(36,6)	(48,4)	9,5 (34,7)
24.813	CANAL BRUSSELS-CHARLEROI	13,00	2	19	35	22	22	43,0	15,2	27,8	–	2,4	2,045	1,710	19,4	35,4	12,9
M 24.814	"	10,50	(2)	(17)	(31)	(19)	(31)	(63,2)	(17,4)	(45,8)	–	(5,7)	1,935	1,520	27,6	42,5	(6,7)
M 24.815	"	16,20	(2)	(31)	(23)	(17)	(27)	(49,4)	(14,3)	(35,1)	–	(2,3)	1,795	1,450	24,05	45,3	(7,6)
40499	DONZERE - MONDRAGON	0,70	1	10	26	30	33	48,6	21,2	27,4	1,9	43,8	1,890	1,470	28,6	44,5	0,83
16.028	WETTEREN	9,00	(1)	(1)	(21)	(33)	(44)	(116,5)	(34,9)	(81,6)	(3,6)	(2,6)	1,800	1,280	40,0	51,5	5,6
16.025	"	10,00		(3)	(20)	(31)	(46)	(130,0)	(41,6)	(88,4)	(1,5)	(4,1)	1,790	1,270	41,7	52,5	16,8
16.013	"	11,00	(2)	(14)	(22)	(31)	(31)	(95,5)	(31,5)	(64,0)	(1,5)	(1,8)	1,800	1,270	41,5	51,8	8,2
16.005	"	12,00	(2)	(12)	(22)	(32)	(32)	(92,5)	(35,8)	(56,7)	(2,5)	(0,7)	1,800	1,260	43,2	52,4	7,8
16.001	"	2,00		5	17	38	40	103,7	40,7	63,0	2,2	2,9	1,740	1,200	45,4	54,8	4,1
16.009	"	3,00		(3)	(12)	(27)	(58)	(133,5)	(32,4)	(101,1)	(1,7)	(3,0)	1,760	1,210	46,0	54,5	7,9
16.022	"	4,00		(2)	(14)	(30)	(54)	(115,3)	(39,3)	(76,0)	(1,5)	(3,1)	1,930	1,490	29,2	43,5	19,8
16.002	"	5,00		(7)	(18)	(29)	(46)	(123,6)	(37,1)	(86,5)	(1,2)	(3,4)	1,760	1,210	45,9	54,4	10,0

Granulometric size

FIG.2

For all the tests the dimensions of the samples are the following:

height = h = 14,5 or 15 cm.
diameter = ϕ = 6,54 or 6,57 cm.

The samples were tested in their undisturbed state unless otherwise specified.

The cell diagrams show a certain number of circles, indicated by numbers. The time taken to obtain the state of stress corresponding to a given circle is indicated in the corresponding tabel of each cell-diagram.

The diagrams of the compression tests give the vertical deformations of the sample in function of the applied vertical pressures, and also the variation of these pressures with time. If possible the diagrams give the angle α between the shear plane and the horizontal direction. The natural vertical effective stress computed from the weight of the overburden, or from direct data, is indicated by $\sigma_{k,o}$.

A. SAMPLES OF YPRESIAN CLAY (Tertiary clay).

Two samples of Ypresian clay, 24827 and 24843 taken at a depth of 17,50 m, resp.20,50 m under the soil surface were tested. The mechanical analysis and the physical properties of samples taken in the same layer and in the neighbourhood of the two samples are given on fig. 2.

When the data of fig. 1 are written between brackets, it means that the physical properties are concerned, not with the tested samples itself, but with samples taken in the neighbourhood.
The results of sample 24843 are given in fig. 3a and 3b; the results of sample 24827 in fig. 4a and 4b.

SAMPLE 24843.

The values of c, φ , deducted from fig. 3a are given in table I. It is worthwhile to note the following special facts:

1) The circle (1) (fig. 3a) doesn't correspond to an extreme state of stress; indeed, to obtain this state under a vertical stress σ_v= 0,894 kg/cm^2, it should be necessary because of the large cohesion, to exert an horizontal pull, what it is impos-

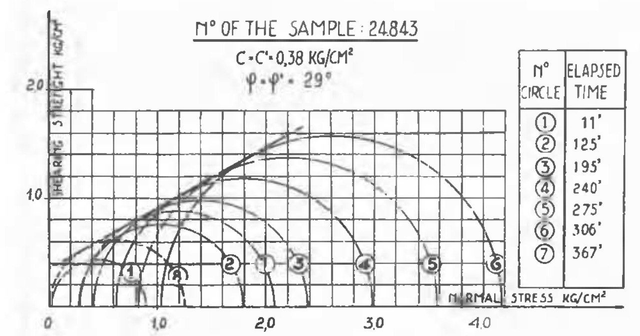


FIG.3a

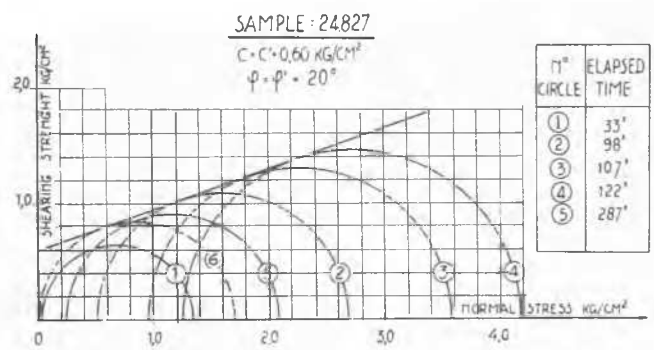


FIG.4a

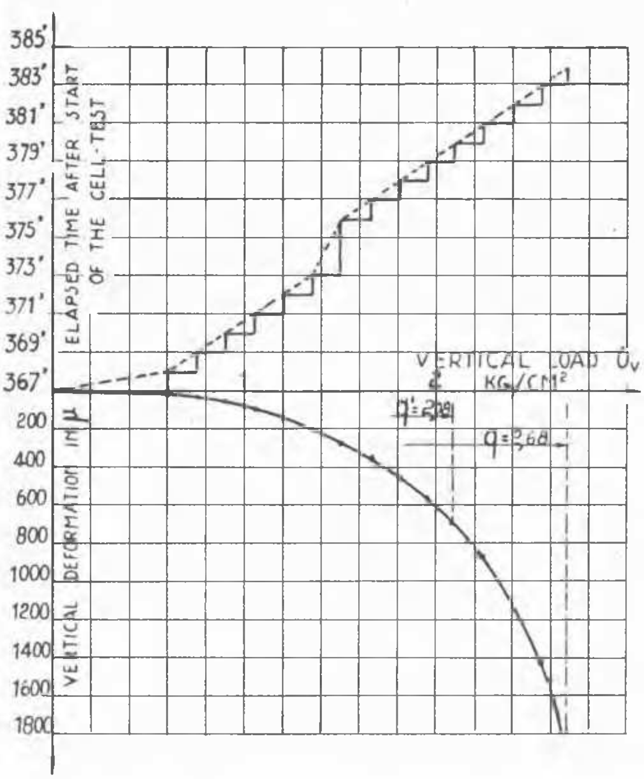


FIG.3b

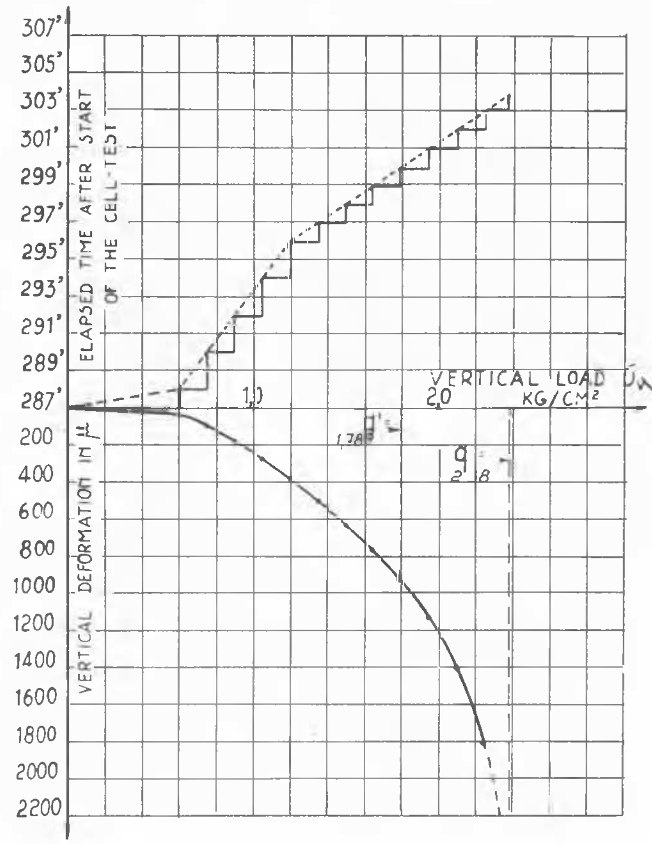


FIG.4b

sible to do in the cell-apparatus.

2) The circle (2) (fig. 3a) is also probably not a limitcircle, because, in a quick test, underneath the natural effective pressure, the lateral stress can be produced by lateral expansion.

3) After having been loaded to 4,18 kg/cm², the sample was unloaded to 2,080 kg/cm². The circle (7), nearly tangent to the straight line $\varphi = 29°$, $c = 0,4$ kg/cm² is obtained.

After having reached the stress-state of circle (7), the sample was farther unloaded to 0,595 kg/cm². Then the lateral pressure was reduced to zero and a compression test was performed on the sample previously subjected to the described cell-test.

Fig. 3b indicates that the sample collapsed under $q = 2,68$ kg/cm², but that the increase of the deformations becomes very rapid from a pressure $q' = 2,08$ kg/cm². Thus according to formula (1) the shearing-resistance should be $W_{o,r} \approx 1,34$ kg/cm² or $W'_o \approx 1,04$ kg/cm². In the compression test there is a doubt concerning the value to adopt for the shearing strength. It can be the value $W_{o,r}$ corresponding to failure, or the value W'_o corresponding to the rapid increase of the deformations. When it is the latter value, it can be seen from fig. 3b that it is very difficult to make an exact choice.

The circle (7) of fig. 3a corresponding to the value $\sigma_k = 2,08$ kg/cm², gives $W_c = 0,85$ kg/cm². This value of W_c is much smaller than the value $W_{o,r}$ and even W'_o of the compression test.

Drawing the limit-circle (8) corresponding to zero horizontal pressure, one gets $\sigma_v = 1,24$ kg/cm², and the corresponding shearing-resistance is 0,54 kg/cm². Comparing these values to those of the compression test, it is concluded, that in the compression test, at rupture, the effective horizontal stress is not zero.

In quick tests with constant watercontent the shearing strength should remain invariable; on the contrary the quick cell test indicate that in function of the applied loads and of the allowed deformations the shearing-resistance even by clays can vary rapidly with time.

A cone test performed on the sample 24843 gives a penetration value $C_{k,o} = 9,5$ kg/cm². The penetration value is given by the formula

$$C_{k,o} = 1,3\,(V_b p_c + V_c c) \qquad (2)$$

where p_c = capillary pressure at the moment of penetration. In accordance with the properties of structural deformability of the sample under shear stresses, p_c can be located between 0 and $\sigma_{k,o}$.

For $\varphi = 29°$ $\quad V_c = 27,5 \quad V_b = 16,4$

$c = 0,38$ kg/cm²

$\sigma_{k,o} \approx 1,58$ kg/cm²

thus $\quad 0 \leqq p_c \leqq 1,58$ kg/cm²

$$1,3 \times 27,5 \times 0,38 \leqq C_{k,o} \leqq 1,3(16,4 \times 1,58 + 27,5 \times 0,38)$$

$$13,6 \text{ kg/cm}^2 \leqq C_{k,o} \leqq 47,2 \text{ kg/cm}^2.$$

Comparing the computed limits of $C_{k,d}$ with the measured value of 9,5 kg/cm², it is concluded that for the sample tested in the cone test the vertical effective stresses at the moment of rupture are nearly zero.

When the penetration value should be computed from the compression test, then the $\varphi = 0$ method has to be applied. For $\varphi = 0$, $V_c = 5,14$. Thus

$$C_{k,o} = 1,3 \times 5,14 \times 1,04 = 6,95 \text{ kg/cm}^2$$

or $$C_{k,o} = 1,3 \times 5,14 \times 3,14 = 9,06 \text{ kg/cm}^2.$$

The values so obtained are smaller than the measured value.

SAMPLE 24827.

The values of c, φ, deducted from fig. 4a are given in table I.

Special facts are:

1) The circle (1) fig. 4a is not a limitcircle, for the same reason as given for circle (1) of sample 24843.

2) After having been located to 4.18 kg/cm², the sample was unloaded to 2,080 kg/cm²; the circle (5) (fig. 4a) nearly tangent to the straight line $\varphi = 20°$, $c = 0,6$ kg/cm² is obtained.

After having reached the stress-state of circle (5), the sample was farther unloaded to 0,595 kg/cm². Then the lateral pressure was reduced to zero and a compression test

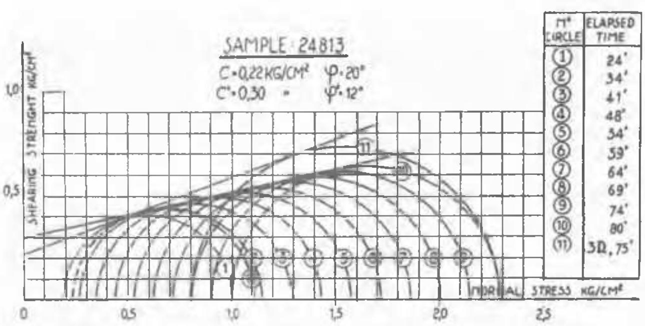


FIG.5a

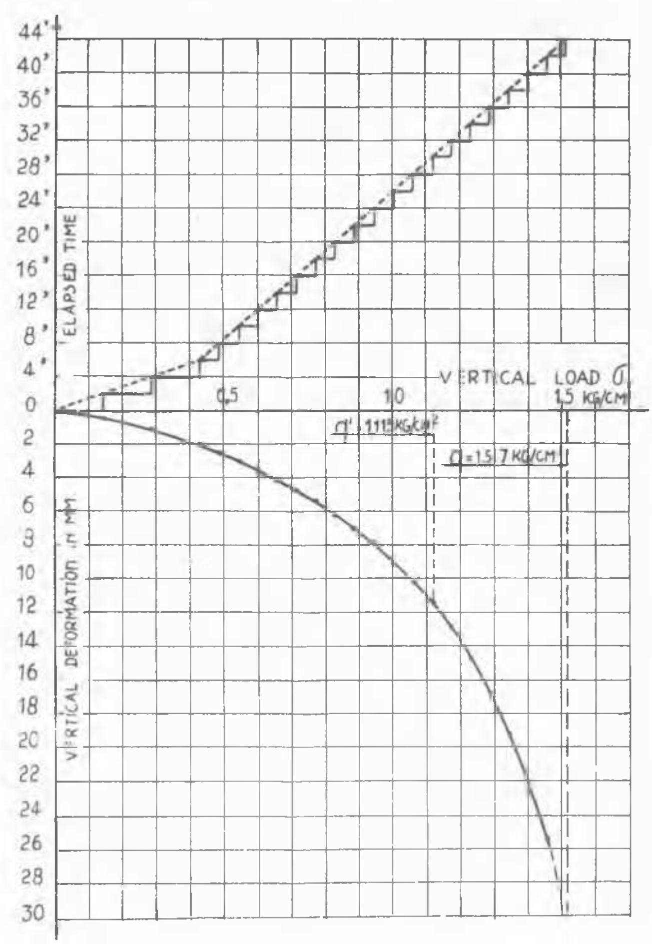


FIG.5b

was performed on the sample previously subjected to the described cell-test.

Fig. 4b indicates that $q = 2{,}38$ kg/cm^2

$$q' \sim 1{,}64 \text{ à } 1{,}785 \text{ kg/cm}^2$$

Thus $W_{o,r} = 1{,}19$ kg/cm2.

$$W'_o \geq 0{,}82 \text{ kg/cm}^2.$$

Again there is a doubt in the compression tet concerning the value to adopt for the shearing-resistance. The limit-circle (6) fig. 4a, corresponding to $\sigma_h = 0$, gives $\sigma_v = 1{,}72$ kg/cm^2, and a shearing-resistance of 0,76 kg/cm^2. Comparing these values to those of the compression test, it is concluded that in the compression test, at the rupture, the effective horizontal stress is not zero. The cell-test shows again that even with constant watercontent in function of the applied loads and the allowed deformations the shearing-strength of clays can vary rapidly with time. The come test gives a penetration value of 15 à 17 kg/cm^2.

$$0 \leq p_c \leq \sigma_{k,o} = 1{,}34 \text{ kg/cm}^2.$$

$\varphi = 20°$ $\quad V_b = 6{,}4 \quad V_c = 14{,}8$

$c = 0{,}6$ kg/cm^2

$$13 \times 14{,}8 \times 0{,}6 \leq C_{k,o} \leq (1{,}9 \times 6{,}4 + 14{,}8 \times 0{,}6)\ 1{,}3$$

$$11{,}5 \text{ kg/cm}^2 \leq C_{k,o} \leq 27{,}4 \text{ kg/cm}^2.$$

The measured value is located between the computed limits. At the moment of rupture, there still remains some value of the capillary pressure, namely:

$$\frac{15 - 11{,}5}{6{,}4} \leq p_c \leq \frac{17 - 11{,}5}{6{,}4}$$

$$0{,}547 \text{ kg/cm}^2 \leq p_c \leq 0{,}86 \text{ kg/cm}^2.$$

When the $\varphi' = 0$ method is applied, with the results of the compression-test

$$1{,}3 \times 5{,}14 \times 0{,}82 \leq C_{k,o} \leq 1{,}3 \times 5{,}14 \times 1{,}19$$

$$5{,}47 \text{ kg/cm}^2 \leq C_{k,o} \leq 7{,}96 \text{ kg/cm2}.$$

The values computed with the $\varphi' = 0$ method are much smaller than the measured values.

B. SAMPLES CONSOLIDATED IN A PRESSURE BOX.

Three series of tests were run on remolded samples which were first consolidated during several days to a known-overall pressure.

The samples having an height $h = 14{,}5$ cm., a diameter = 6,67 cm, were placed in a rubber bag with a larger diameter; inside the bag the samples were surrounded by Rhine sand allowing free drainage. The samples were then put in a pressure box and subjected to a known overall pressure. From the same sample there were as many specimens consolidated, as tests had to be performed.

SAMPLE 24813.

physical properties: fig. 1.

Two identical specimens of this sample were subjected during 4 days to an overall pressure $\sigma_{k,o} = 1{,}08$ kg/cm^2. Thereafter one of the specimens was subjected to a cell test, the other to a compression test. The diagrams are respectively given in fig. 5a and 5b, and the results therefrom in tabel I.

The singular point of the cell-test, gives, by means of circle (12), $\sigma_t = 1{,}12$ kg/cm^2 and $W_c = 0{,}42$ kg/cm2.

In the compression test complete failure is obtained for $q = 1{,}517$ kg/cm^2. When $q' = 1{,}115$ kg/cm^2 small fissures were observed. It can be noted that it is practically impossible to discern a discontinuity in the diagram deformations versus pressures of fig. 5b for

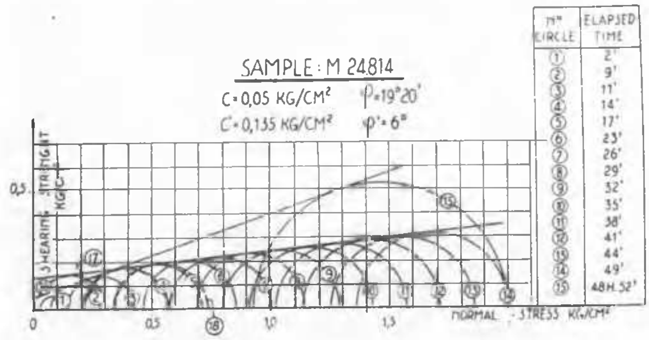


FIG.6a

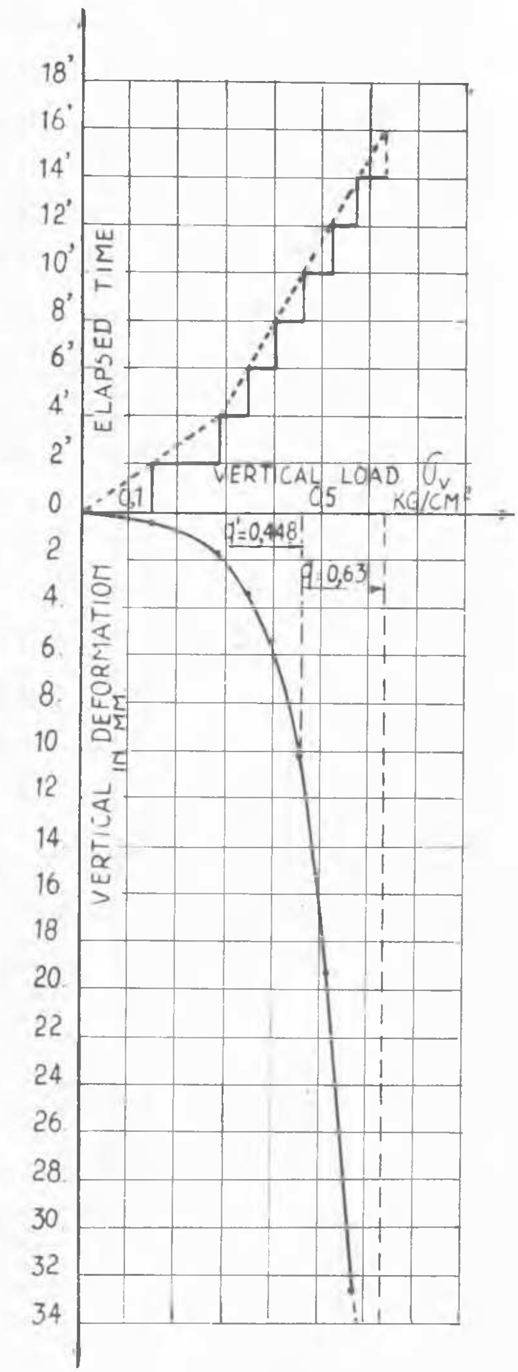


FIG.6b

TABLE I

Number of Sample	Nature	Depth under soil surface	Computed effective natural vertical stress $\sigma_{k,o}$	σ_t	q	q'	c	c'	φ	φ'	W_c	$W_{o,r}$	W'_o	φ''
				cell-test	compression test		cell- test				compression-test			
		m	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	degrees	degrees	kg/cm^2	kg/cm^2	kg/cm^2	degrees
24843	Ypresian clay	20,50 à 20,90	1,58	-	2,68	2,08	0,38	-	29	-	0,84	1,34	1,04	-
24827	id.	17,50 à 17,90	1,34	-	2,38	1,785	0,6	-	20	-	0,85	1,19	0,82	-
24813	Remolded clay	-	1,08	1,12	1,517	1,115	0,22	0,3	20	12	0,42	0,71	0,52	-
M24814	id.	-	0,52	0,57	0,63 q_w = 0,457	0,448	0,05	0,135	19°20'	6	0,17 W_a = 0,195	0,293	0,22	-
M24815	id.	-	0,6	0,70	0,8 q_w = 0,424	0,63	0,05	0,16	24	10	0,22 W_a = 0,229	0,372	0,3	30 φ''_w = 20
40500	Clayey Marl	1,30-1,70	-	0,45	0,477	0,416	0,005	0,10	34	14	0,15	0,232	0,19	24
40499	id.	0,70-1,10	-	0,29	0,357	-	0	0,07	26	7	0,09	0,178	-	8
40497	id.	0,50-0,90	-	0,52	0,357	-	0,03	0,13	27	9	0,17	0,179	-	6
16028	Tertiary clay	9,00-9,40	1,24	0,62	1,042	0,74	0,02	0,12	23	9	0,18	0,501	0,355	16
16025	id.	10,00-10,40	1,32	1,10	0,744	-	0,19	0,27	18	11	0,40	0,354	0,354	18
16013	id.	11,00-11,40	1,40	1,49	1,31	1,19	0,05	0,28	26	12	0,46	0,635	0,577	14
16005	id.	12,00-12,40	1,48	1,15	1,25	1,071	0,10	0,23	22	12	0,36	0,611	0,524	12
16001	id.	2,00-2,90	≥ 0,27 (unloaded by 33 years old cut)	0,54	0,417	-	0,01	0,11	27	11	0,17	0,200	0,200	16
16009	id.	3,00-3,40	≥ 0,35	0,92	0,536	0,476	0,04	0,18	25	11	0,28	0,264	0,234	10
16022	id.	4,00-4,40	≥ 0,43	1,32	1,37	1,25	0,05	0,16	27	19	0,40	0,643	0,587	20
16002	id.	5,00-5,40	≥ 0,51	0,87	0,595	0,535	0,08	0,18	24	13	0,29	0,288	0,259	14

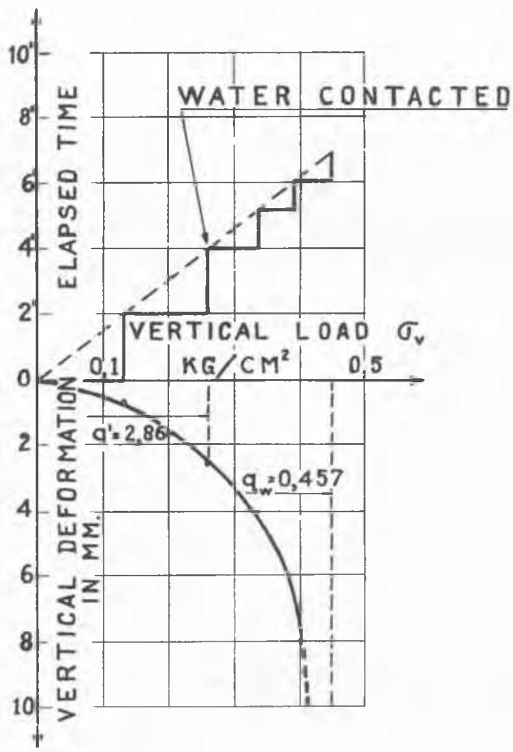


FIG.6c

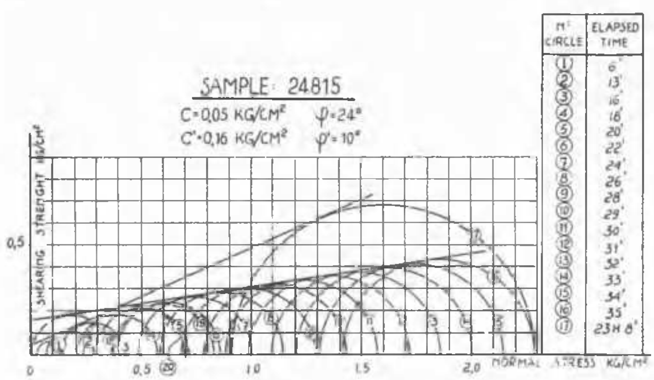


FIG.7a

σ_v = 1,115 kg/cm2. Only a visual inspection of the sample during the test gives this value.

Table I shows that the value W'_o and especially $W_{o,r}$, which is the only exactly measurable quantity, is noticeably larger than the value W_c.

SAMPLE M 24814.

physical properties: fig. 1.

Four identical specimens of this sample were subjected during 18 days to an overall pressure $\sigma_{k,o}$ = 0,52 kg/cm2. Directly afterwards the specimens were subjected to an ordinary cell-test, an ordinary compression test, a compression test under water and a special cell test.

Ordinary cell-test : fig. 6a and Table I.

Ordinary compression test:fig.6b and Table I.

Collapse of the sample occured by q = 0,63 kg/cm², but a fissure was detected at the base of the sample by q' = 0.448 kg/cm².

The values $W_{o,r}$ and even W'_o are larger than W_c.

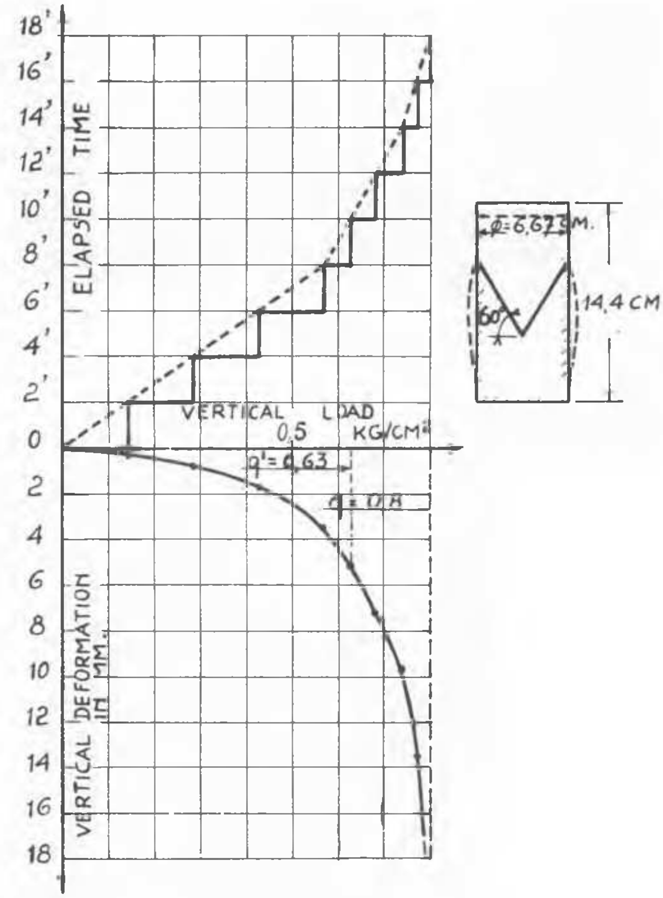


FIG.7b

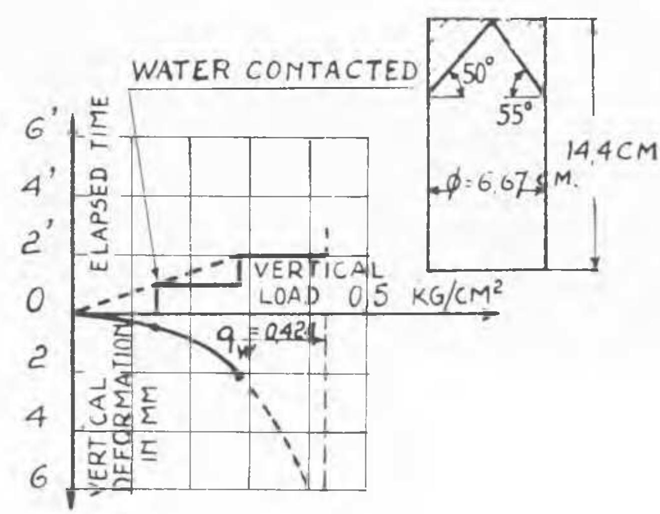


FIG.7c

COMPRESSION TEST UNDER WATER: fig. 6c.

The sample is first loaded with σ_v = 0,286 kg/cm², and then its base is contacted with a free waterlevel. Now the vertical pressures are rapidly increased. Seven minutes after the start of the test and three minutes after contacting with water, the sample collapsed under a pressure q_w = 0.457 kg/cm². This is nearly the same value as q', i.e. the pressure producing the first fissure in the ordinary compression test.

It is worthwhile to note that the circle

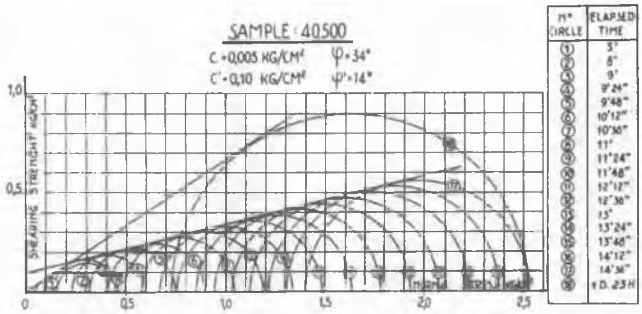


FIG.8a

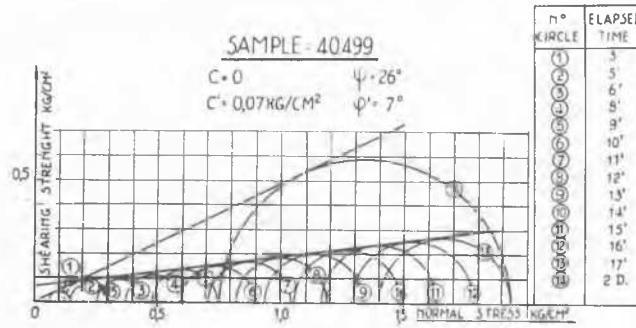


FIG.9a

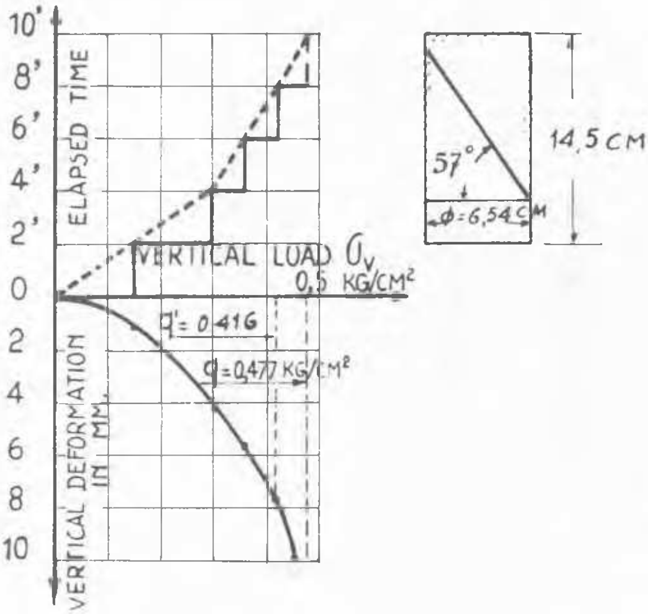


FIG.8b

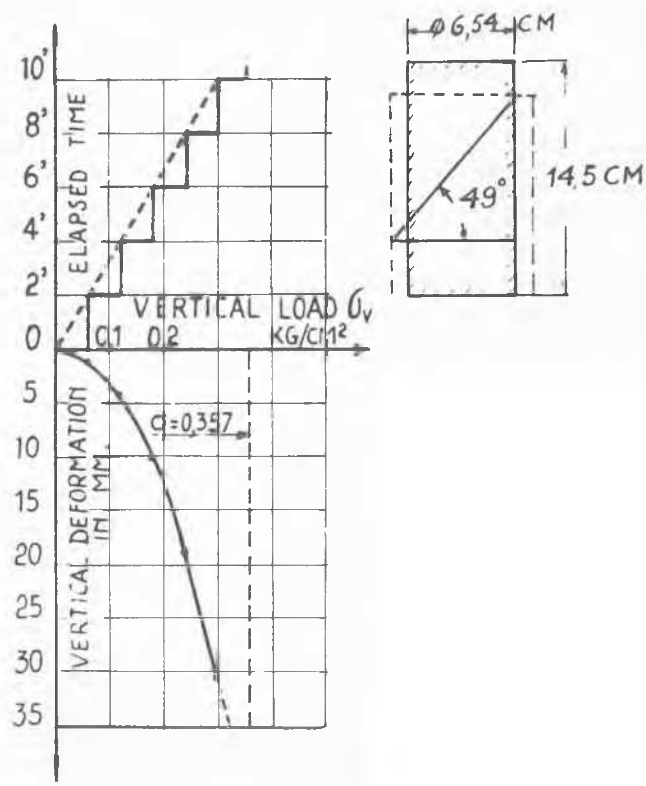


FIG.9b

(16) of fig. 6a, corresponding to zero horizontal pressure, gives σ_v = 0,32 kg/cm².

Special cell test: fig. 6a - circle (18)

In this test the sample is first brought in the cell-apparatus under an overall pressure of 0,503 kg/cm². Then the vertical pressure is increased by successive increments of 0,057 kg/cm², and the horizontal pressure at the same time decreased with the same quantity. A limit-state is obtained for σ_v =0,73 kg/cm² σ_h = 0,34 kg/cm², giving $W_4 = \frac{0,73 - 0,34}{2}$ = 0,195 kg/cm². This value is a little larger than W_c (table I).

SAMPLE M 24815.

physical properties: fig. 1.

Four identical specimens of this sample were subjected during 14 days to an overall pressure $\sigma_{k,o}$ = 0,6 kg/cm². For the rest see sample M 24814.

ordinary cell-test: fig. 7a and Table I.
ordinary compression test: fig. 7b and TableI.

The total failure occured by q = 0,8 kg/cm², but vertical fissures appeared already by q' = 0,63 kg/cm². After them inclined fissures started, until the total failure by 0,8 kg/cm². The plane of rupture was rather rough, but its mean inclination to the horizontal is α = 60°. Thus φ'' = 2(α -45°) = 30°.

It is worthwhile to note that it is practically impossible to discern a abrupt change in the diagram deformations-stresses of fig. 7b for q' = 0,63 kg/cm². Only a visual inspection of the sample during the test allowed to detect this value.

The values $W_{o,r}$ and even W'_o are larger than W_c.

compression test under water: fig. 7c.

The sample was first contacted at its bases to a free water source and was then loaded rapidly vertically. The specimen failed under a stress q_w = 0,424 kg/cm², 2' after the start of the test.

Angles α = 50° and α = 55° were measured, giving φ''_w = 20°.

The limit circle (18) of fig. 7a, corresponding to σ_h = 0, gives σ_v = 0,37 kg/cm², value which is a little smaller than the measured value q_w = 0,424 kg/cm²

special cell-test: fig. 7a - circle (19)

The same procedure as for the sample M 24814 was followed, but the initial overall

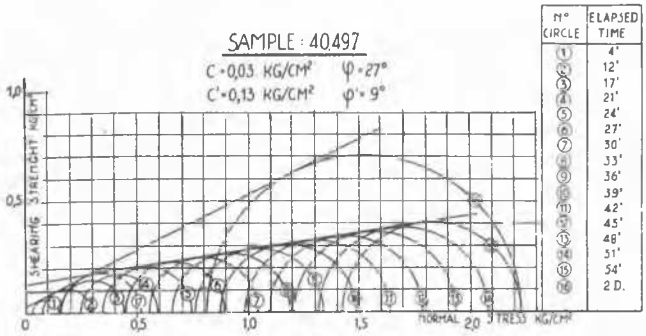


FIG.10 a

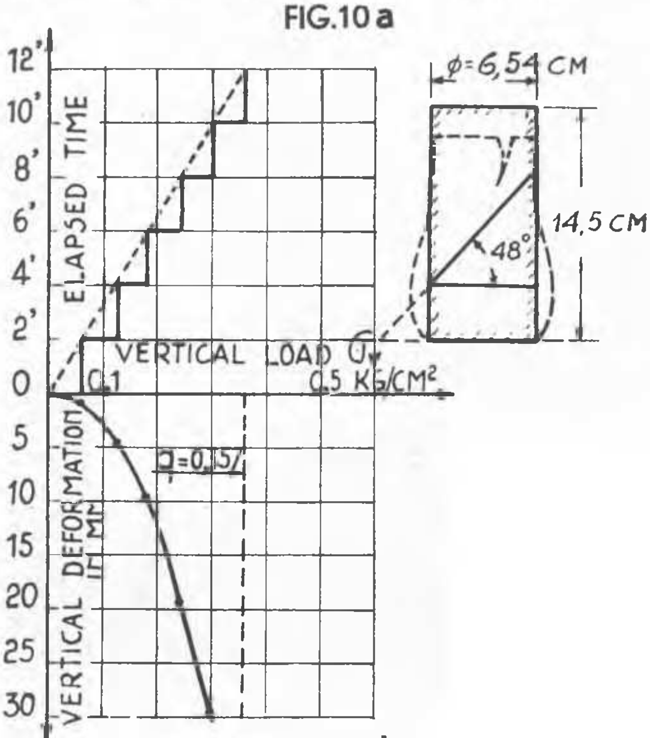


FIG.10 b

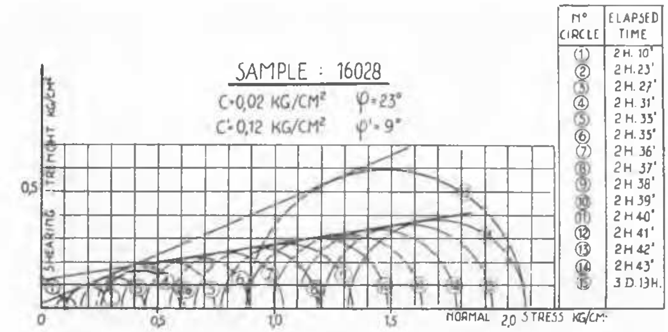


FIG.11a

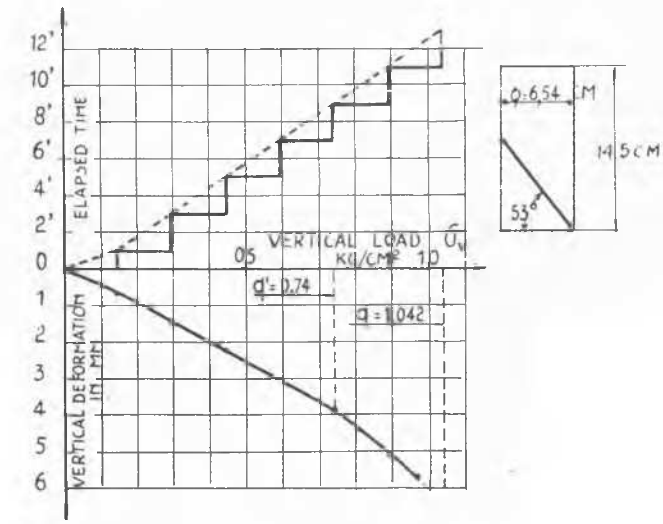


FIG.11b

pressure was now 0,600 kg/cm². A limit state is obtained for σ_v = 0,83 kg/cm² σ_h = 0,372 kg/cm², giving

$$W_4 = \frac{0{,}83 - 0{,}372}{2} = 0{,}229 \text{ kg/cm}^2.$$

This value is a little larger than the value W_c of the singular point, but smaller than the ordinate of the point of tangency to the straight line c' = 0,16 kg/cm² φ' = 10° (fig. 7a). The smaller value of the shearing resistance obtained in the special cell-test is related to the fact, that because of the loading schedule the deformations by constant volume are smaller in the special test than in the ordinary one, thus giving a smaller value of the angle φ'.

C. SAMPLES OF CLAYEY MARL.

Three undisturbed samples of clayey marl were subjected to cell-tests and compression tests. A distinct part of the same sample was used for each of both tests.

The physical properties of one of the samples are given in fig. 1. All specimens had h = 14,5 cm, Ø = 6,54 cm. The results of the tests are given in fig. 8,9 and 10 and in table I.

SAMPLE 40500.

- cell-test: fig. 8a - table I.

In 14' 36" the sample was loaded to 2,53 kg/cm². After consolidation under this load circle (18) is obtained. The value φ = 34° is probably a little too high and the value c = 0,005 kg/cm² a little too small, because by considering the common tangent to the circles (1) and (18), the influence of the increase of compacity on the shearing-resistance is neglected.

Farther σ_t = 0,45 kg/cm². The sample having been taken at a depth of only 1,30 m, the value of σ_t indicates that the sample has been consolidated under capillary pressures.

W_c = 0,15 kg/cm².

- compression test: fig. 8b - table I.

q = 0,477 kg/cm² q' = 0,416 kg/cm² α = 57°

φ'' = 24° $W_{o,r}$ = 0,232 kg/cm² W'_o = 0,19 kg/cm².

$W_{o,r}$ and W'_o are again larger than W_c. The angle φ'' deducted from the observed plane of rupture is located between φ and φ'.

SAMPLE 40.499.

- cell-test: fig. 9a and table 1.

The value of φ is a little too high, that of c a little too small.

- compression- test: fig. 9b and table I.

The value of $W_{o,r}$ is larger than W_c. The angle φ'' is located between φ' and φ.

SAMPLE 40.497.

- cell-test: fig. 10a and table I.
- compression-test: fig. 10b and table I.

One gets $W_{o,r} \approx W_c$

In this case φ'' is smaller than φ.

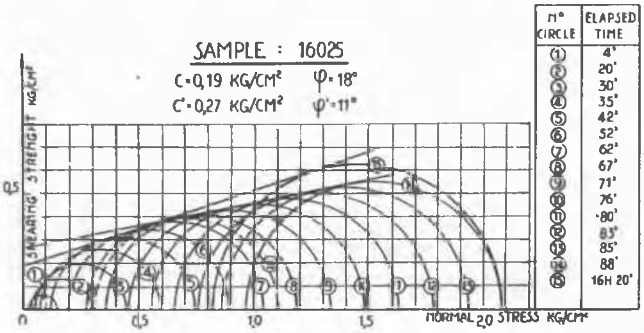


FIG.12a

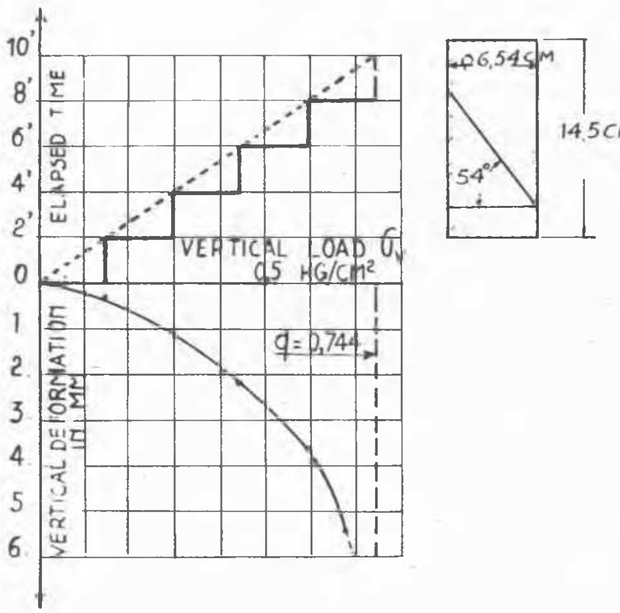


FIG.12b

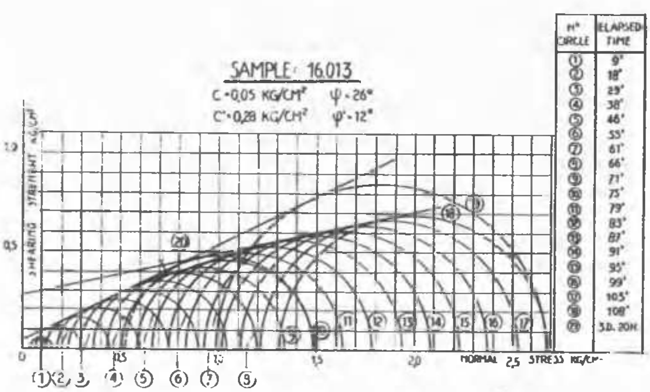


FIG.13a

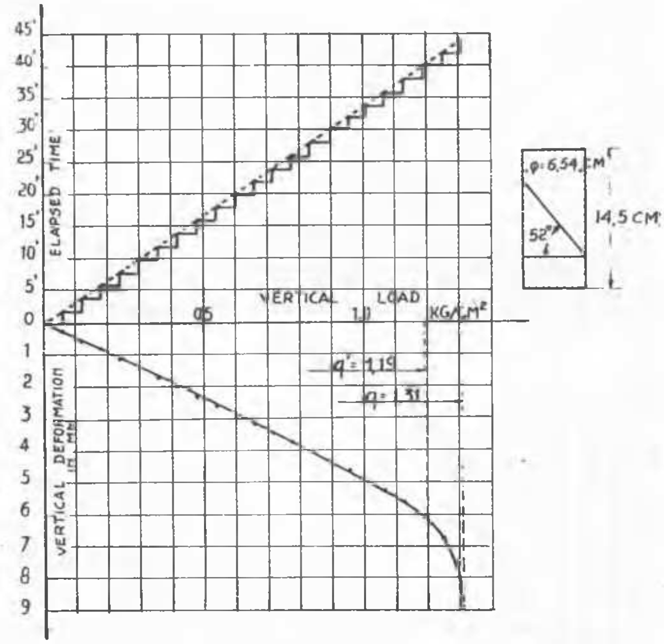


FIG.13b

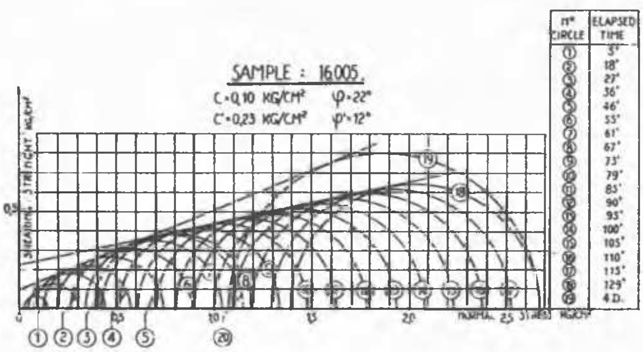


FIG.14a

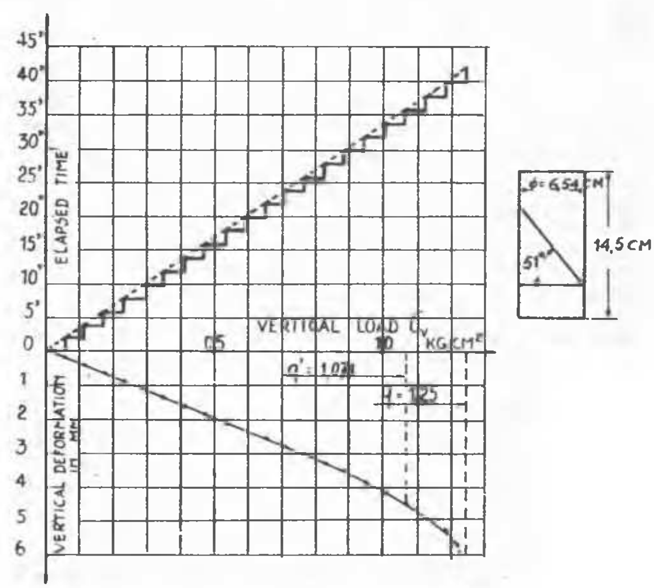


FIG.14b

D. UNDISTURBED SAMPLES OF TERTIARY CLAY (WETTEREN).

Eight samples were subjected to cell- and compressiontests. For each of both tests a distinct part of the same sample was used.

The physical properties of the sample and their location underneath the soil surface are given in fig. 1.

All specimens had h = 14,5 cm. Ø = 6,54 cm. The results of the tests are given in fig. 11 till 18, and in table I. The part "a" of each fig. gives the celltest, the part "b" the compression test. The compression test gives

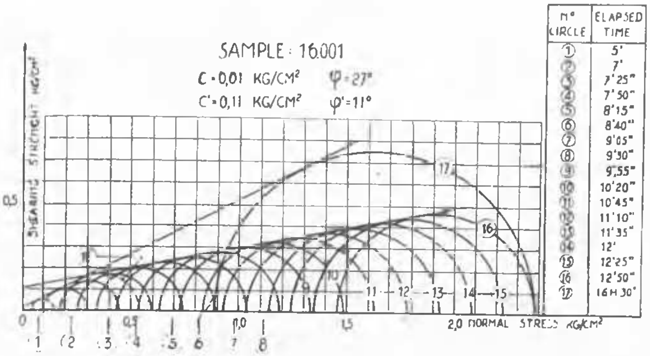


FIG.15a

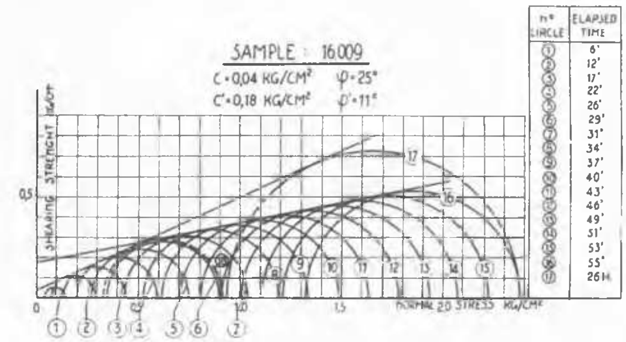


FIG.16a

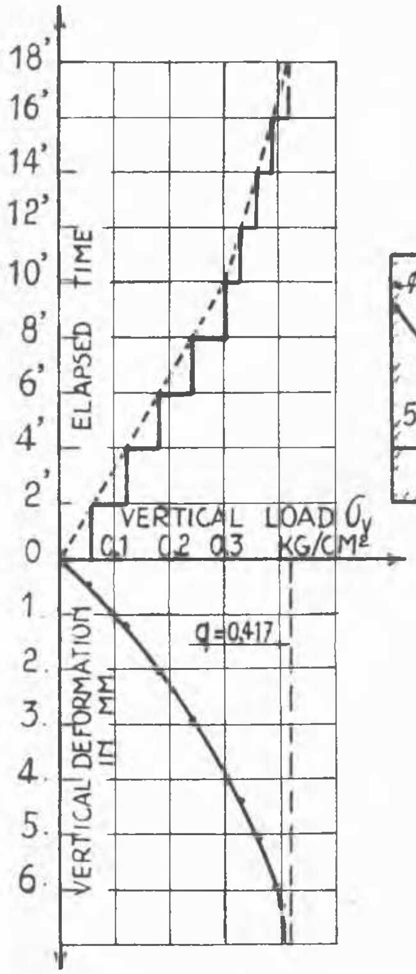


FIG.15b

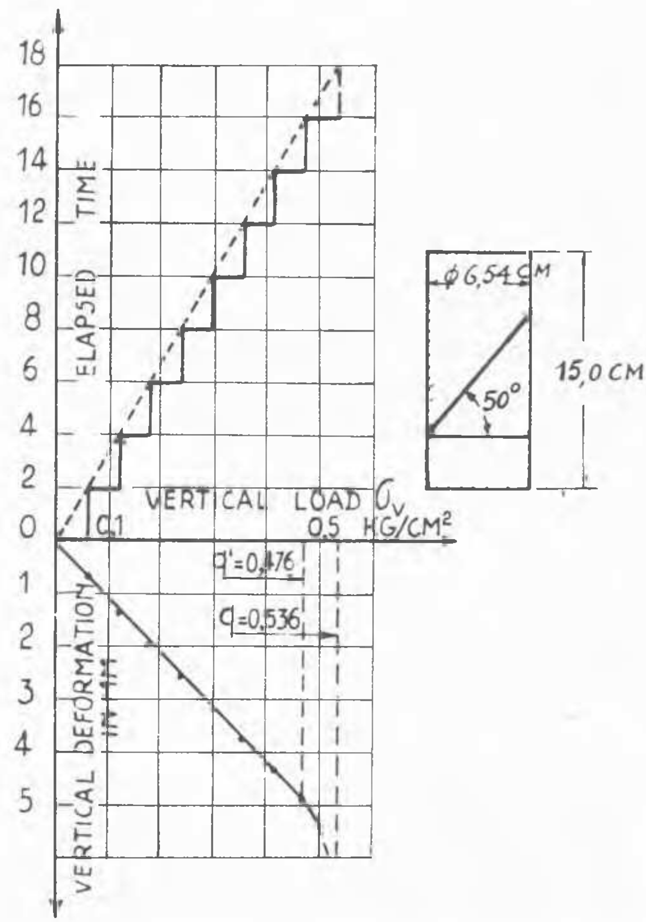


FIG.16b

tne load of failure q, the measured angle α , and the quantities $W_{o,r}$ and φ^* deducted from the measurements.

A trial was also made to deduct from the shape of the compression diagram a value q', from which the deformations start to increase rapidly.

It is difficult to determine exactly the value of q': thus this value is more or less arbitrary.

From these values q' the quantities W'_o are computed. Comparing the results of the compression tests with those of the cell-tests for the 8 samples tested, the following conclusions are obtained:

1) The values $W_{o.r}$ are generally noticeably larger than the values W_c of the cell-tests.
2) The values W'_o, which are difficult to determine exactly, are generally larger than or equal to those of W_c. For W_c the central value is located between 0,36 and 0,29 kg/cm^2, and the mean value is 0,318 kg/cm^2. For W'_o the central value is 0,354 kg/cm^2, and the mean value 0,386 kg/cm ^{2}.
3) The values of φ^* deducted from the planes of rupture are generally located between those of φ or φ' ,but are sometimes equal to one of these quantities.

GENERAL CONCLUSIONS.

1) The shearing-resistance deducted from the load of failure in compression tests is larger than that corresponding to the singular point of the cell-tests. If the latter is considered to be the shearing-resistance of

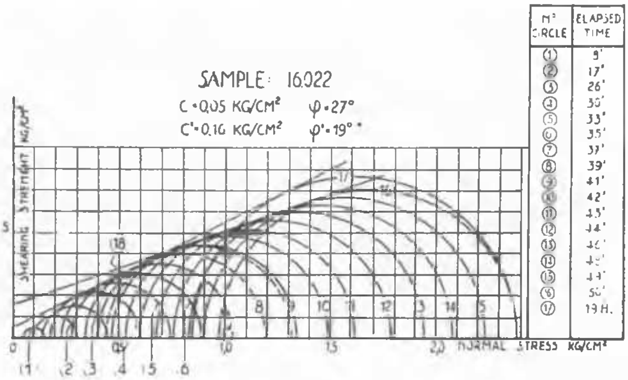


FIG.17a

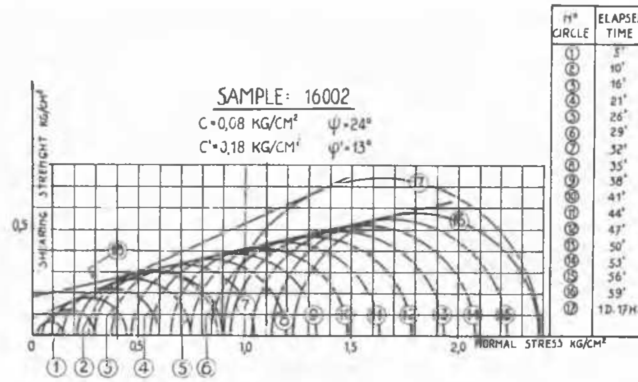


FIG.18a

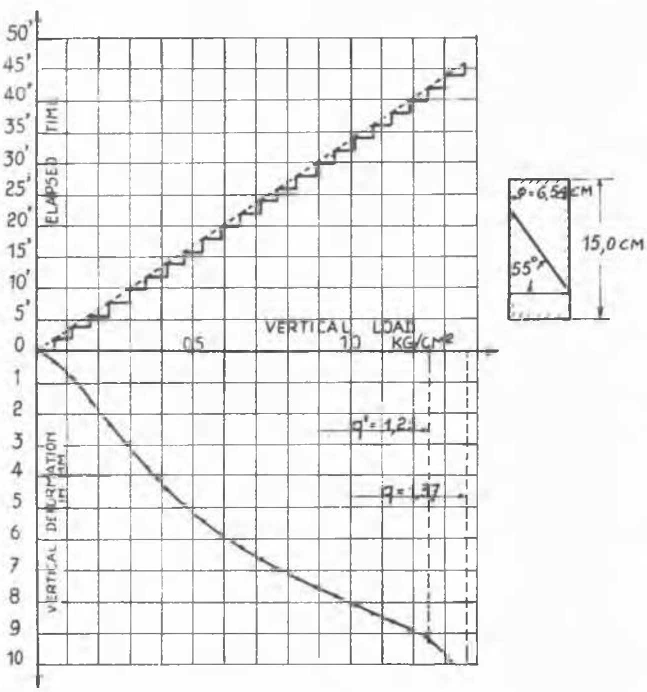


FIG.17b

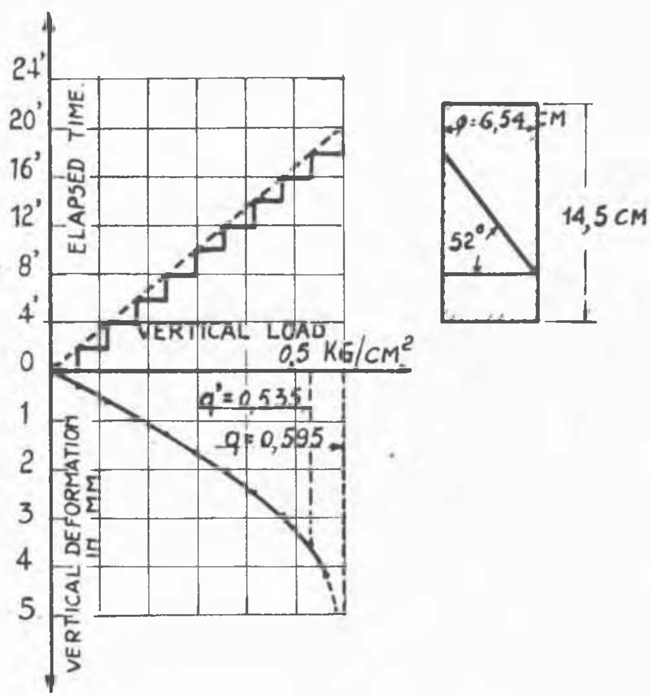


FIG.18b

the soil in its natural state, it is concluded that, for the tested samples of very various origin, the shearing-resistance increases in the compression test with the applied load, even when the watercontent remains constant. This increase becomes especially important when the deformations of the sample are large and is thus correlated to a structural resistance.

2) In the compression tests it is possible to fix, though in a rather arbitrary and not very exact manner, the load q' under which the first fissures appear, or from which in the diagram deformations-loads the former start increasing rapidly. The shearing-resistance W'_o corresponding to this load q', is generally still a little larger than the value W_c of the cell-test, but approaches more to this latter value. The better accordance is to be correlated to the fact that the deformations by constant volume being smaller for loads smaller than q', the influence of the structural resistance is less than for values higher than q'.

3) The influence of the structural resistance is also indicated by the results of the special cell-tests, where, by smaller deformation under the same state of stress, the shearing-resistance is smaller.

4) The apparent angles of friction φ', obtained in very quick cell-tests, thus practically performed by constant watercontent, are also considered to be produced for a large part by the influence of the structural resistance.

5) Finally, the good agreement between the values of the natural effective pressures $\sigma_{k.o}$ and the values σ_t deducted from the cell-tests, and also the good agreement of the magnitude of the values W_c and W'_o, indicate that the results of the cell-tests are at least as reliable as those of compression tests and of the quick triaxial tests.

But the cell-tests have the advantage that they give much more complete information concerning the shearing-resistance, and that they can be rapidly performed on one and the same sample.

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