UNIVERSITY OF CYPRUS

MEDICAL SCHOOL AND HEALTH SCIENCES

GEOTECHNICAL INVESTIGATION REPORT

Client: University of Cyprus

Nicosia, July 2017

SH Soil Engineering Ltd

CONTENTS

1. INTRODUCTION

The purpose of this Report is to give an account of the geotechnical investigations carried out at the site proposed for the construction of the "Nicos Shiacolas" Medical School and Health Centre of the University of Cyprus. The site is located within the Campus of the University of Cyprus in Athalassa area, which is situated at about 5.5 km South-East of the Nicosia Centre. Figure 1 shows the location of the site.

The aim of this geotechnical investigation was to establish the geotechnical profile at the site investigated, obtain the geotechnical characteristics and engineering properties of the strata encountered, and record the water table profile at the site.

The report describes the field and laboratory work carried out and includes all the results of the in-situ and laboratory tests performed. It presents the engineering properties of the soil layers encountered at the site during drilling and give typical values of their bearing capacity and the engineering parameters required to perform geotechnical calculations, such as foundation settlement, earth pressures on retaining walls etc.

The work was undertaken at the instruction of the Technical Services for the Development of the University Campus, after winning the relevant competition and the award of the Contract to SH Soil Engineering Ltd by the University of Cyprus, letter reference UC: EA/EA/396/17, dated 21 April 2017.

In 2004, our Company, carried out another geotechnical investigation at the same site by drilling 5 Boreholes with depths ranging from 7.50 to 10.50m. The Boreholes in the present Investigation had depths of 30 and 35m each.

2. FIELD WORK

The field work included the drilling of three boreholes with a total depth of 95,0m, the recovery of disturbed and undisturbed soil samples, in-situ testing and measurement of the water depth. A stand pipe was also installed in one of the boreholes for the observation of the water table variation.

The drilling was carried out using a "crawler" type rig, and the drilling method was "auger drilling" with continuous flight augers.

2.1 Boreholes

The three boreholes drilled were numbered BH1, BH2 and BH3 and had depths of 35, 30 and 30 metres respectively. Their position is shown on the Borehole Location Plan, Fig.2. As mentioned above, the boreholes were drilled using continuous flight augers and the resulting borehole diameter was 200mm. No casing of the boreholes was used.

The soil layers encountered in the boreholes are presented on the Borehole Records, Figs. 4 to 10, in Appendix A.

2.2 Sampling

Four types of soil samples were recovered from the boreholes during drilling:

(a) **Disturbed** representative bulk samples were recovered from the soil cuttings brought to the surface by the continues augers. These samples are suitable for identifying and describing the soil layers encountered and carrying out classification tests such as particle size distribution, Atterberg Limits etc.

(b) **Disturbed** samples recovered from the split spoon sampler of the Standard Penetration Tests. These are suitable for identifying and describing more accurately the soil layers encountered and performing classification tests as above.

(c) **Undisturbed** cohesive samples recovered from the split spoon sampler of the Standard Penetration Test. Apart from the above classification tests, these samples are suitable for performing Unconfined Compression Tests and in some cases Quick Undrained Triaxial Tests. In addition, they can be used for carrying out natural moisture content tests and natural density tests.

(d) **Six Undisturbed (U100)** samples were recovered from the khaki and grey Marl layers. In addition, three U100 samples were taken from the top layer of silty clay, overlying the Khaki Marl in Borehole 2. These three samples were taken on behalf and request of Dr. Demetrios Loukidis, lecturer at the University of Cyprus. The samples were taken using 100mm diameter by 460mm long U100 sampling tubes. Penetration of the tubes was effected by pushing them into the soil layers using the drilling rig equipment.

2.3 In-situ Testing

In-situ testing performed in the boreholes consisted of the Standard Penetration Test (SPT). The tests were performed at intervals of 3.00m. The total number of tests performed was 25 and the results are recorded on the Borehole Records. The SPT results are also presented graphically in Fig. 11. The tests were performed in accordance with BS 1377:90 titled

"Methods of Testing Soils for Civil Engineering Purposes". A standard split spoon sampler is driven into the soil to a depth of 450mm by the repeated blows of a 63.5 Kg standard penetration monkey trip hammer. The number of blows for every 150mm penetration is recorded. The penetration resistant "N" is defined as a number of blows required to drive the sampler into the soil the last 300mm.

In sandy gravel layers, the open split sampler is substituted by a closed cone sampler. In this case no sample is recovered.

3. LABORATORY TESTING

A program of laboratory testing was carried out on a selection of the disturbed and undisturbed samples recovered. The tests included classification tests (natural moisture content, particle size distribution, Atterberg limits, specific gravity, natural density), shear strength tests (unconfined compression and triaxial tests) swelling and consolidation tests on samples of the Marl. The number and type of tests carried out are outlined in the following sections and the results are presented in the relevant Figures in Appendix B and in tabular form in Tables 1 and 2.

The purpose of the laboratory tests was to establish the mechanical characteristics of the soil layers and obtain their engineering properties, which are required for the proper design of the foundations of the proposed structures.

3.1 Classification Tests

Classification tests carried out on selected samples included natural moisture content, liquid and plastic limit, particle size distribution by wet sieving and sedimentation (hydrometer) tests, specific gravity and density tests. The results of these tests enable the classification and correlation of the soil strata and their comparison with other tests such as SPT, shear strength and consolidation tests. They are also useful for a better understanding of the behaviour of the soil layers encountered.

3.1.1 Natural Moisture Content: A total of 37 natural moisture content tests were performed on cohesive samples of Khaki and grey Marl, recovered from the split spoon sampler and from the undisturbed U100 samples. The results are presented in a graphical form Fig. 12, where the moisture content was plotted against depth. They are presented in the Summary of Test Results Table 1 and recorded on Figures presenting the Unconfined Compression and Triaxial Tests.

The moisture content variation with depth of the Marl, Fig.12, shows some lower moisture content values at shallow depths. Over the depth range of 9,0 to 35,0m, the moisture content of the Marl recorded varies generally from 30 to 33.5%. At depths greater than 18.0m, the variation is even smaller (33.1 to 33.50%) with the exception of one low value of 28.9% and one higher value of 34.6%.

3.1.1 Atterberg Limits: The Liquid Limit of eight cohesive samples was found using the Cone Penetration Method. Their Plastic limits were also determined and hence their Plasticity Index obtained. The results are presented in Figures 13 to 20 and in the Summary of Tests Results, Table 1. Two of the samples were from the Khaki silty Marl and gave liquid limits of 69.0 and 70.0% with plastic limits of 31.7 and 32.5% and plasticity index of 42.7 and 37.5%. The other six samples were from the grey silty Marl giving Liquid Limits of 62.1 to 69.1%, plastic limits of 26.3 to 32.5% and plasticity index of 31.4 to 37.5%.

The above results have also been plotted on the Plasticity Classification Chart Figure 21. The results plot just above the A-line for all Marl Samples. According to the Chart, the khaki and grey Marl are classified as "Inorganic Clays of High Plasticity".

3.1.3 Specific Gravity: The specific gravity of six cohesive samples tested also for their particle size distribution (hydrometer) and consolidation characteristics was found. One of the khaki Marl gave specific gravity value of 2.88, whereas five samples of the grey Marl, gave values of 2.75 to 2.89.

3.1.4 Natural Density Tests: Thirty-five natural density tests were carried out on khaki and grey silty Marl samples. The density values obtained for the khaki and grey Marl was found to be very similar for the two types of Marl. They ranged between 18.7 and 21.0 kN/m^3 with an average value of 19.4 kN/m^3 . The results are presented in the Summary of test Results, Table 1 and on the Figures of the Unconfined Compression and Triaxial tests.

3.1.5 Particle Size Distribution: The particle size distribution of ten samples was determined. Six of the samples were cohesive Marl samples and the hydrometer (sedimentation) method was used for the finer particles and wet sieving for the coarser ones. The remaining 4 samples were non-cohesive, silty sands and gravels and the wet sieving method was adopted. The results are presented in Figures 22 to 31.

Two samples of the khaki Marl gave 23 and 30% clay size particles (less than 0.002mm) 54 and 60% Silt and 16 and 17% fine sand. Four samples of grey Marl gave 19 to 25% of clay, 47 to 61% silt and 9 to 31% fine sand.

The particle size distribution of the non-cohesive deposits, show a variation of silty Sands with Gravels ad sandy Gravels. Three gradings of predominantly sand samples gave sand content of 72 to 85% with gravel content of 0 to 5% and 6 to 20% silt. One gravel sample gave gravel content of 57% with sand content of 33 and 10% silt.

It must be mentioned that large size gravels were not included in the samples recovered from the boreholes since these could not be recovered by the drilling augers. Therefore, this should be born in mind when examining the particle size distribution curves of the sandy and gravelly layers.

3.2 Unconfined Compression Tests

Twenty two unconfined compression tests were performed on selected cohesive samples. Sixteen samples were of the grey Marl, five of the khaki Marl and one of the brown sandy Clay. The samples were recovered from the split spoon sampler and were considered suitable for these tests. The tests were performed using the triaxial compression machine with suitable attachments designed for such tests.

The stress-strain curves resulted from the tests are presented in Figures 32 to 42. The undrained cohesion c_u obtained from the 5 samples of the khaki silty Marl, ranged from 125 to 286 kN/m^2 with an average of 193 kN/m^2 . The 16 samples of the grey silty Marl gave c_u values of 95 to 207 kN/m^2 and the average was 147 kN/m^2 . The brown sandy sample gave a c_u value of 170 kN/m^2 .

The undrained cohesion c_u is taken as half of the maximum unconfined compression stress.

3.3 Triaxial Tests

Three sets of quick undrained triaxial tests were carried out on undisturbed samples, one from the khaki silty Marl and two from the grey silty Marl. The tests were performed on samples recovered from the U100 samplers. The samples tested had a diameter of 35mm and a height of 70mm. They were tested in the triaxial machine using cell pressures of 100, 200 and 300 kN/m^2 .

The stress-strain curves obtained with the corresponding Mohr circles of stresses are presented in Figs. 43 to 48. The undrained cohesion c_u obtained from the Mohr circle of stresses was 75 kN/m^2 for the khaki Marl with an angle of shearing resistance φ_u of 15^0,

whereas for the grey Marl, c_u was found to be 170 and 180 kN/m^2 and φ_u values of 10^0 and 9^0 respectively.

3.4 Swelling Pressure Tests

Swelling Pressure Tests were performed on undisturbed specimens which were also tested for their consolidation characteristics. The tests were performed in the Oedometer front loading machine on six Marl samples, one from the khaki Marl and five from the grey Marl. The specimens had a diameter of 50 mm and a thickness of 19.05mm.
After placing the specimen in the Oedometer machine, it was first loaded with a load approximately equal to its effective overburden pressure. Water was then added to the consolidation cell and the specimen observed for any swelling tendency. In case a tendency for swelling was observed, this was prevented by loading the specimen accordingly. The loads on the specimen and the corresponding time were recorded. The results are presented in Figs. 84 to 89.

The swelling pressure observed for two of the samples tested, was 25 kN/m^{2}and for the third one was 75 kN/m^2. The other three samples did not show any swelling tendency, and no swelling pressure was measured.

3.5 Consolidation Tests

After completion of the swelling pressure test, the consolidation test was started by adding load on the specimen and recording its compression at frequent time intervals. The load on the specimen was doubled every 24 hours until the maximum pressure of 1600 kN/m^2 was reached. The specimen was then unloaded in stages every 24 hours, allowing the specimen to swell and recording the swelling of the specimen at each load. From the compression measurements, the void ratio 'e' v_s log Pressure was produced and the modulus of volume change m_v and the coefficient of consolidation c_v were calculated.

Six consolidation tests were performed, one on a sample of the khaki Marl and five on samples of the grey Marl. The results are presented in Figures 49 to 83, and in Table 2.

4. SITE GEOLOGY

4.1 The Site

The proposed site for the Medical School is shown on the Location Plan in Fig.1 and on the Borehole Location Plan Fig.2. It has a rectangular shape approximately with approximate dimensions of 75x55m. The site slopes towards the Southeast having a steeper slope near its Northwestern boundary. The only vegetation existing on the site was dry grass.

4.2 General Geology

A stream, named Kaloyeros, flows from Southwest to Northeast, separating the University Campus in two. A valley of about 400 to 500 meters wide extends on both sides of the stream.

The main bedrock in the broader area of the University Campus is the Marl of the Nicosia-Athalassa Formation. The Marl is stiff to hard and has a yellowish-khaki colour. The khaki Marl is underlain by the grey Marl which is usually more silty and sandy.

The Marl is overlain by younger deposits, such as the Fanglomerates, composed mainly of gravels in a calcareaous silty sand matrix with a variable degree of cementation. This layer is found on the hillsides or on top of the hills on either side of the valley. Talus, or hill wash material, usually composed of brown clayey sandy silty or sandy silty clay is found on the lower part of the hill slopes and in the stream valley.

Finally, the stream valley is covered by Alluvium deposits composed of sands and sandy gravels. The overall depth of the Alluvium deposits reaches a maximum of 9.0 metres.

4.3 Information from Boreholes

The strata encountered by the three boreholes drilled is shown on the Borehole Records Figs. 4 to 10 and in the Geological Section Fig. 3 and may be distinguished into three main layers:

The first layer, i.e. the uppermost layer, is composed of brown sandy clays or brown clayey sands with some gravel in places. This layer was most probably formed from slope-wash material. A thin layer of top soil covers this layer. The maximum thickness of this layer was found to be 7.0m in Borehole 3.

The second layer is the khaki silty Marl which is stiff to hard, with a considerable variation in thickness. This layer has a greater thickness in the Northwestern part of the site where the

thickness of the first layer is smaller. The thickness of this layer was found to vary from 3.0m to 9,50m.

The bottom layer is the stiff to hard grey silty sandy Marl below the khaki Marl, which extends down to considerable depth.

4.4 Ground Water

Ground water was encountered during drilling in all Boreholes. The depth of the water was measured and the water table was found to be at about the same elevation (about 127,0 m) in Boreholes 2 and 3, and higher in Borehole 1. The recorded water depths are given on the Borehole Records and have been plotted on the Geological Section, Figure 3.

5. ENGINEEERING PROPERTIES OF STRATA

The laboratory test results have been presented in Section 3. The engineering properties of the layers encountered are presented in this section and are based on the laboratory test results and the in-situ testing.

5.1 First Layer

Visual examination of samples and the particle size distribution obtained from the grading tests of the first layer, shows a variation of silty Sands and sandy Clays with the presence gravels in places. This layer is quite variable both in texture and engineering characteristics.

Only three Standard Penetration Tests were carried out in this layer which gave values of Standard Penetration Resistance N ranging from 30 to 35 with an average value of 32. The unconfirmed compression test on one sample gave a c_u value of 170 kN/m^2.

5.2 Khaki Marl

A number of tests were performed on samples of this layer, i.e. classification tests, shear strength tests and compressibility tests. Also in-situ SPT tests were performed.

5.2.1. Classification Tests

For the natural moisture content, Atterberg Limits, natural density and particle size distribution, please refer to Section 3.

5.2.2. Standard Penetration Resistance

The Standard Penetration Resistance values measured for the khaki Marl are shown on the Borehole Records and have been plotted in Figure 11. Five SPTs were performed in this layer. The N values measured ranged from 29 to 59 giving an average of 40.

5.2.3. Shear Strength

In addition to the Standard Penetration tests, in order to assess the shear strength of the khaki Marl, one set of quick undrained triaxial test and four tests of unconfined compression have been carried out. The undrained cohesion c_u obtained from the unconfined compression tests on of the khaki Marl ranged from 125 to 286 with an average of 193 kN/m^2.

The triaxial test performed on samples of the khaki Marl gave a c_u value of 75 kN/m^2 and ϕ_u of 15°.

5.2.4 Modulus of Elasticity Es

The modulus of elasticity Es of the khaki Marl can be estimated from the stress-strain curves of the unconfined compression and triaxial test. Using the triaxial stress-stain curves this was estimated to have a value of 16,000 kN/m^2. A value of 21.000 kN/m^2 was obtained from the unconfined compression tests. The in-situ Es, however, is almost 2 to 5 times greater than the values estimated from the stress-strain curves. Therefore, an approximate value for Es for the khaki Marl of the order of 70,000 kN/m^2 may be taken.

5.2.5. Swelling and Compressibility of the Marl

One specimen of the Khaki Marl tested for its swelling potential developed a swelling pressure of 25 kN/m^2.

By plotting the plasticity index and clay fraction of the Marl on the Chart for Expansiveness of Soils, Fig. 90, the expansiveness of the khaki Marl is indicated to be 'high'.

The values of the coefficient of volume change m_v of the khaki Marl were found to range between 3.93 to 6.25 $x10^{-5}$ m^2/kN with an average value of $5.06x10^{-5}$ m^2/kN. The values of m_v are used to estimate the amount of consolidation settlement of foundations. Consolidation settlement can also be estimated using the e-log p curve obtained, Fig 60.

The coefficient of consolidation c_v was found to vary from 3.57 to 6.91 m^2/year with an average of 5.13 m^2/year. The c_v values are used to estimate the time (number of years) taken for the consolidation settlement to be completed.

5.3 Grey Marl

The engineering properties of the grey Marl are very similar to those of the khaki Marl.

5.3.1 Standard Penetration Resistance

Seventeen SPTs were performed in the grey Marl layer. The N values recorded are presented on Fig. 11. Fifteen N values ranged from 27 to 44 with an average value of 33. Two higher values of 48 and 52 were also recorded.

5.3.2 Shear Strength

The 16 samples of the grey Marl gave c_u values of 95 to 207 kN/m^2 and their average was 147 kN/m^2.

Two sets of triaxial tests performed gave undrained cohesion c_u of 170 and 180 kN/m^2 and angle of shearing resistance ϕ_u of 10° and 9^0 respectively.

5.3.3 Swelling and Consolidation

Two of the five samples tested has shown a swelling pressure of 25 and 75 kN/m^2. The other three samples did not show any swelling tendency and therefore no swelling pressure was recorded.

The plot in Figure 90, of the plasticity index and clay fraction of the sample, shows that the grey Marl has a high expansiveness potential.

The coefficient of volume change m_v was found to vary from 3.44 to $6.5x10^{-5}m^2/kN$ with an average of $4.35x10^{-5}$ m^2/kN and the coefficient of consolidation c_v, varied from 4.09 to 6.37 m^2/year with an average of 5.42 m^2/year.

6. BEARING CAPACITY AND SETTLEMENT OF FOUNDATIONS

The Bearing Capacity of the strata encountered and the settlement of the foundations depend not only on the engineering properties of the strata but on the type, shape and depth of the foundations to be adopted. Hence, the allowable bearing capacity values given below, are only indicative. The bearing capacity and settlement of foundations can be found when the foundation loads, their depth and type are known.

6.1 Bearing Capacity

6.1.1 Top silty clayey Sand or Sandy Clays

(a) The allowable bearing capacity for this layer, can be estimated using the empirical relationship between standard penetration resistance and allowable bearing pressure proposed by Terzaghi and Peck. This correlation was intended to limit the foundation settlement to a maximum of 25 mm.

Using the average value of Standard Penetration Resistance of 3 measurements of 35, for a foundation width of 1.50m, the allowable bearing capacity obtained from the relevant chart is 400 kN/m^2.

(b) For the sandy clay, assuming a $\phi_u=0$ and taking c_u= 170 kN/m^2 , which was the only value measured, the safe Bearing Capacity of isolated foundations may be estimated using Skempton's bearing capacity formula

$$q_{safe}=(c_u N_u)/ F + \gamma'D$$

where: c_u=undrained cohesion, kN/m^2

N_c = Bearing capacity factor

F= factor of safety

$\gamma'D$ = effective overburden at foundation level

For a square foundation of 1.5 m at a depth of 2.5m, N_c=8.3 and assuming F=4.0, q_{safe} is calculated to be 400 kN/m^2. In order to minimize settlement, an Allowable Bearing Capacity of 300 kN/m^2 can be adopted.
Since the sandy Clays and clayey Sands cannot be differentiated, a safe value of 300 kN/m^2 could be adopted.

6.1.2 Khaki Marl

For foundations resting on the upper part of the khaki Marl layer, the bearing capacity can be estimated assuming ϕ_u=0 and c_u=190 kN/m^2 (conservative assumption) and a factor of safety of 3.0, the safe bearing capacity is found to be 575 kN/m^2. A higher bearing capacity will result if the values of ϕ_u = 15^0 and c_u = 75 kN/m^2 obtained from the triaxial test are used with the relevant bearing capacity coefficients.

6.2 Settlement

Foundation settlement would not exceed 25 mm for foundations constructed on the uppermost layer under the assumptions made in sections 6.1.1 and 6.1.2 above, and using the allowable pressures stated. In view of the variability of these layers, this should be checked by carrying out settlement calculations during the design of the foundations.

For foundations constructed on the khaki or grey Marl on large in size foundations (raft foundations) which impose stresses on the Marly layers, foundation settlement '**s**' is made up of the immediate elastic '$\mathbf{s_i}$' and consolidation settlement '$\mathbf{s_c}$'.

$$\mathbf{s = s_i + s_c}$$

Now $$\mathbf{s_i = \mu_o \mu_i \times q\, B/E_s}$$

Where:

μ_o and μ_i depend on the depth and size of the foundation and are obtained from Charts published by Janbu and Bjerrum

q is the effective bearing pressure

B is the foundation width

Es is the elastic or compressibility modulus

The consolidation settlement $\mathbf{s_c = \mu \Sigma m_v \Delta_\sigma h}$

Where:

μ = coefficient of settlement (0.5 for overconsolidated clays)

m_v = coefficient of volume change

Δ_σ= change in stress due to foundation load

h= thickness of clay layer considered

Values of Δ_σ for the various soil layers considered, are calculated using the appropriate 'Influence coefficients' found from relevant charts.

7. CONCLUSIONS AND RECOMMENDATIONS

The strata encountered by the boreholes drilled may be divided into three layers:

The top layer which is composed of brown clayey, silty Sand or sandy Clay, with the presence of some gravel in places. It is a layer of variable shear strength and characteristics. The estimated allowable bearing capacity for this layer, calculated for a 1.5 m square footing placed at 2.5 m depth, is 300 kN/m^2. Foundation settlement for such footing is expected to be not greater than 25 mm.

The underlying "middle" layer is the khaki Marl which has relatively high shear strength. The allowable bearing capacity for a 1.5m square foundation at 2.5m depth was calculated to 500 kN/m^2 in order to keep the settlement to acceptable limits.

The bottom layer, the grey Marl, is more silty and sandy with shear strength values of the same order as for the khaki Marl.

Any type of foundation can be used on the above layers, such as isolated pad footings, strip footings, raft and piles. However, in view of the different nature of the above layers, and the possibility of the foundations of the same building to bear on different layers, the foundation type, bearing capacity and foundation settlement should be considered carefully and relevant calculations performed by an experienced geotechnical engineer using the engineering parameters given in this report. It is recommended that the foundation depth should not be less than 2.5m.

Consultation with a Geotechnical Engineer during the design of the foundations is strongly recommended. Professional consideration of the engineering properties and extensive calculations for the bearing capacity and settlement of the foundations should be made in order to achieve both safe and economic foundations.

Due to rapid deterioration of the Marl when exposed, it is very important to keep such exposure to minimum. As soon as the excavation for the foundation is completed and the bottom of the excavation cleaned carefully, it should be covered with a blinding concrete of about 80mm thick. The construction of the foundations should proceed and completed as soon as possible. Drying and wetting of the bottom of excavations in the Marl should be avoided. The excavation sides, especially in Marl layers, should also be protected from drying or wetting.

For the construction of piles, `especially below the water table, a concrete with water / cement ratio of 0.50 is recommended. Adequate vibration of concrete should be used during the construction of the piles in order to avoid the formation of voids in the concrete.

APPENDIX A

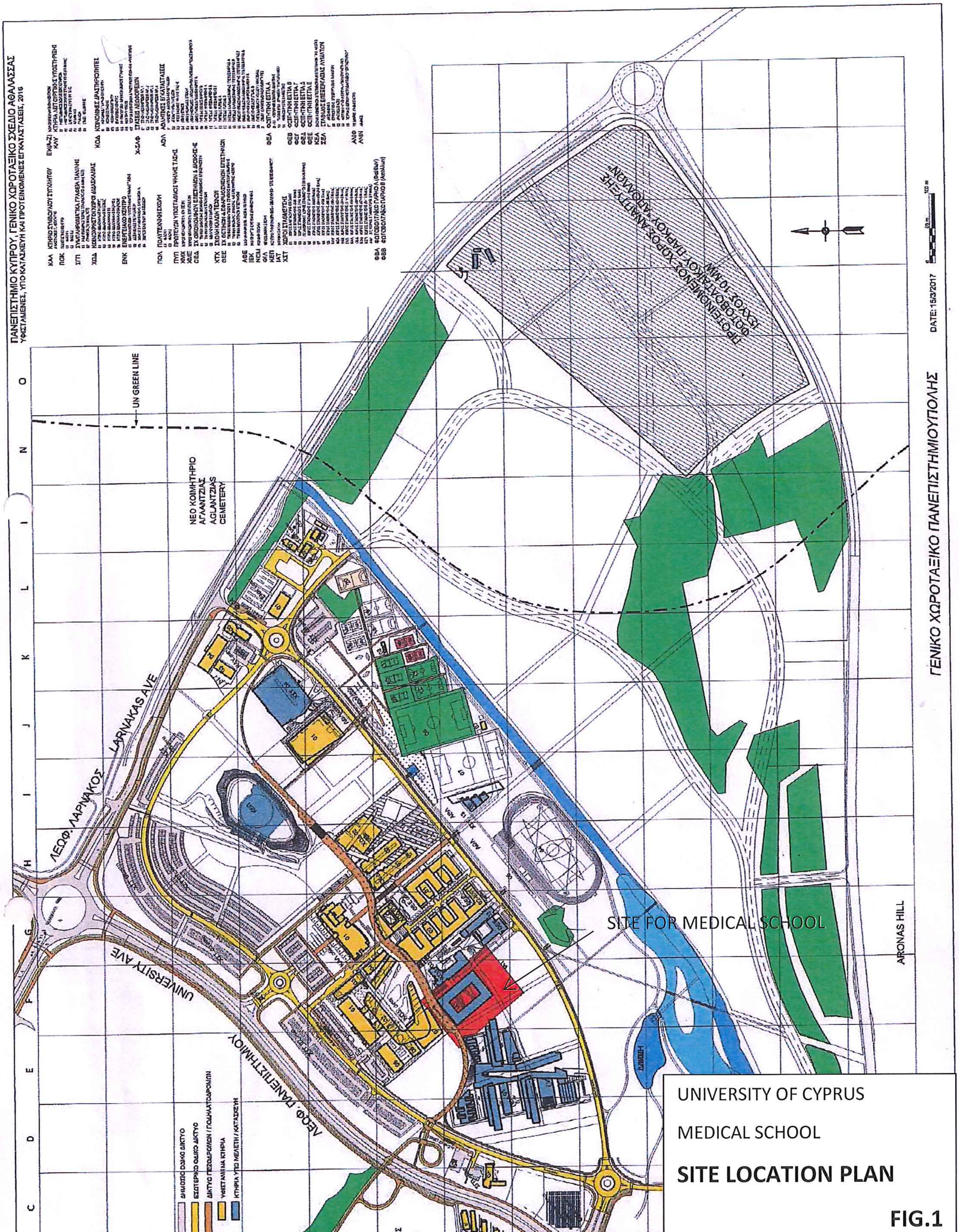
Fig.1: Site Location Plan

Fig. 2: Borehole Location Plan

Fig.3: Geological Section

Fig.4 to 10: Borehole Records

Fig.11: SPT Results



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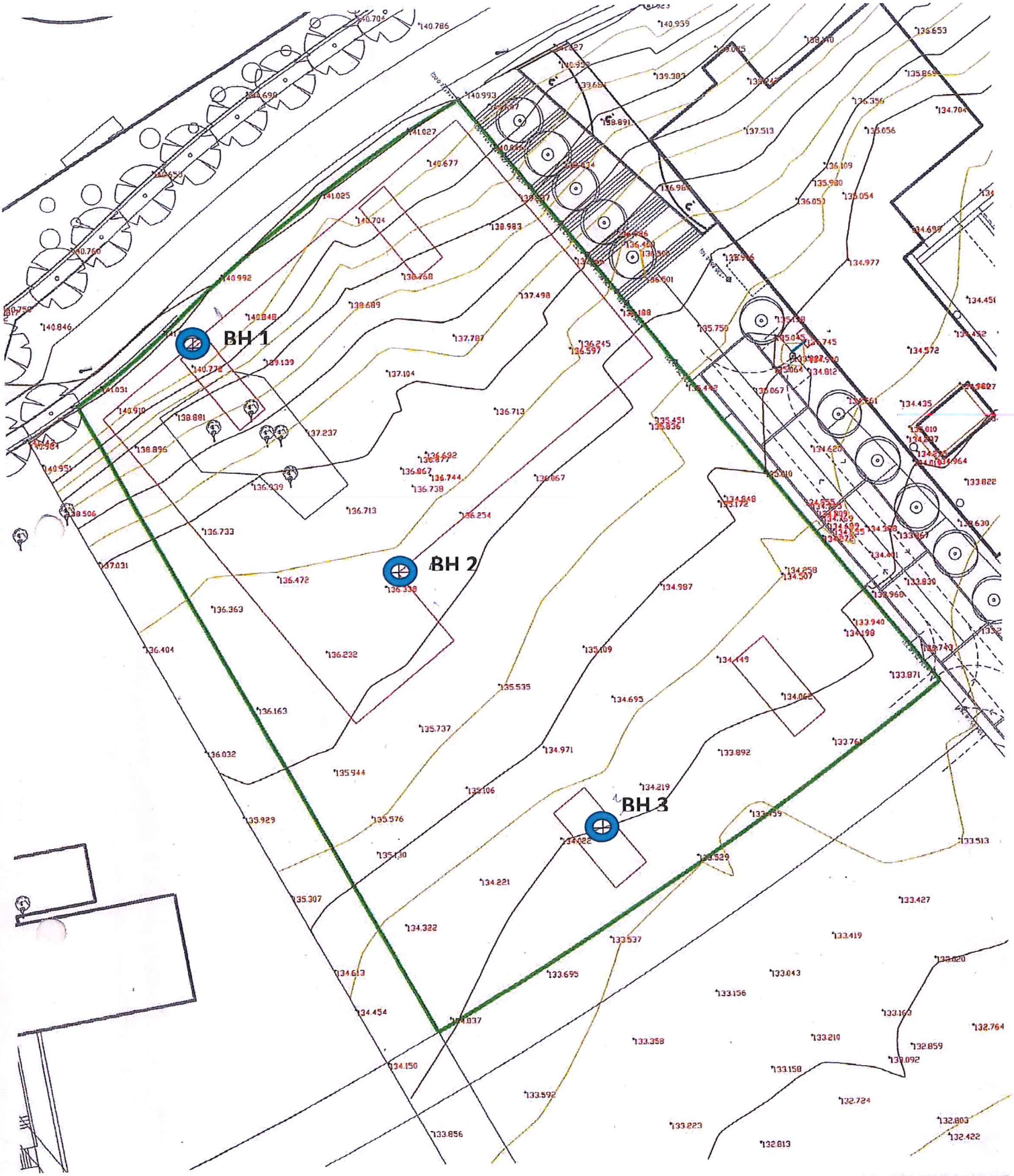
SITE LOCATION PLAN

FIG.1



⊕ 3 NEW BAREHOLES BELOW THE FUTURE EARTH RETAINING WALLS AND CONCRETE CORE

BOREHOLE LOCATION PLAN **FIG 2**

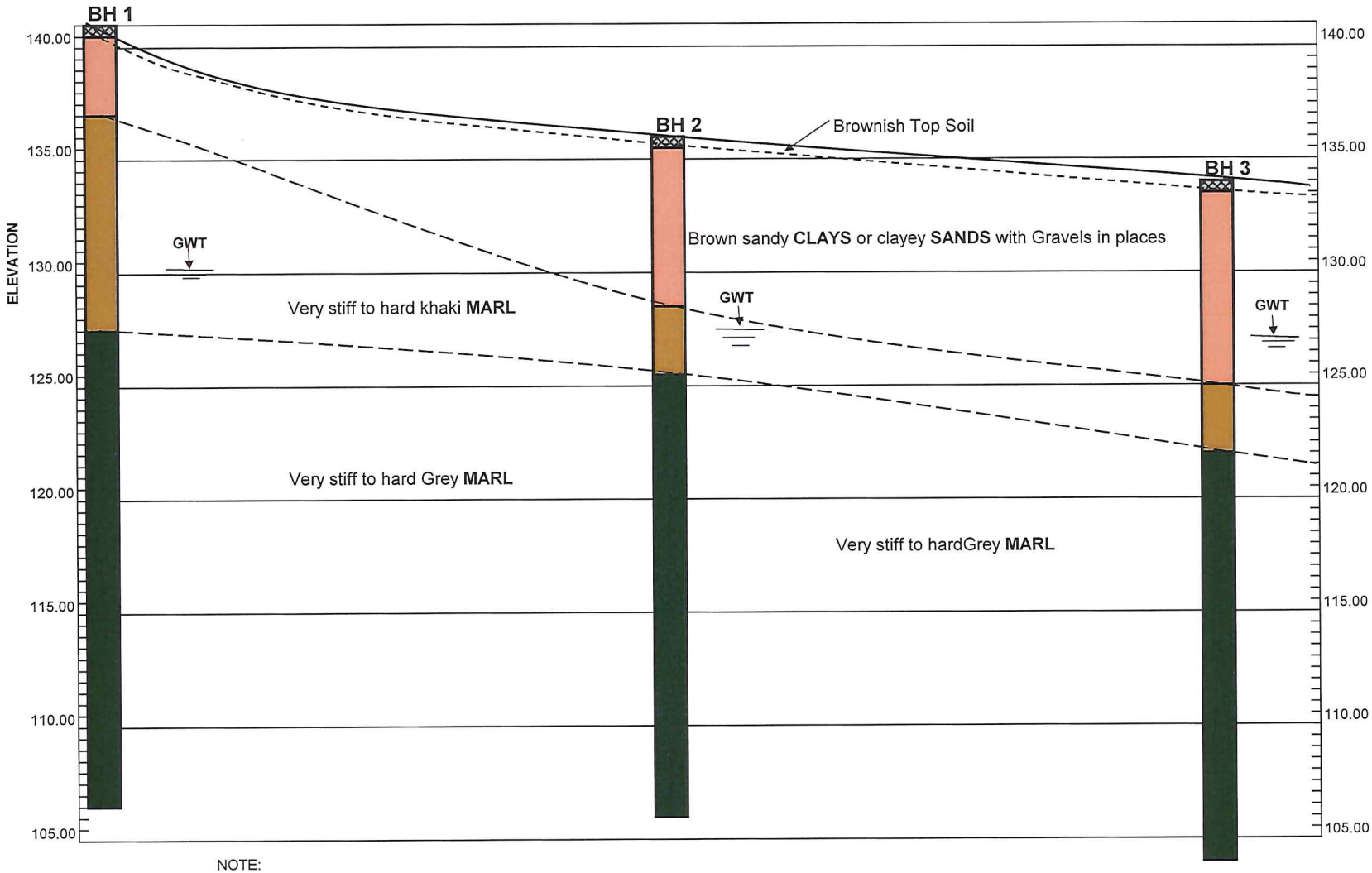
ΤΙΤΛΟΣ ΕΡΓΟΥ / PROJECT TITLE

MEDICAL SCHOOL AND HEALTH SCIENCES BUILDING "NICOS K. SHAKOLAS"

ADITIONAL GEOTECHNICAL SURVEY
NEW BAREHOLES PLACEMENT

FEB-2017

1: 500



NOTE:
Drawn boundaries between layers are infered, based on the borehole findings and are not exact

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GEOLOGICAL SECTION FIG.3

BOREHOLE RECORD

SURFACE LEVEL: *141.0 m approx.**
DATE STARTED: *18/05/17*
DRILLING METHOD: *Auger drilling*
**from contour plan*

NOMINAL B.H. DIA.: *200mm*
DATE COMPLETED: *19/5/17*

BH.NO./Sht No. BH1/1
SCALE: *1:100*

STRATA	B.H. LOG	B.H. DEPTH (m)	SAMPLE & SPT	SAMPLE & SPT DEPTH (m)	S.P.T. NUMBER N	GROUND WATER & REMARKS
Brown sandy **TOP SOIL**		0.50				
Light brown silty sandy **CLAY** or fine clayey **SAND** with gravel in places						
			●			
			s∇	3.00-3.45	35	
		4.00				Depth of water on 29/05/17
Very stiff khaki silty **MARL** greyish in places			●			was 11,00m
			s∇	6.00-6.45	59	
			●			
			●			
			s∇	9.00-9.45	30	
			●			
			s∇	12.00-12.45	29	
		13.50	●			
Very stiff dark grey silty **MARL** sandy in places						
Borehole continues on sheet 2		15.00				s=split spoon sampler
						c=closed cone sampler

UNDISTURBED □ {No} **SAMPLE U100** {Blows}	**DISTURBED SAMPLE** ●	**WATER SAMPLE** 0	**BULK SAMPLE** ⇓	**STANDARD PENETRATION TEST** s∇c

Project **Medical School**	Location **University Campus**	INVESTIGATION No. 17/05/01
client **University of Cyprus**	engineer **Elena Anaxagora**	**BOREHOLE No. BH 1 (1)**

BOREHOLE RECORD

SURFACE LEVEL: *141.0 m approx.**
DATE STARTED: *18/05/17*
DRILLING METHOD: *Auger drilling*
**from contour plan*

NOMINAL B.H. DIA.: *200mm*
DATE COMPLETED: *19/5/17*

BH.NO./Sht No. BH1/2
SCALE: *1:100*

STRATA	B.H. LOG	B.H. DEPTH (m)	SAMPLE & SPT	SAMPLE & SPT DEPTH (m)	S.P.T. NUMBER N	GROUND WATER & REMARKS
Borehole continues from sheet 1		15.00				
Very stiff dark grey silty **MARL** sandy in places			□	15.00-15.45		U100 by pushing
			●			
				18.00-18.45	28	
			s∇			
			●	21.00-21.45	33	
			s∇			
			●			
			□	24.00-24.45		U100 by pushing
			●			
			s∇	27.00-12.45	44	
			●			
Borehole continues on sheet 3		30.00				s=split spoon sampler
						c=closed cone sampler

UNDISTURBED □ {No} SAMPLE U100 {Blows}	DISTURBED SAMPLE ●	WATER SAMPLE 0	BULK SAMPLE ⇓	STANDARD PENETRATION TEST s∇c

Project **Medical School**	Location **University Campus**	INVESTIGATION No. 17/05/01
client **University of Cyprus**	engineer **Elena Anaxagora**	**BOREHOLE No. BH 1 (2)**

SH Soil Engineering Ltd, Fokionos 14, 1010 Nicosia. **FIG. 5**

BOREHOLE RECORD

SURFACE LEVEL: *141.0 m approx.**
DATE STARTED: *18/05/17*
DRILLING METHOD: *Auger drilling*
**from contour plan*

NOMINAL B.H. DIA.: *200mm*
DATE COMPLETED: *19/5/17*

BH.NO./Sht No. BH1/3
SCALE: *1:100*

STRATA	B.H. LOG	B.H. DEPTH (m)	SAMPLE & SPT	SAMPLE & SPT DEPTH (m)	S.P.T. NUMBER N	GROUND WATER & REMARKS
Borehole continues from sheet 2		30.00				
Very stiff dark grey silty **MARL** sandy in places			s∇	30.00-30.45	33	
			●			
			●			
			s∇	33.00-33.45	35	
			●			
Bottom of Borehole		35.00	s∇	35.00-35.45	48	
						s=split spoon sampler
						c=closed cone sampler

UNDISTURBED ☐ {No} SAMPLE U100 {Blows}	DISTURBED SAMPLE ●	WATER SAMPLE 0	BULK SAMPLE ⇓	STANDARD PENETRATION TEST s∇c

Project **Medical School**	Location **University Campus**	INVESTIGATION No. 17/05/01
client **University of Cyprus**	engineer **Elena Anaxagora**	**BOREHOLE No. BH 1 (3)**

SH Soil Engineering Ltd, Fokionos 14, 1010 Nicosia . ***FIG. 6***

BOREHOLE RECORD

SURFACE LEVEL: *136.33 m approx.**
DATE STARTED: *22/05/17*
DRILLING METHOD: *Auger drilling*
**from contour plan*

NOMINAL B.H. DIA.: *200mm*
DATE COMPLETED: *27/05/17*

BH.NO./Sht No. BH2/1
SCALE: *1:100*

STRATA	B.H. LOG	B.H. DEPTH (m)	SAMPLE & SPT	SAMPLE & SPT DEPTH (m)	S.P.T. NUMBER N	GROUND WATER & REMARKS
Brown sandy **TOP SOIL**		0.50				
Light brown silty clayey **SAND** at top, changing to light brown silty sandy **CLAY**		1.50	●			
			□	1.60-1.95	(45)	U100 with blows
			●			
						Depth of water
			●			was 9.00m
			□	4.50-4.95		U100 by pushing
			□	6.00-6.40		U100 by pushing
			●			
		7.50				
Very stiff khaki silty **MARL**			s∇	7.50-7.95	53	
			●			
			□	9.00-9.45		U100 by pushing
		10.50	●			
Very stiff dark grey silty **MARL** sandy in places						
			●			
			s∇	12.00-12.45	29	
			●			
Borehole continues on sheet 2		15.00				s=split spoon sampler
						c=closed cone sampler

UNDISTURBED □ {No} SAMPLE U100 {Blows}	DISTURBED SAMPLE ●	WATER SAMPLE 0	BULK SAMPLE ⇓	STANDARD PENETRATION TEST s∇c

Project **Medical School**	Location **University Campus**	INVESTIGATION No. 17/05/01
client **University of Cyprus**	engineer **Elena Anaxagora**	**BOREHOLE No. BH 2 (1)**

BOREHOLE RECORD

SURFACE LEVEL: *136.33 m approx.** **NOMINAL B.H. DIA.:** *200mm* **BH.NO./Sht No. BH2/2**
DATE STARTED: *22/05/17* **DATE COMPLETED:** *27/05/17* **SCALE:** *1:100*
DRILLING METHOD: *Auger drilling*
**from contour plan*

STRATA	B.H. LOG	B.H. DEPTH (m)	SAMPLE & SPT	SAMPLE & SPT DEPTH (m)	S.P.T. NUMBER N	GROUND WATER & REMARKS
Borehole continues from sheet 1		15.00				
Very stiff dark grey silty **MARL**			□	15.00-15.40		U100 by pushing
sandy in places			●			
			s∇	18.00-18.45	28	
			●			
			s∇	21.00-21.45	34	
			●			
			●			
			s∇	24.00-24.45	37	
			●			
			s∇	27.00-12.45	52	
			●			
						s=split spoon sampler
Bottom of Borehole		30.45	s∇	30.00-30.45	34	c=closed cone sampler

UNDISTURBED □ {No} SAMPLE U100 {Blows}	DISTURBED SAMPLE ●	WATER SAMPLE O	BULK SAMPLE ⇓	STANDARD PENETRATION TEST s∇c

Project **Medical School**	Location **University Campus**	INVESTIGATION No. 17/05/01
client **University of Cyprus**	engineer **Elena Anaxagora**	**BOREHOLE No. BH 2 (2)**

BOREHOLE RECORD

SURFACE LEVEL: *134.0 m approx.**
DATE STARTED: *16/05/17*
DRILLING METHOD: *Auger drilling*
**from contour plan*

NOMINAL B.H. DIA.: *200mm*
DATE COMPLETED: *17/5/17*

BH.NO./Sht No. BH3/1
SCALE: *1:100*

STRATA	B.H. LOG	B.H. DEPTH (m)	SAMPLE & SPT	SAMPLE & SPT DEPTH (m)	S.P.T. NUMBER N	GROUND WATER & REMARKS
Brown sandy **TOP SOIL**		0.50				
Light brown silty sandy **CLAY** or fine clayey **SAND** with gravel in places						
			●			
			s∇	3.00-3.45	30	
						Depth of water on 29/05/17
			●			was 7,00m
			s∇	6.00-6.45	32	
			●			
		9.00	●			
Very stiff khaki silty **MARL**			s∇	9.00-9.45	29	
			●			
		12.00				
Very stiff dark grey silty **MARL** sandy in places			s∇	12.00-12.45	27	
			●			
Borehole continues on sheet 2		15.00				s=split spoon sampler
						c=closed cone sampler

UNDISTURBED □ {No} **SAMPLE** U100 {Blows}	**DISTURBED SAMPLE** ●	**WATER SAMPLE** 0	**BULK SAMPLE** ⇓	**STANDARD PENETRATION TEST** s∇c

Project **Medical School**	Location **University Campus**	INVESTIGATION No. 17/05/01
client **University of Cyprus**	engineer **Elena Anaxagora**	**BOREHOLE No. BH 3 (1)**

BOREHOLE RECORD

SURFACE LEVEL: *134.0 m approx.**
DATE STARTED: *16/05/17*
DRILLING METHOD: *Auger drilling*
**from contour plan*

NOMINAL B.H. DIA.: *200mm*
DATE COMPLETED: *17/5/17*

BH.NO./Sht No. BH3/2
SCALE: *1:100*

STRATA	B.H. LOG	B.H. DEPTH (m)	SAMPLE & SPT	SAMPLE & SPT DEPTH (m)	S.P.T. NUMBER N	GROUND WATER & REMARKS
Borehole continues from sheet 1		15.00				
Very stiff dark grey silty **MARL** sandy in places			□	15.00-15.45		U100 by pushing
			●			
			s∇	18.00-18.45	28	
			●			
			s∇	21.00-21.45	33	
			●			
			●			
			□	24.00-24.45		U100 by pushing
			●			
			s∇	27.00-12.45	44	
			●			
						s=split spoon sampler
Bottom of Borehole		30.45	s∇	30.00-30.45	31	c=closed cone sampler

UNDISTURBED □ {No} SAMPLE U100 {Blows}	DISTURBED SAMPLE ●	WATER SAMPLE 0	BULK SAMPLE ⇓	STANDARD PENETRATION TEST s∇c

Project **Medical School**	Location **University Campus**	INVESTIGATION No. 17/05/01
client **University of Cyprus**	engineer **Elena Anaxagora**	**BOREHOLE No. BH 3 (2)**

STANDARD PENETRATION RESISTANCE

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

Soil: Khaki & grey silty Marl

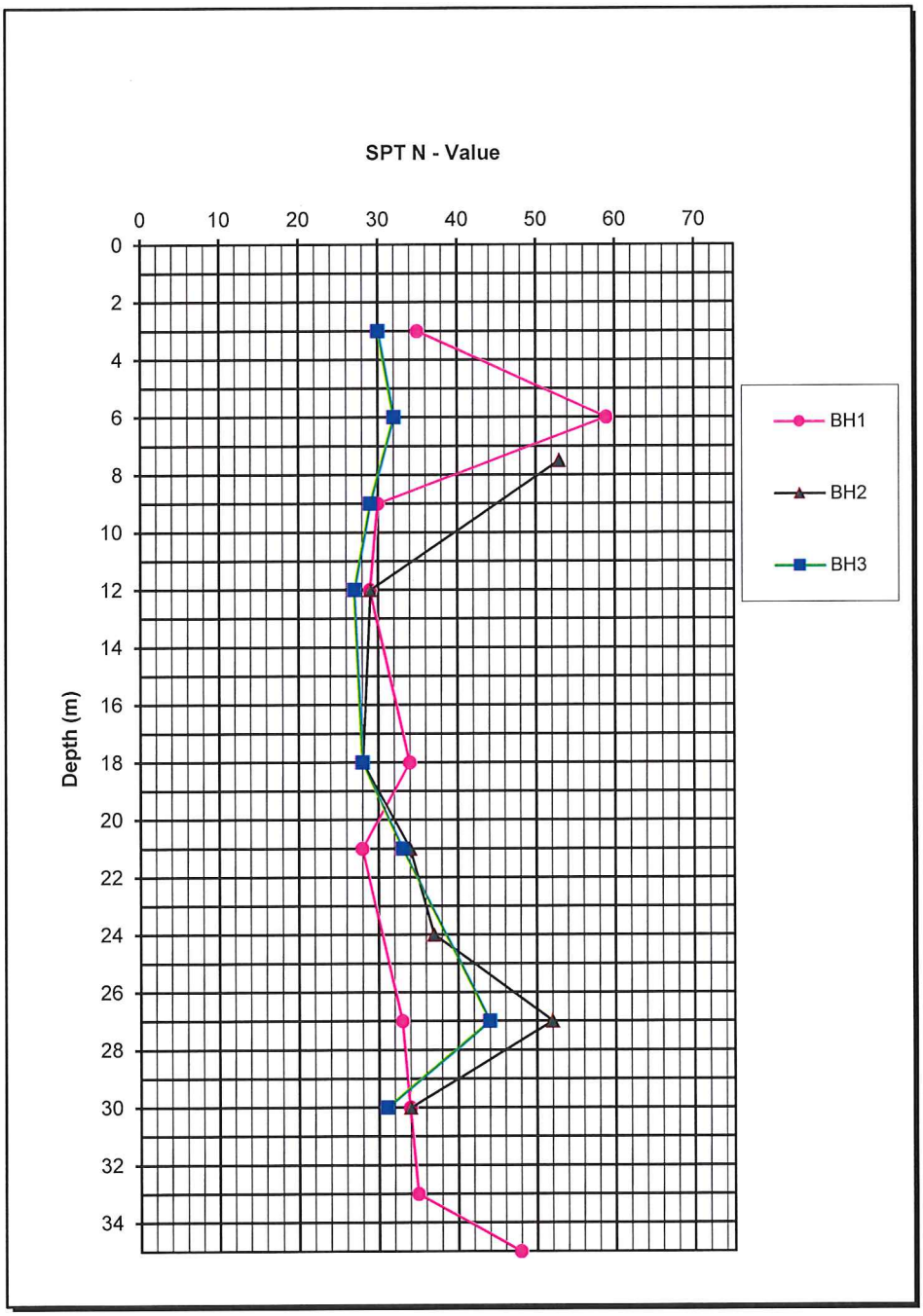

FIG. 11

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APPENDIX B

LABORATORY TEST RESULTS

TABLE 1

SUMMARY OF TEST RESULTS

B.H. No /DEPTH m	Natural Moisture Content %	Natural Density kN/m^2	Specific Gravity	Liquid Limit %	Plastic Limit %	Plasticity Index %	Clay %	Silt %	Sand %	Gravel %	Cohesion cu kN/m^2	Angle ϕu	Soil Type
1/9	30.4	19.5									251		Khaki Silty Marl
12	30.5	19.0									136		Khaki Silty Marl
15	34.4	18.7	2.75	69.1	31.7	37.4	22	47	31				Grey Silty Marl
18	28.9	19.7									160		Grey Silty Marl
21	33.1	19.4									130		Grey Silty Marl
24	32.8*	19.5*	2.87	66	29.1	36.9					170	10	Grey Silty Marl
27	34.6	19.0									136		Grey Silty Marl
30	33.3	19.3									129		Grey Silty Marl
33	33.5	18.8									140		Grey Silty Marl
35	33.3	19.4									167		Grey Silty Marl
2/1.5								10	33	57			Brown Silty Sand and Gravel
3								20	80	0.0			Brown Silty Sand
7.5	20.4	19.7									125		Khaki Silty Marl
9	29.7*	19.7*	2.88	69.0	26.3	42.7	30	54	16		75	15	Khaki Silty Marl
12	31.3	19.4									169		Grey Silty Marl
15	32.2*	19.4*	2.89	63.3	31.9	31.4	25	56	19		180	9	Grey Silty Marl
18	33.2	19.2									152		Grey Silty Marl
21	33.2	19.5									207		Grey Silty Marl
24	32.4	19.5									204		Grey Silty Marl
27	33.0	19.1									95		Grey Silty Marl
30	33.5	18.8									109		Grey Silty Marl
3/3								10	85	5			Silty, Gravelly Sand
6	24.4	21.0									170		Brown Sandy Clay
7								6	72	22			Brown Gravelly Sand
9	28.9	20.1					23	60	17		286		Khaki Silty Marl
12	33.3	19.0		70.0	32.5	37.5					167		Grey Silty Marl
15	30.5		2.82	62.1	29.8	32.3	19	53	28				Grey Silty Marl
18	33.1	19.5		65.0	28.5	36.5					151		Grey Silty Marl
21	34.1	19.5									111		Grey Silty Marl
24	32.9		2.85	64.0	29.1	34.9	20	61	19				Grey Silty Marl
27	32.5	19.4									148		Grey Silty Marl
30	33.3	19.4									142		Grey Silty Marl

* Average of 4 resultss

TABLE 2

SUMMARY OF CONSOLIDATION AND SWELLING PRESSURE TESTS RESULTS

B.H. No / Depth	Soil Type	Initial Moisture Content %	Final Moisture Content %	Initial Density kN/m^2	Initial Void Ratio	Final Void Ratio	Av. Coeffic. Of Vol. Change m_v $m^2/kNx10^{-5}$	Av. Coeffic. Of Consolidation c_v $m^2/year$	Initial Saturation Sr %	Final Saturation Sr %	Swelling Pressure kN/m^2
1/15	Grey silty MARL	34.4	32.5	18.7	0.973	0.895	3.87	6.24	97	100	ZERO
1/24	Grey silty MARL	32.3	32.7	19.5	0.947	0.906	3.44	5.34	98	100	ZERO
2/9	Khaki silty MARL	32.7	31.3	19.3	0.990	0.888	5.06	5.13	96	100	25
2/15	Grey silty MARL	32.9	30.9	19.3	0.998	0.866	6.50	5.06	96	100	ZERO
3/15	Grey silty MARL	30.5	28.7	19.6	0.880	0.787	4.58	6.37	98	100	25
3/24	Grey silty MARL	32.9	31.5	19.2	0.970	0.894	3.38	4.09	97	100	75

NATURAL MOISTURE CONTENT

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

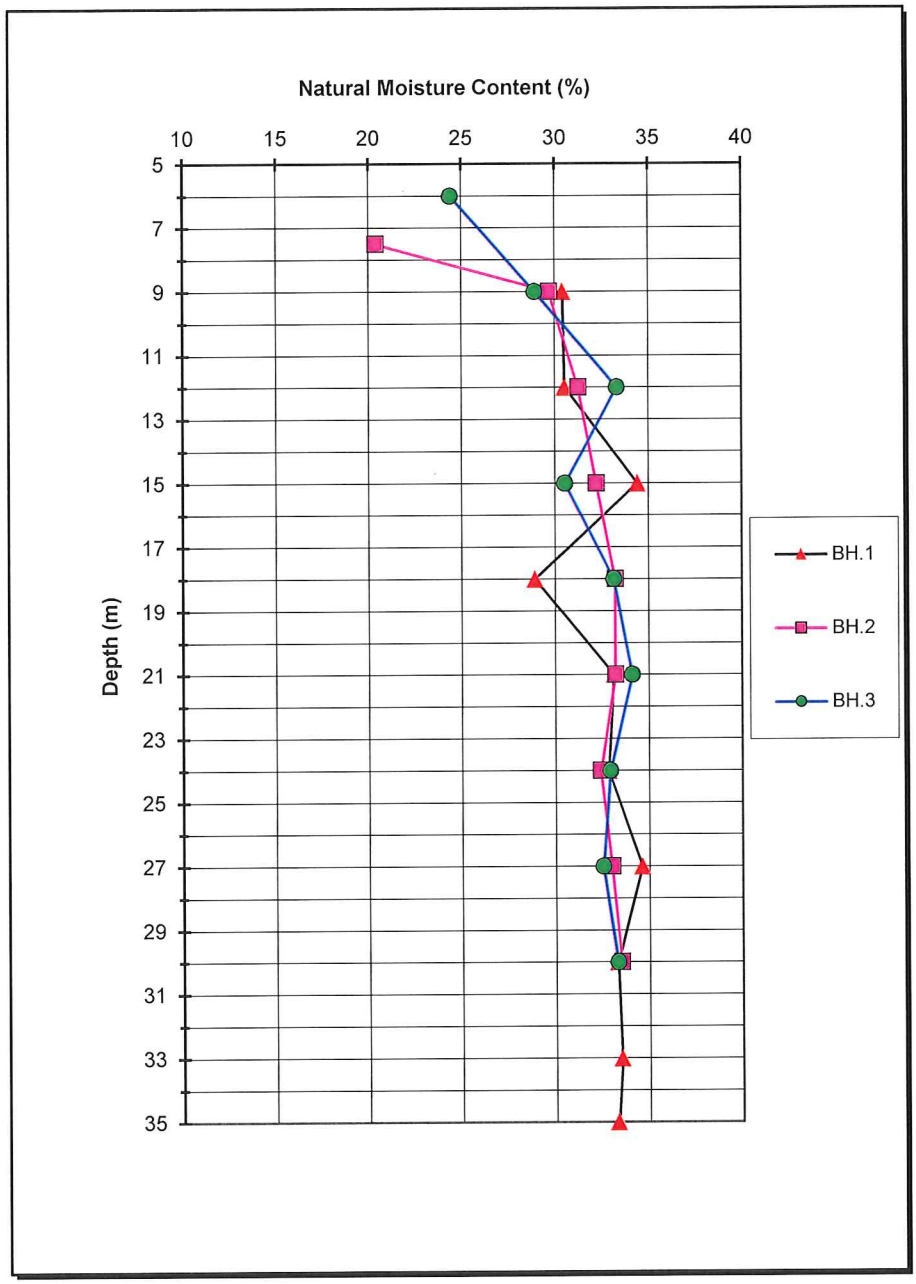

FIG.12

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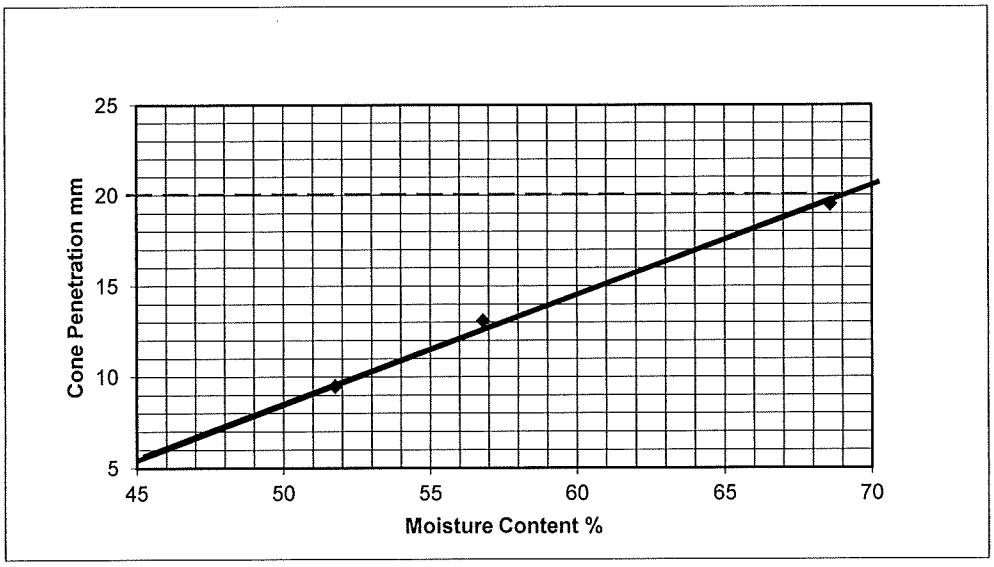
Liquid Limit Test

Cone Penetration Method

Project: Medical School | **BH No.:** BH1 | **Date:** 23/07/2017
Site Location: University Campus | **Depth:** 15,0m | **Operator:**
Client: University of Cyprus | **Soil:** Grey silty MARL



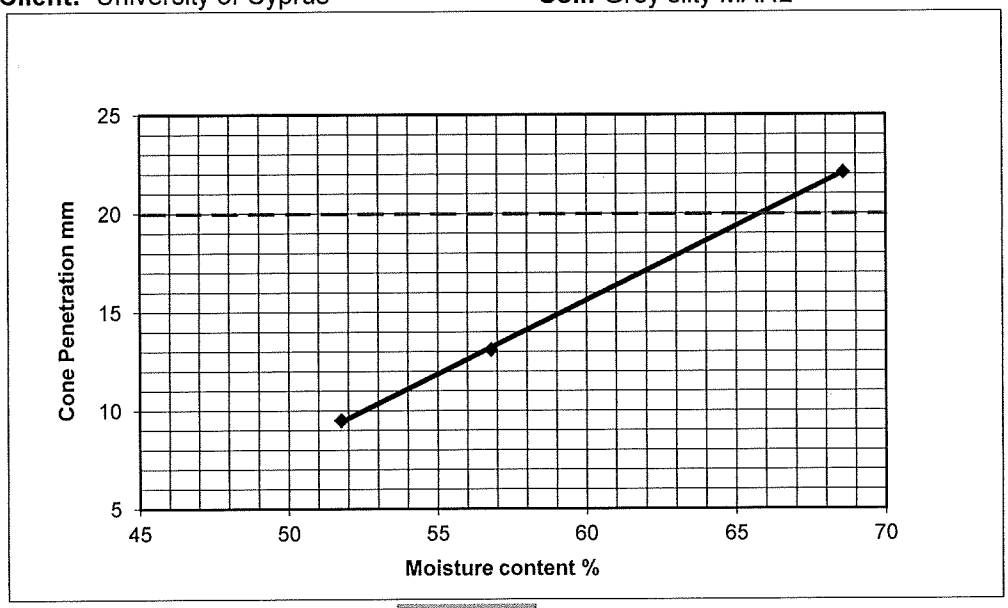
Liquid limit	69.1%
Plastic limit	31.7%
Plasticity Index	37.4%

FIG. 13

Liquid Limit Test

Cone Penetration Method

Project: Medical School | **BH No.:** BH1 | **Date:** 23/07/2017
Site Location: University Campus | **Depth:** 24,0m | **Operator:**
Client: University of Cyprus | **Soil:** Grey silty MARL



Liquid limit	66.0%
Plastic limit	29.1%
Plasticity Index	36.9%

FIG.14

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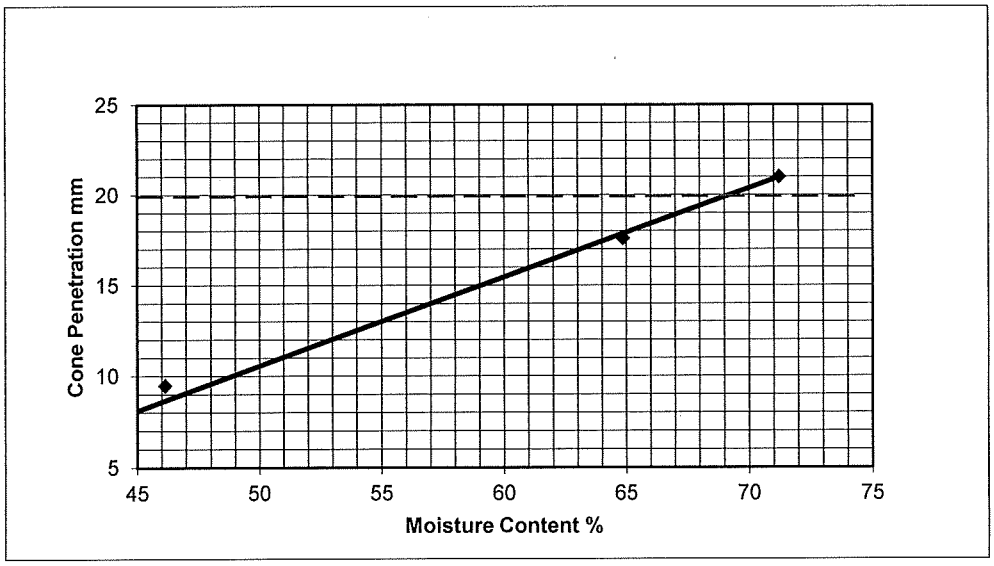
Liquid Limit Test

Cone Penetration Method

Project: Medical School | **BH No.:** BH2 | **Date:** 22/07/2017
Site Location: University Campus | **Depth:** 9,0m | **Operator:**
Client: University of Cyprus | **Soil:** Khaki silty MARL



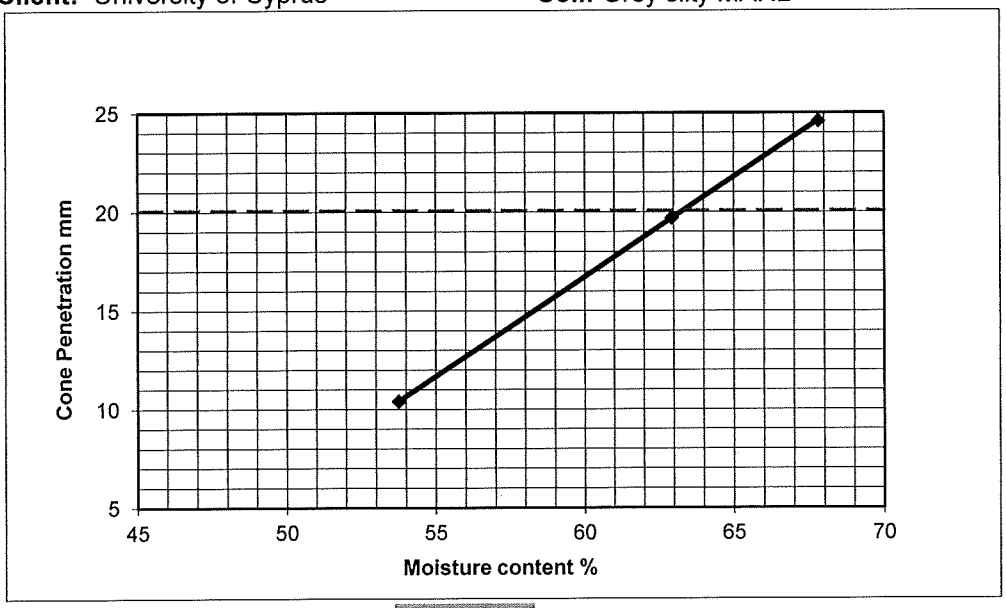
Liquid limit	69.0%
Plastic limit	26.3%
Plasticity Index	42.7%

FIG.15

Liquid Limit Test

Cone Penetration Method

Project: Medical School | **BH No.:** BH2 | **Date:** 22/07/2017
Site Location: University Campus | **Depth:** 15,0m | **Operator:**
Client: University of Cyprus | **Soil:** Grey silty MARL



Liquid limit	63.3%
Plastic limit	31.9%
Plasticity Index	31.4%

FIG.16

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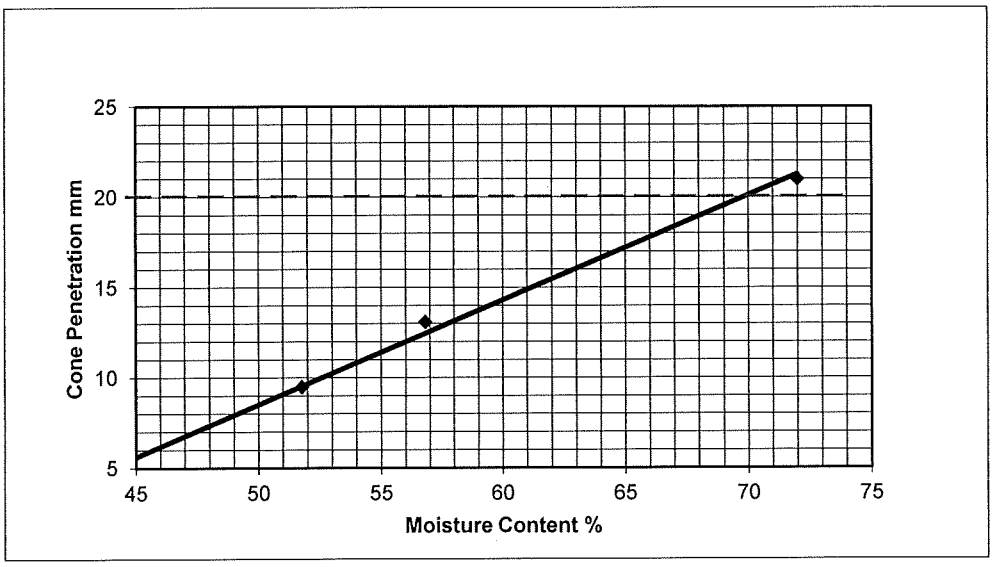
Liquid Limit Test

Cone Penetration Method

Project: Medical School | **BH No.:** BH1 | **Date:** 23/07/2017
Site Location: University Campus | **Depth:** 12,0m | **Operator:**
Client: University of Cyprus | **Soil:** Khaki silty MARL



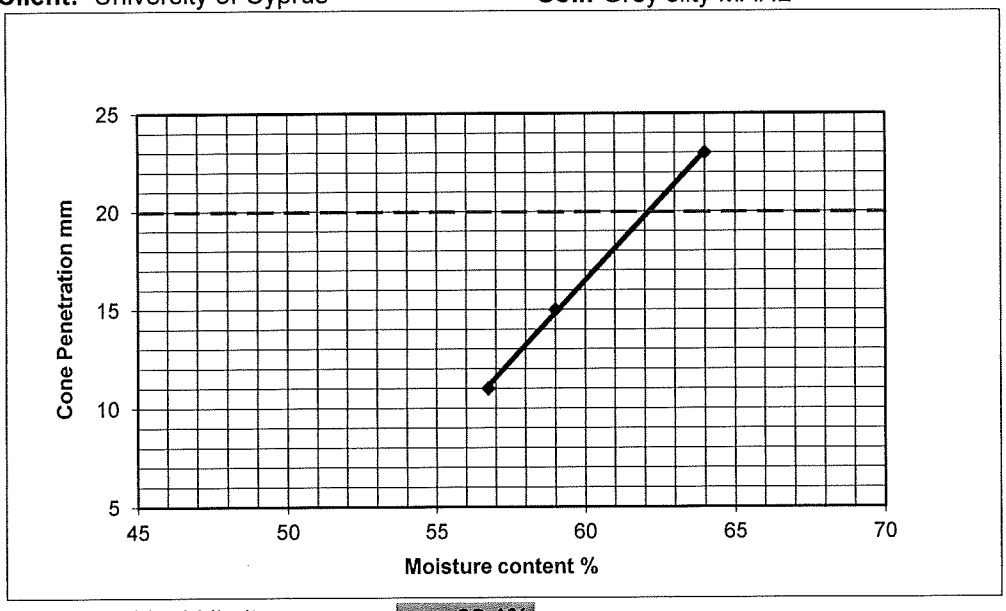
Liquid limit	70.0%
Plastic limit	32.5%
Plasticity Index	37.5%

FIG. 17

Liquid Limit Test

Cone Penetration Method

Project: Medical School | **BH No.:** BH3 | **Date:** 23/07/2017
Site Location: University Campus | **Depth:** 15,0m | **Operator:**
Client: University of Cyprus | **Soil:** Grey silty MARL



Liquid limit	62.1%
Plastic limit	29.8%
Plasticity Index	32.3%

FIG. 18

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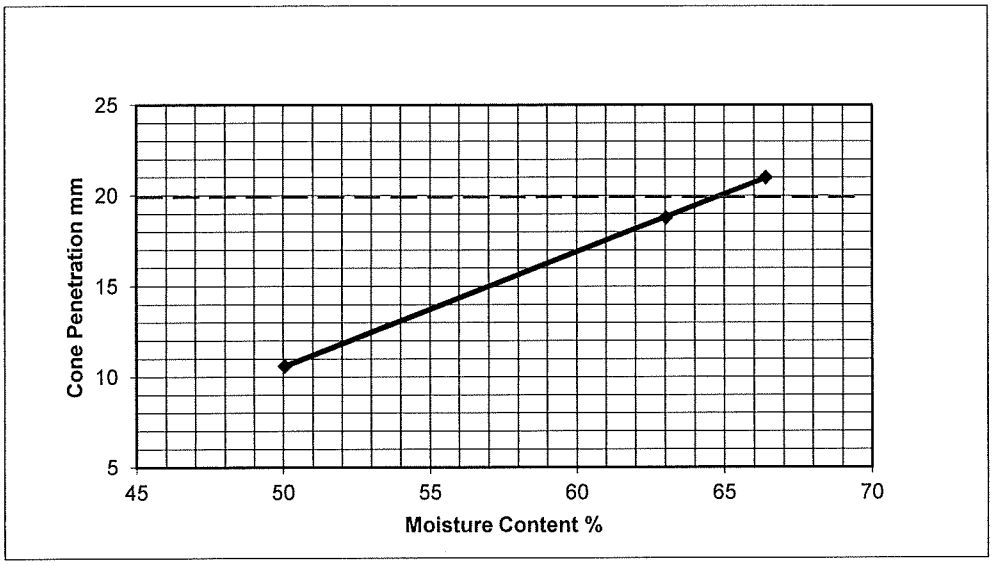
Liquid Limit Test

Cone Penetration Method

Project: Medical School | **BH No.:** BH3 | **Date:** 23/07/2017
Site Location: University Campus | **Depth:** 18,0m | **Operator:**
Client: University of Cyprus | **Soil:** Grey silty MARL



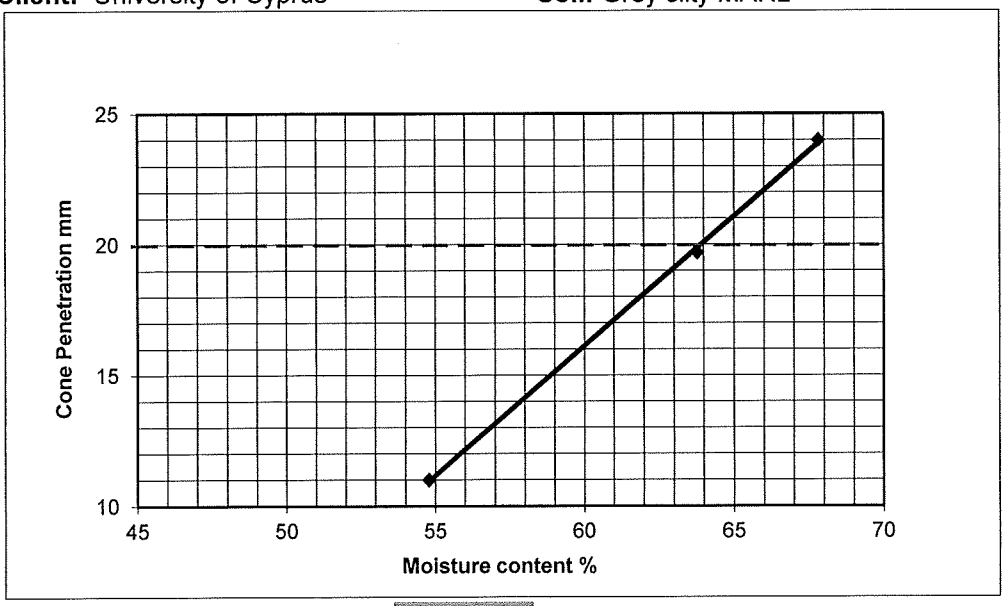
Liquid limit	65.0%
Plastic limit	28.5%
Plasticity Index	36.5%

FIG. 19

Liquid Limit Test

Cone Penetration Method

Project: Medical School | **BH No.:** BH3 | **Date:** 23/07/2017
Site Location: University Campus | **Depth:** 24,0m | **Operator:**
Client: University of Cyprus | **Soil:** Grey silty MARL



Liquid limit	64.0%
Plastic limit	29.1%
Plasticity Index	34.9%

FIG.20

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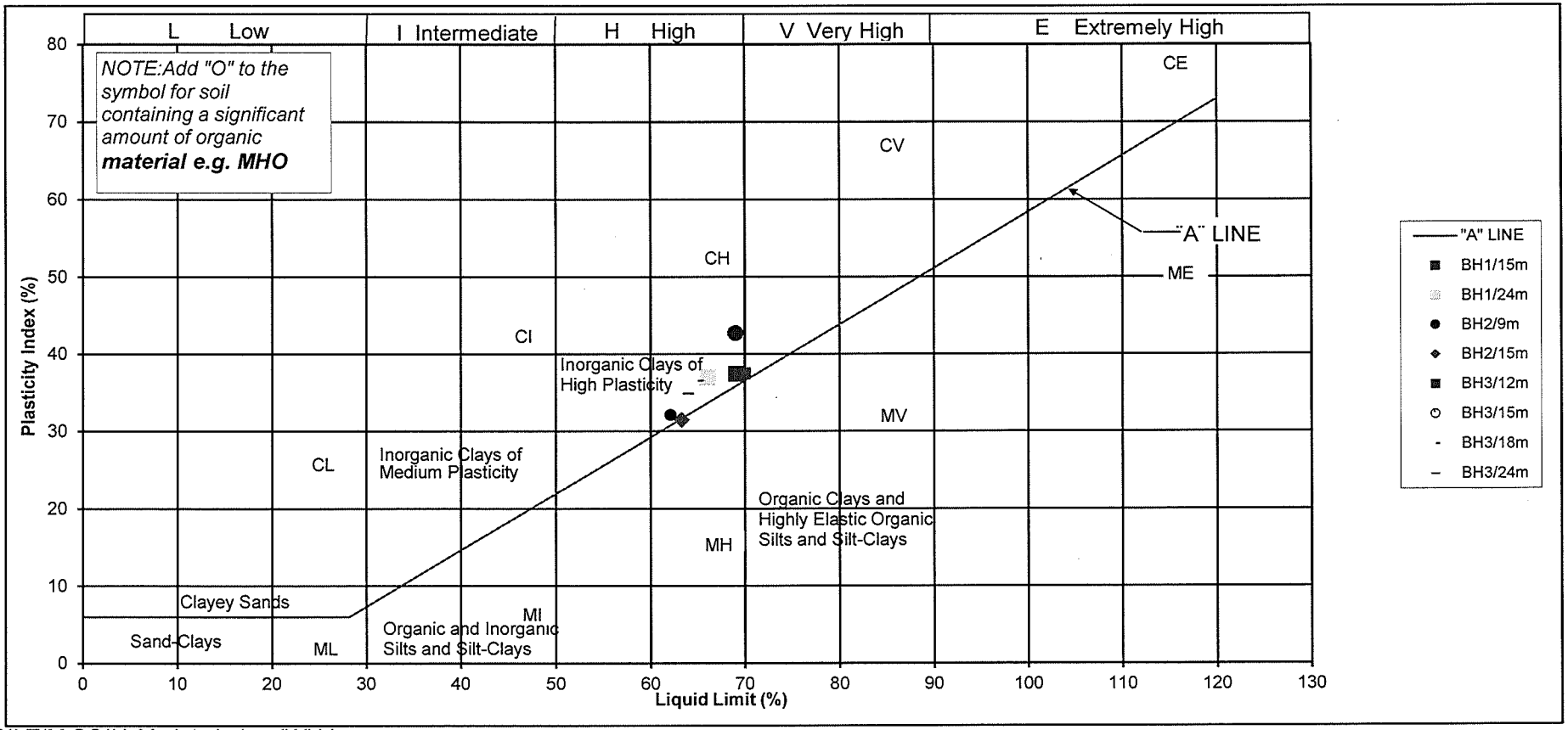
PLASTICITY CLASSIFICATION CHART

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

Date: June 2017
Operator:



SILT(M-SOIL),M,plots below "A" Line
CLAY,C,plots above "A" Line
M and C may be combined as FINE SOIL,F

FIG.21

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PARTICLE SIZE DISTRIBUTION

HYDROMETER TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 1
Depth: 15.0m
Soil: Grey silty sandy Marl

Date: 27/06/2017
Operator:
Sieving: Wet

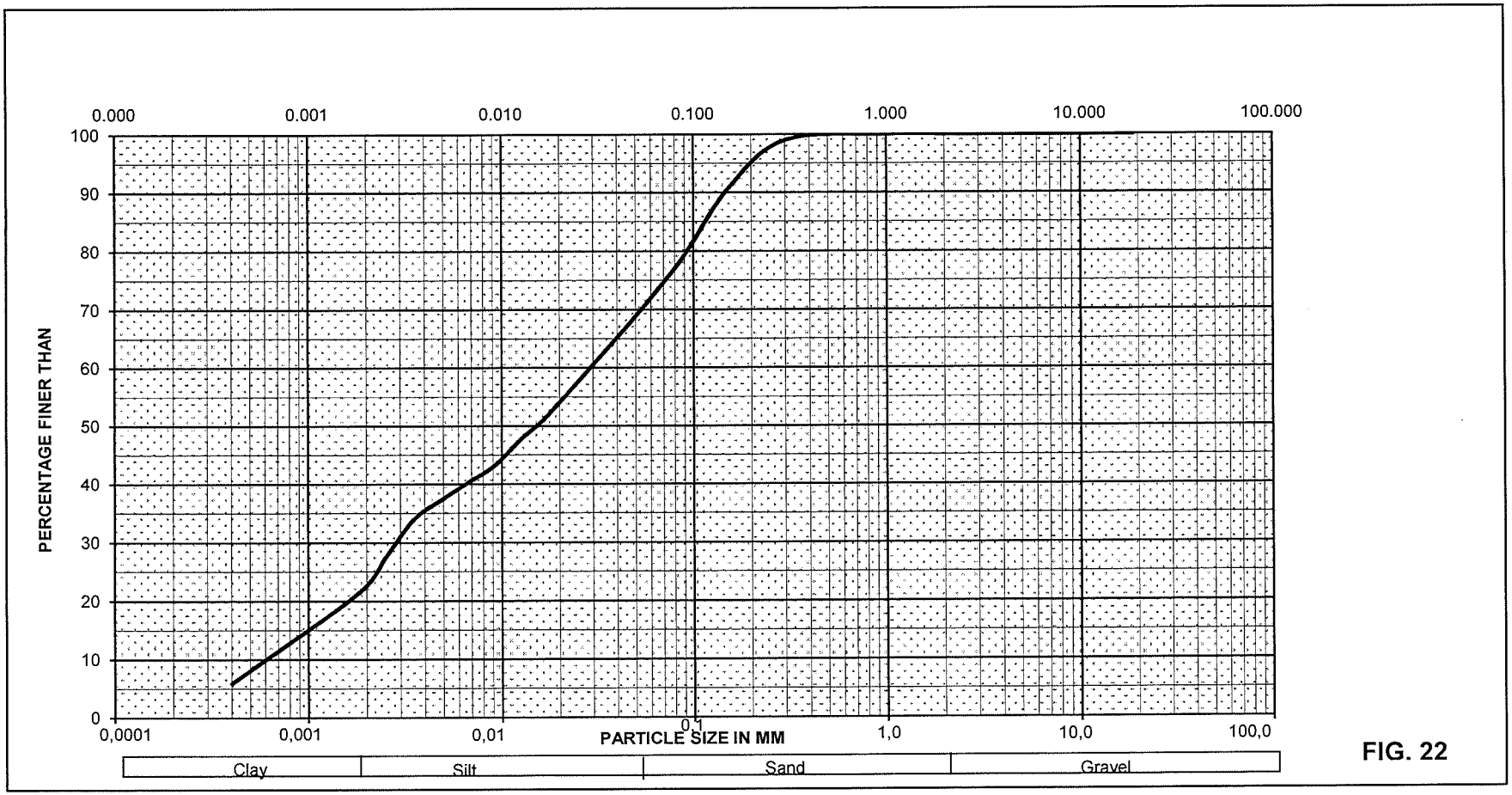

FIG. 22

HYDROMETER BH1 15,0

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PARTICLE SIZE DISTRIBUTION

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 1,5m
Soil: Brown and grey Sand and Gravel

Date: 19/06/17
Operator:
Sieving: Wet

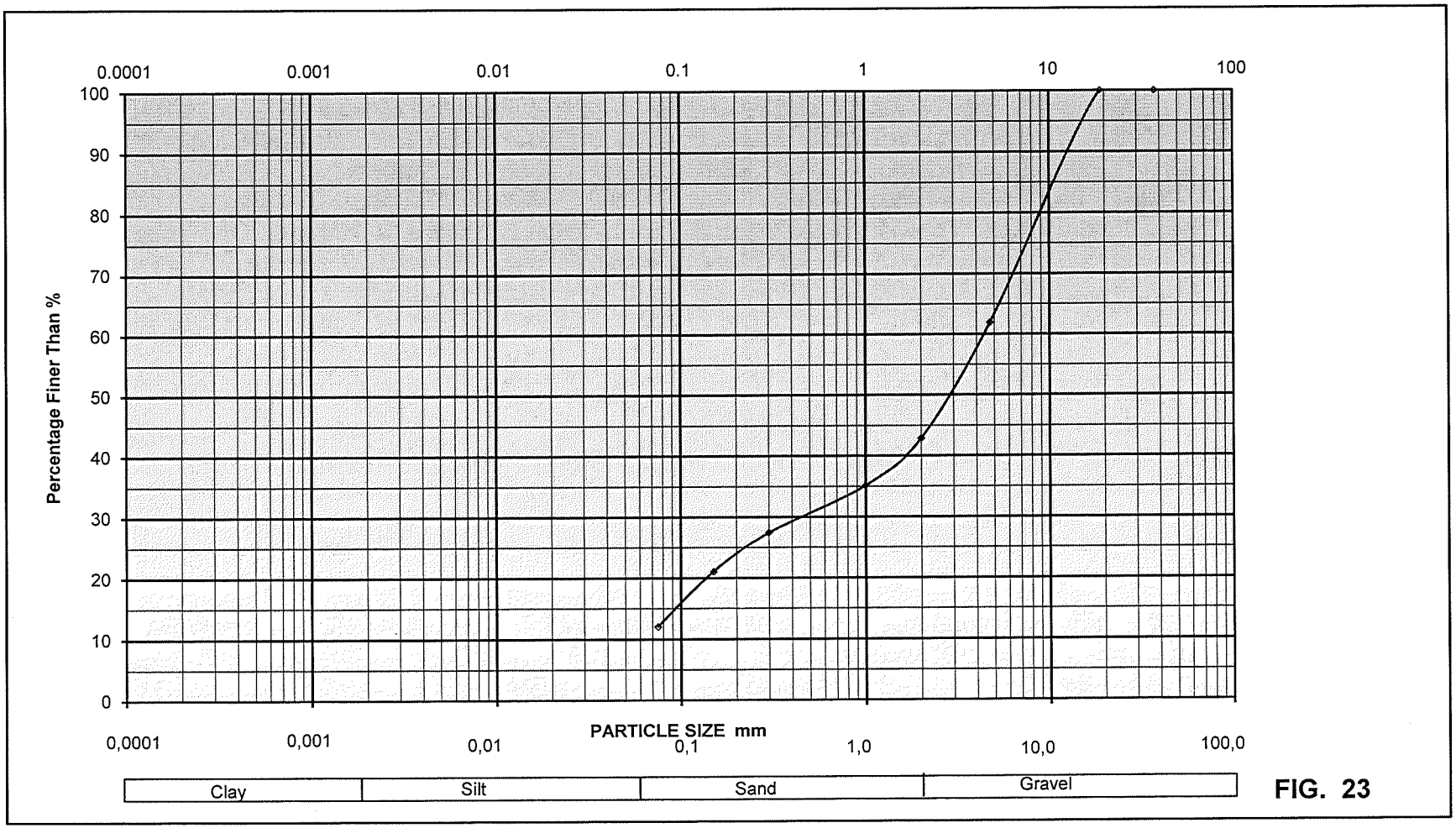

FIG. 23

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Tel.No.22663191, Fax22663192

UC MEDICAL GRADINGS BH2 1,5m

PARTICLE SIZE DISTRIBUTION

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 3,0m
Soil: Brown and yellow silty, clayey Sand

Date: 19/06/17
Operator:
Sieving: Wet

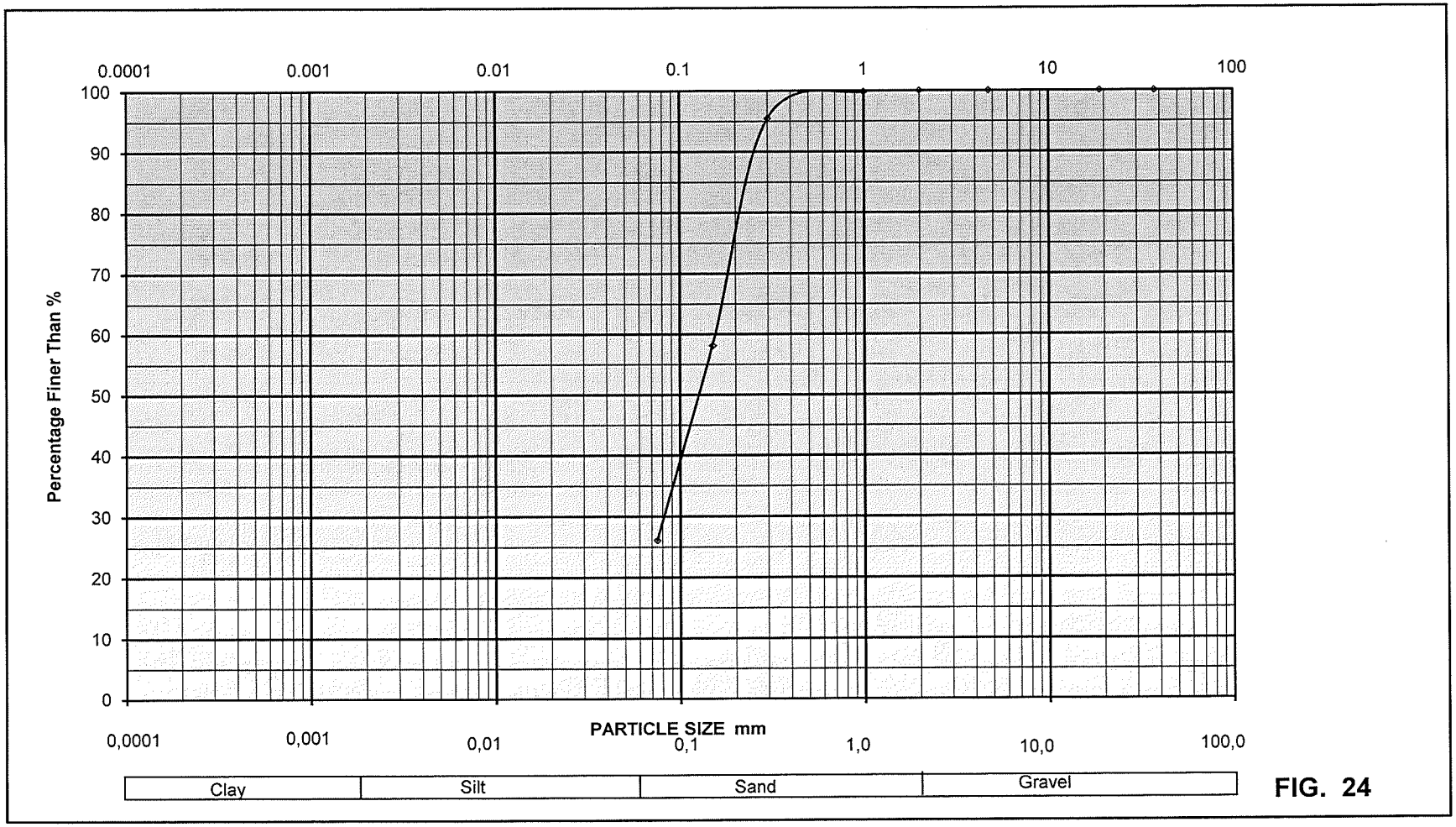

FIG. 24

UC MEDICAL GRADINGS BH2 3,0m

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Tel.No.22663191, Fax22663192

PARTICLE SIZE DISTRIBUTION

HYDROMETER TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 9.00m
Soil: Khaki silty sandy Marl

Date: 24/06/2017
Operator:
Sieving: Wet

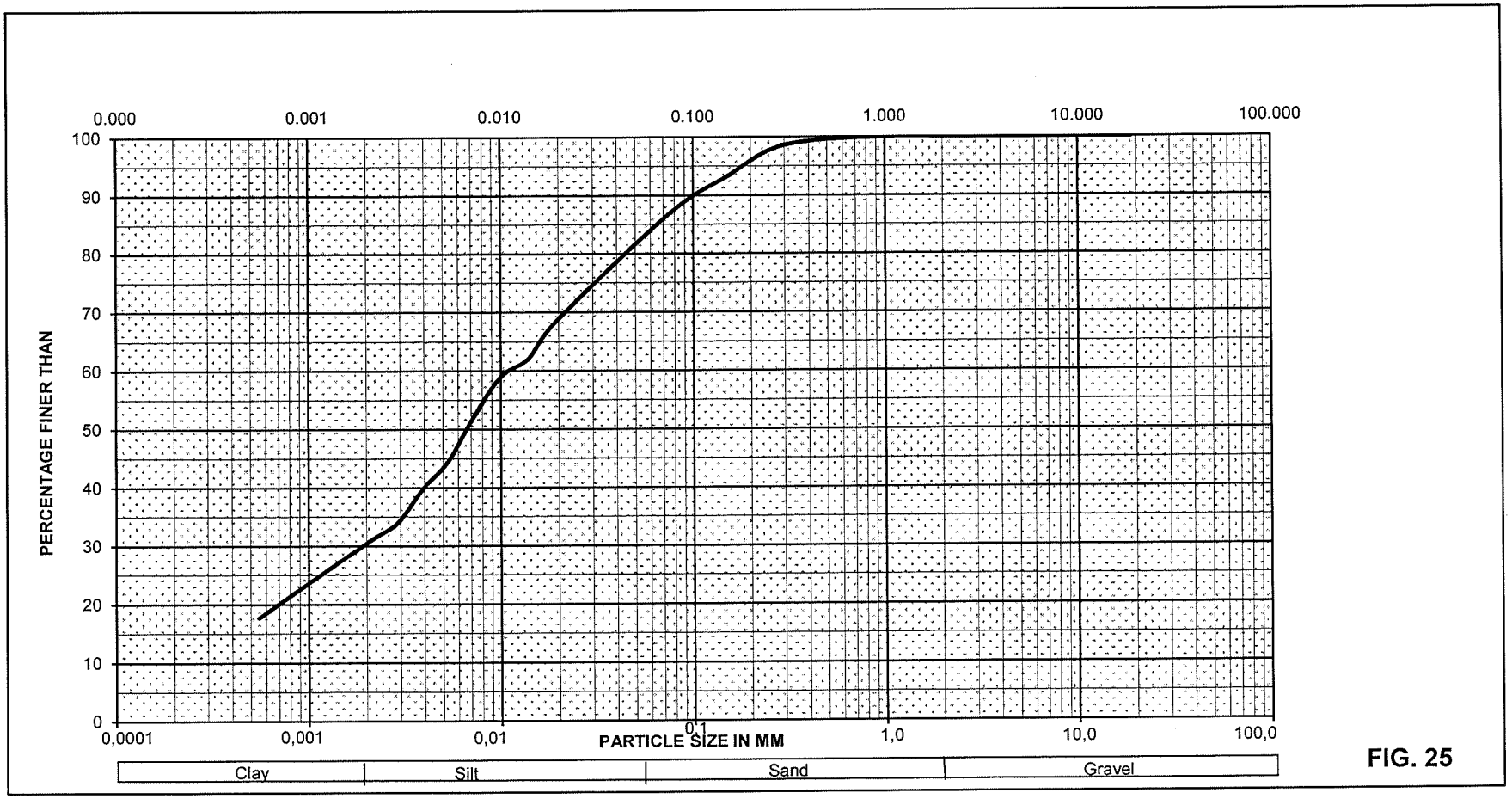

FIG. 25

HYDROMETER BH2 9,0

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PARTICLE SIZE DISTRIBUTION

HYDROMETER TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 15,00m
Soil: Grey silty sandy Marl

Date: 26/06/2017
Operator:
Sieving: Wet

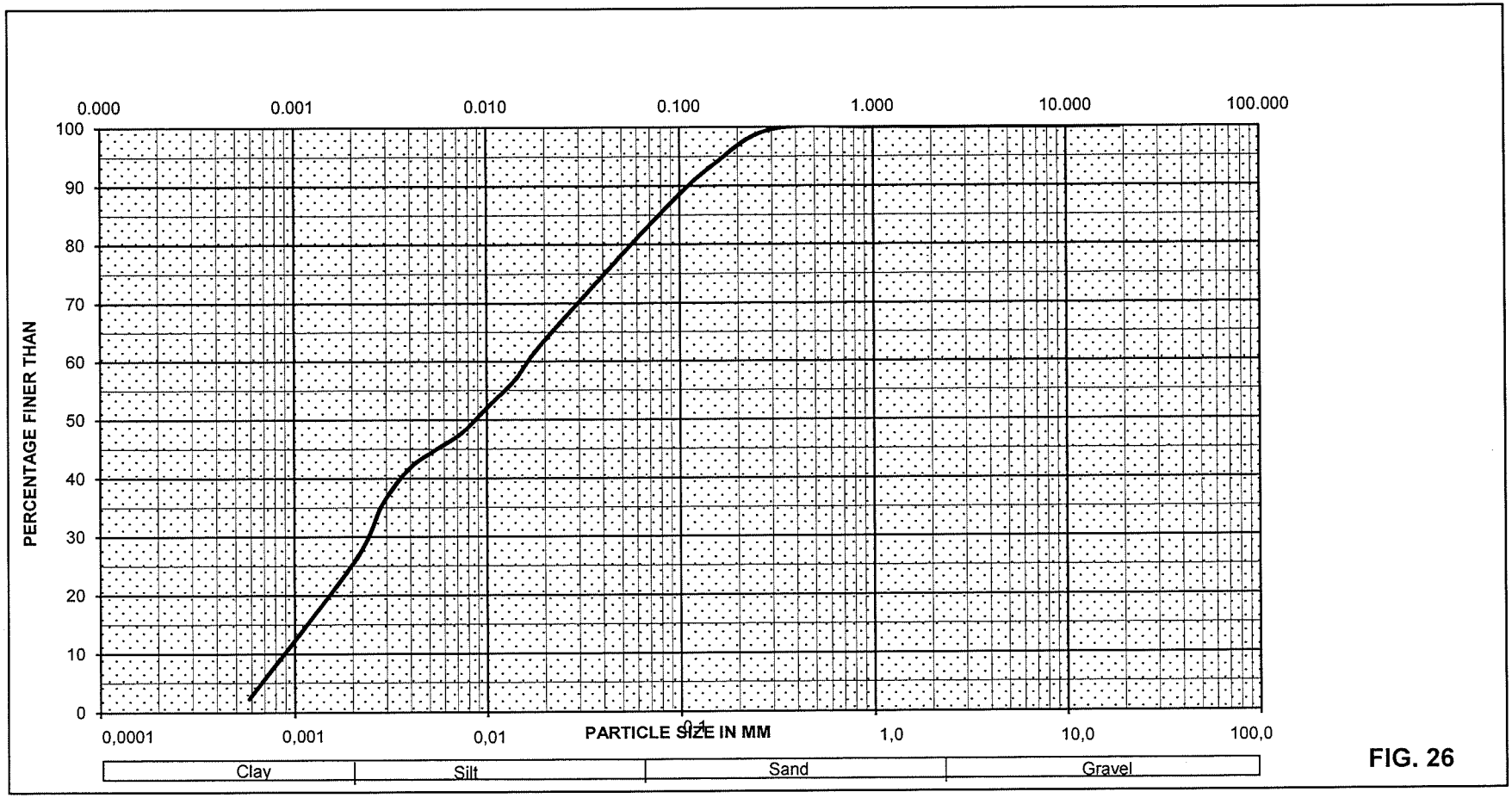

FIG. 26

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PARTICLE SIZE DISTRIBUTION

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 3 to 6m
Soil: Brown silty, gravelly Sand

Date: 19/06/17
Operator:
Sieving: Wet

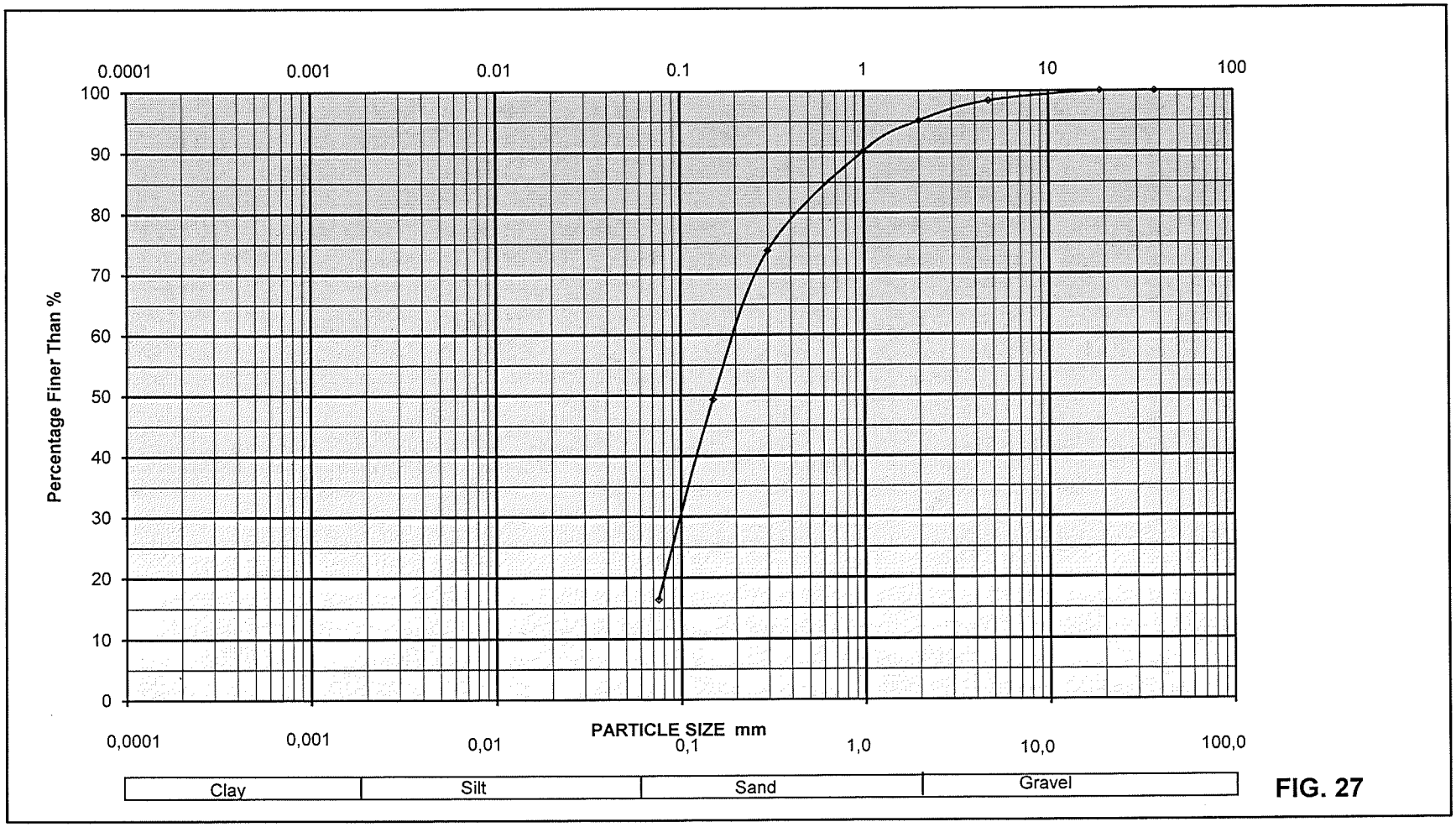


FIG. 27

UC MEDICAL GRADINGS BH3 3-6,0m

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax22663192

PARTICLE SIZE DISTRIBUTION

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 7-9,0m
Soil: Brown silty Sand with gravel

Date: 19/06/17
Operator:
Sieving: Wet

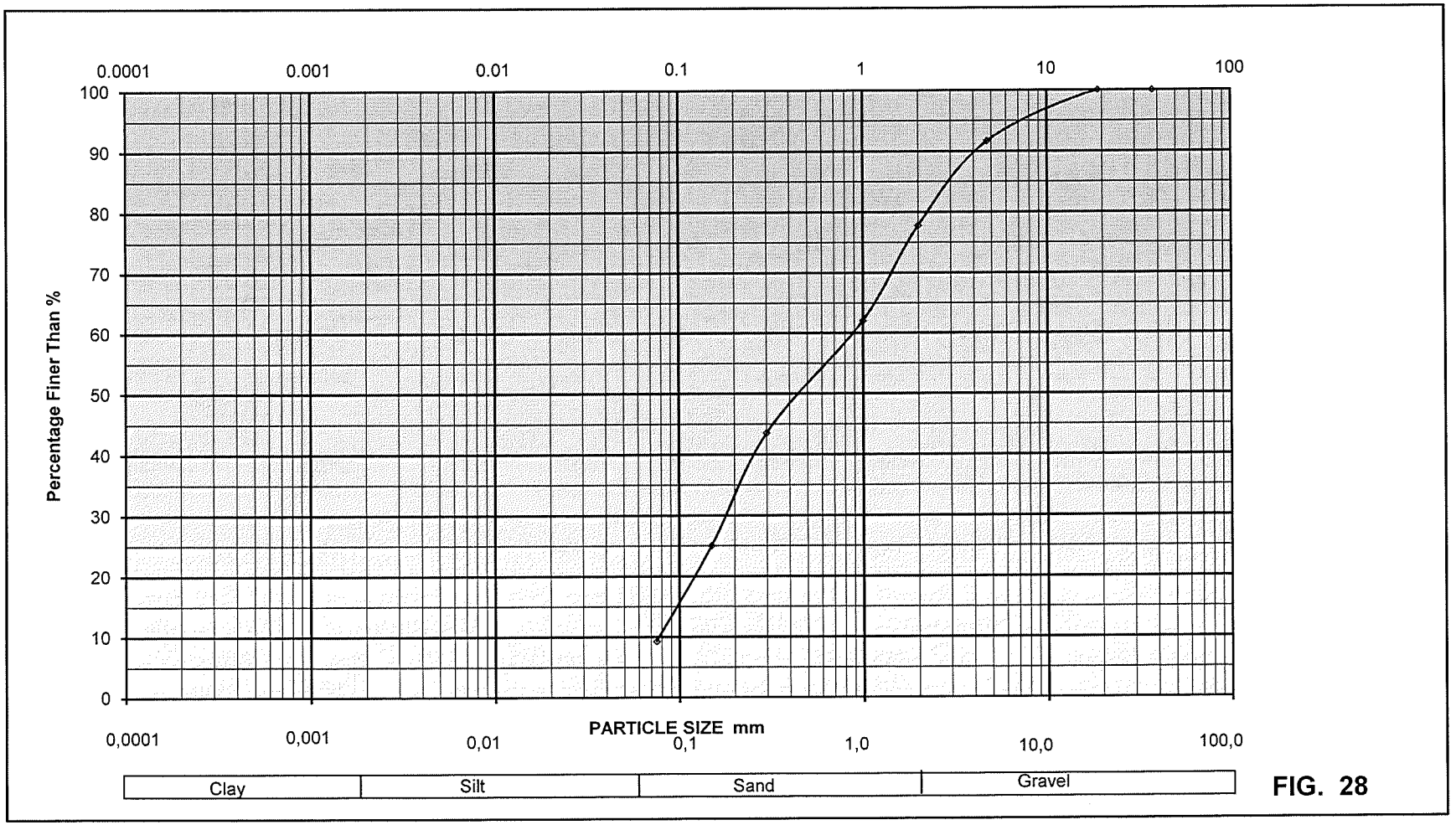


FIG. 28

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax22663192

UC MEDICAL GRADINGS BH3 7-9,0m

PARTICLE SIZE DISTRIBUTION

HYDROMETER TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 9,0m
Soil: Khaki silty sandy Marl

Date: 27/06/2017
Operator:
Sieving: Wet

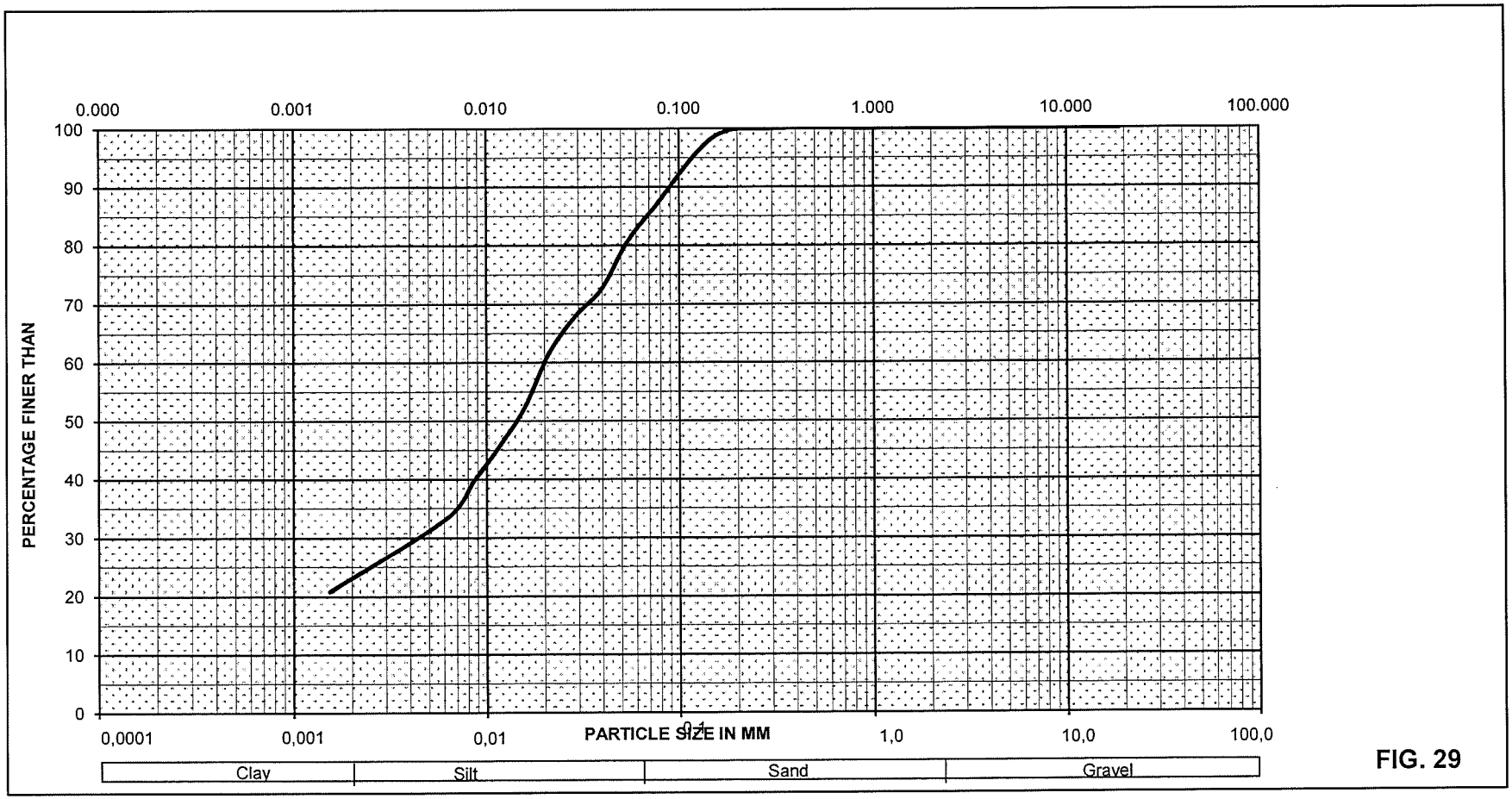


FIG. 29

HYDROMETER BH3 9,0

SH Soil Engineering Ltd
PO Box 25457, 1310 Nicosia
Tel 22663191, Fax 22663192

PARTICLE SIZE DISTRIBUTION

HYDROMETER TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 15.0m
Soil: Grey silty sandy Marl

Date: 26/06/2017
Operator:
Sieving: Wet

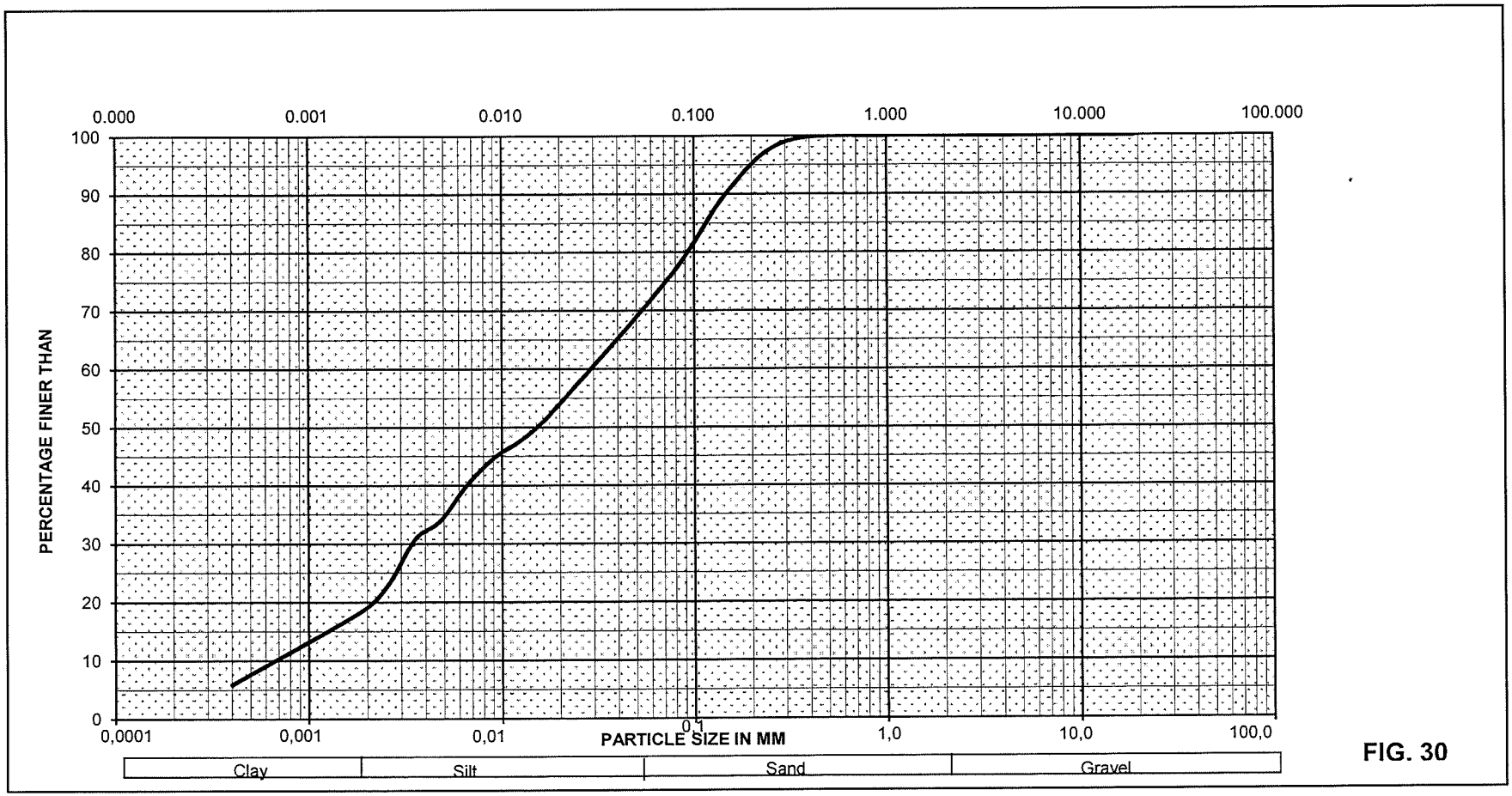


FIG. 30

HYDROMETER BH3 15,0

SH Soil Engineering Ltd
PO Box 25457, 1310 Nicosia
Tel 22663191, Fax 22663192

PARTICLE SIZE DISTRIBUTION

HYDROMETER TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 24.0m
Soil: Grey silty sandy Marl

Date: 24/06/2017
Operator:
Sieving: Wet

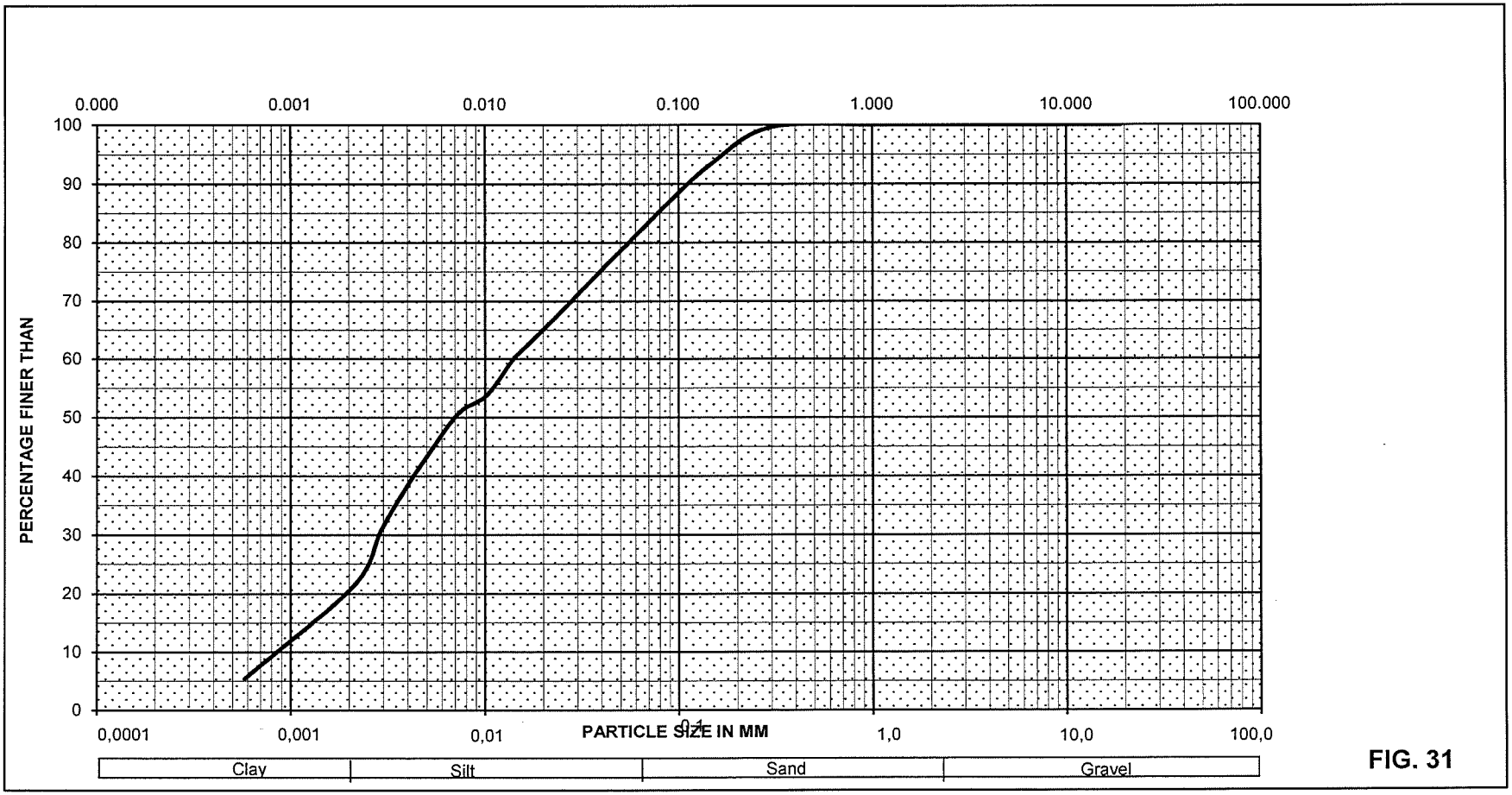


FIG. 31

SH Soil Engineering Ltd
PO Box 25457, 1310 Nicosia
Tel 22663191, Fax 22663192

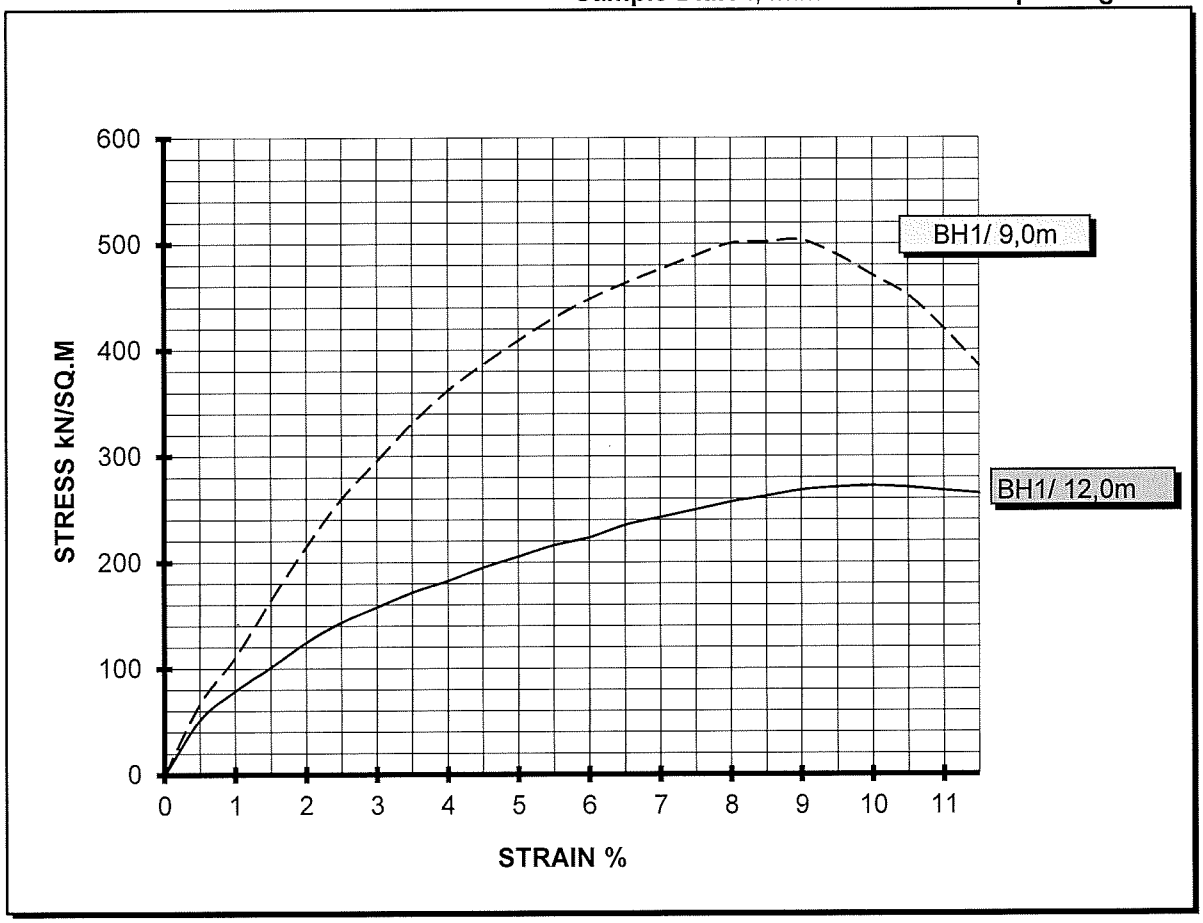
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 1 **Date:** 5/6/17

Site Location: University Campus **Depth:** 9,0 &12,0m **Operator:**

Client: University of Cyprus **Soil:** Khaki silty MARL

Sample Dia:34,4mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	1	9.00	19.5	30.37	251
2	1	12.00	19.0	30.47	136

FIG. 32

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

UNCONFINED COMPRESSION TEST

Project: Medical School

BH No.: 1

Date: 5/6/17

Site Location: University Campus

Depth: 18 &21,0m

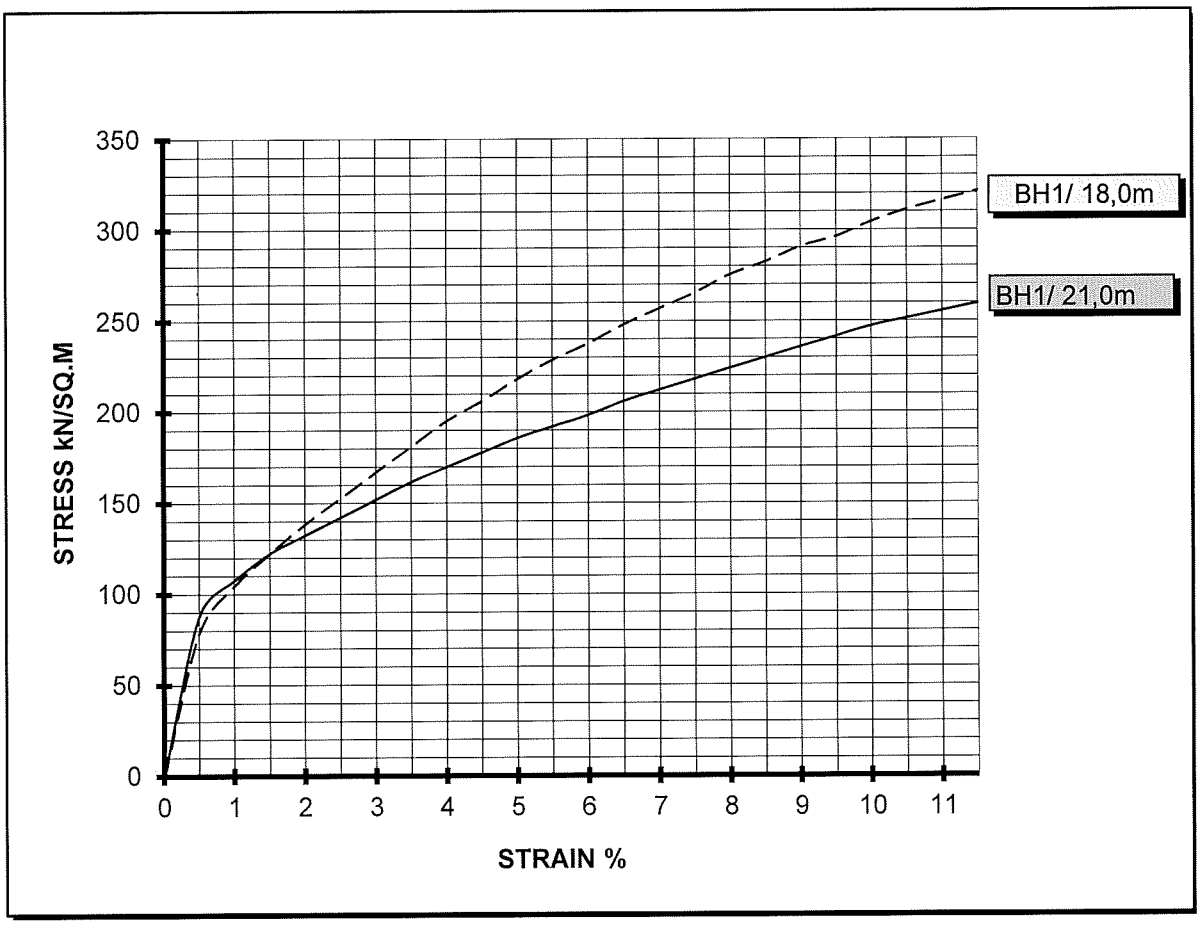
Operator:

Client: University of Cyprus

Soil: Grey silty MARL

Sample Dia:34,2mm

Sample height: 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	1	18.00	19.7	28.98	160
2	1	21.00	19.4	33.08	130

FIG. 33

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

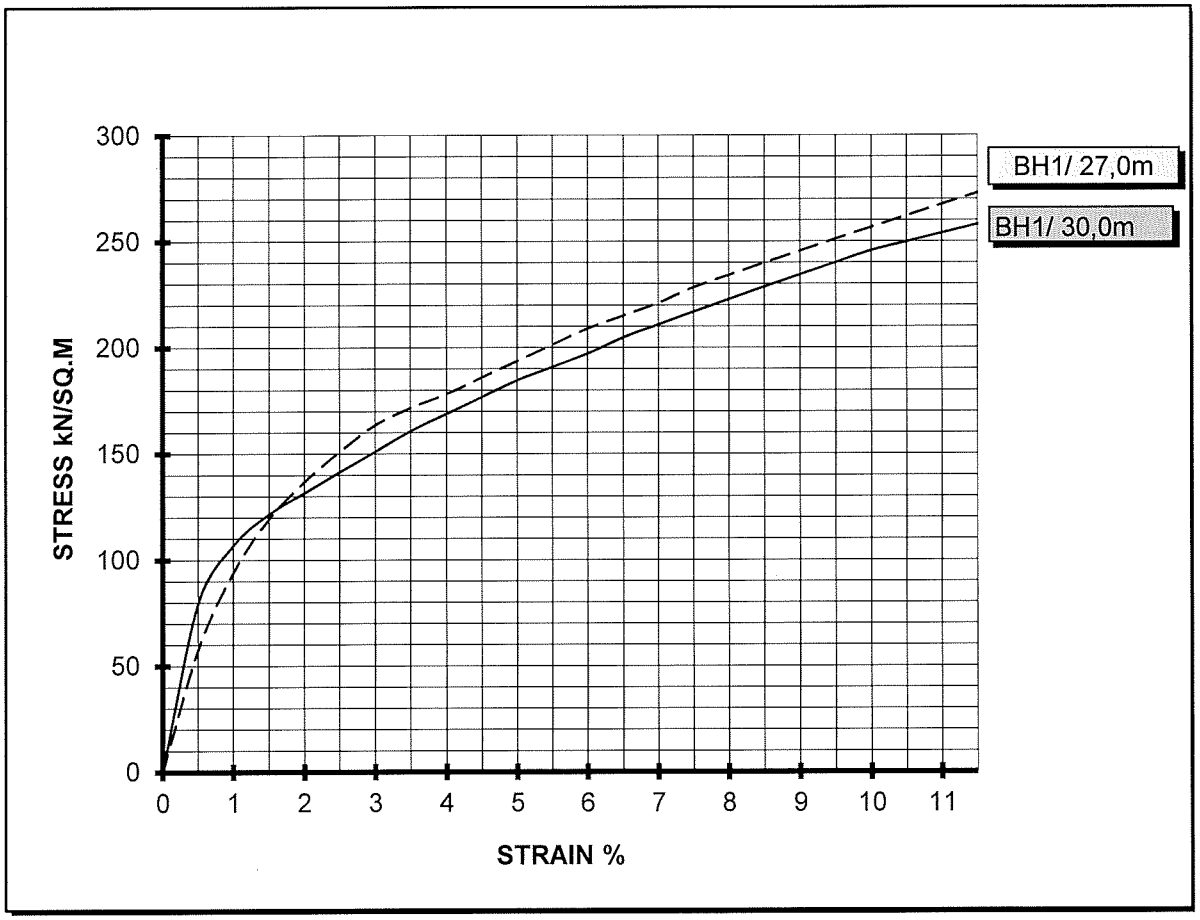
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 1 **Date:** 5/6/17

Site Location: University Campus **Depth:** 27&30,0m **Operator:**

Client: University of Cyprus **Soil:** Grey silty MARL

Sample Dia:34,5mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	1	27.00	19.0	34.56	136
2	1	30.00	19.3	33.29	129

FIG. 34

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

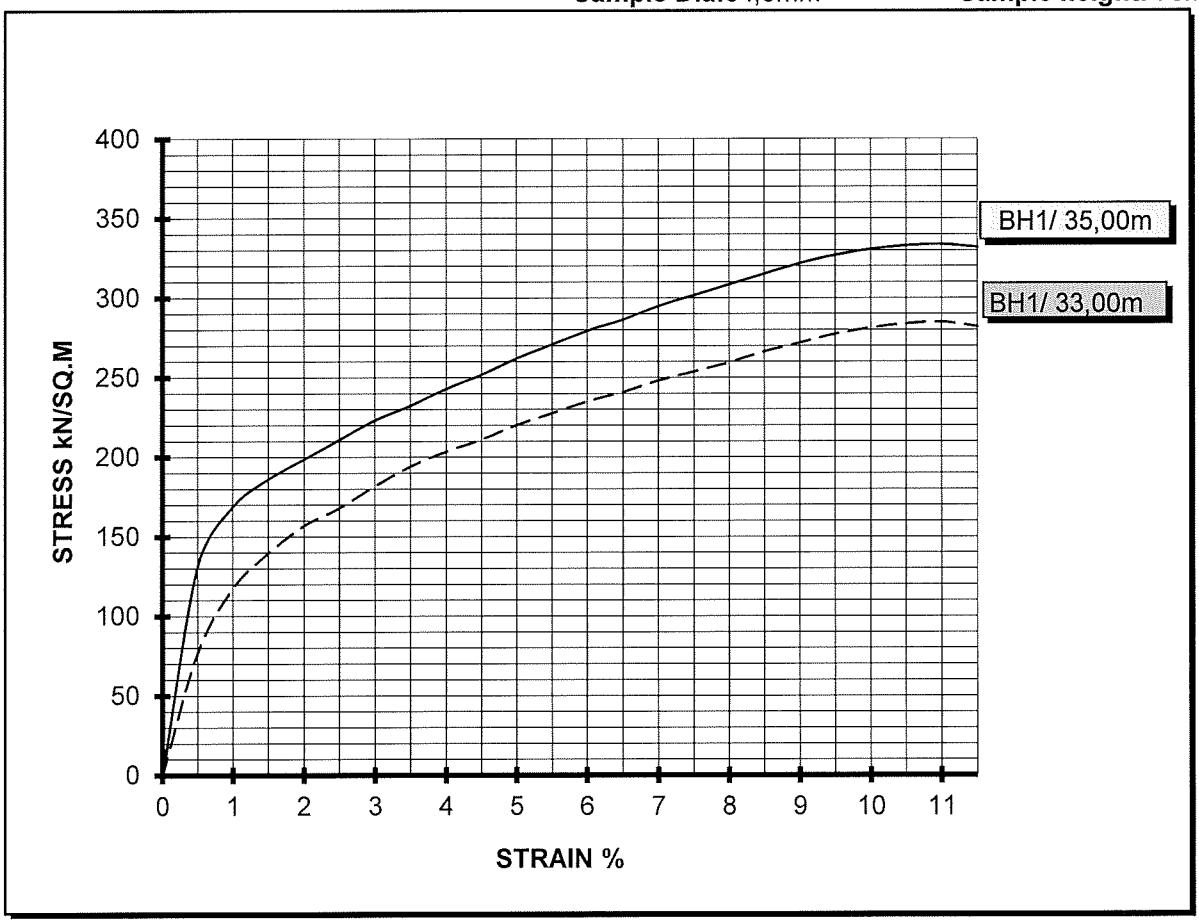
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.: 1** **Date:** 31/5/17

Site Location: University Campus **Depth:** 33,0&35,0m **Operator:**

Client: University of Cyprus **Soil:** Grey silty MARL

Sample Dia:34,5mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	1	33.00	18.8	33.54	140
2	1	35.00	19.4	33.31	167

FIG. 35

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

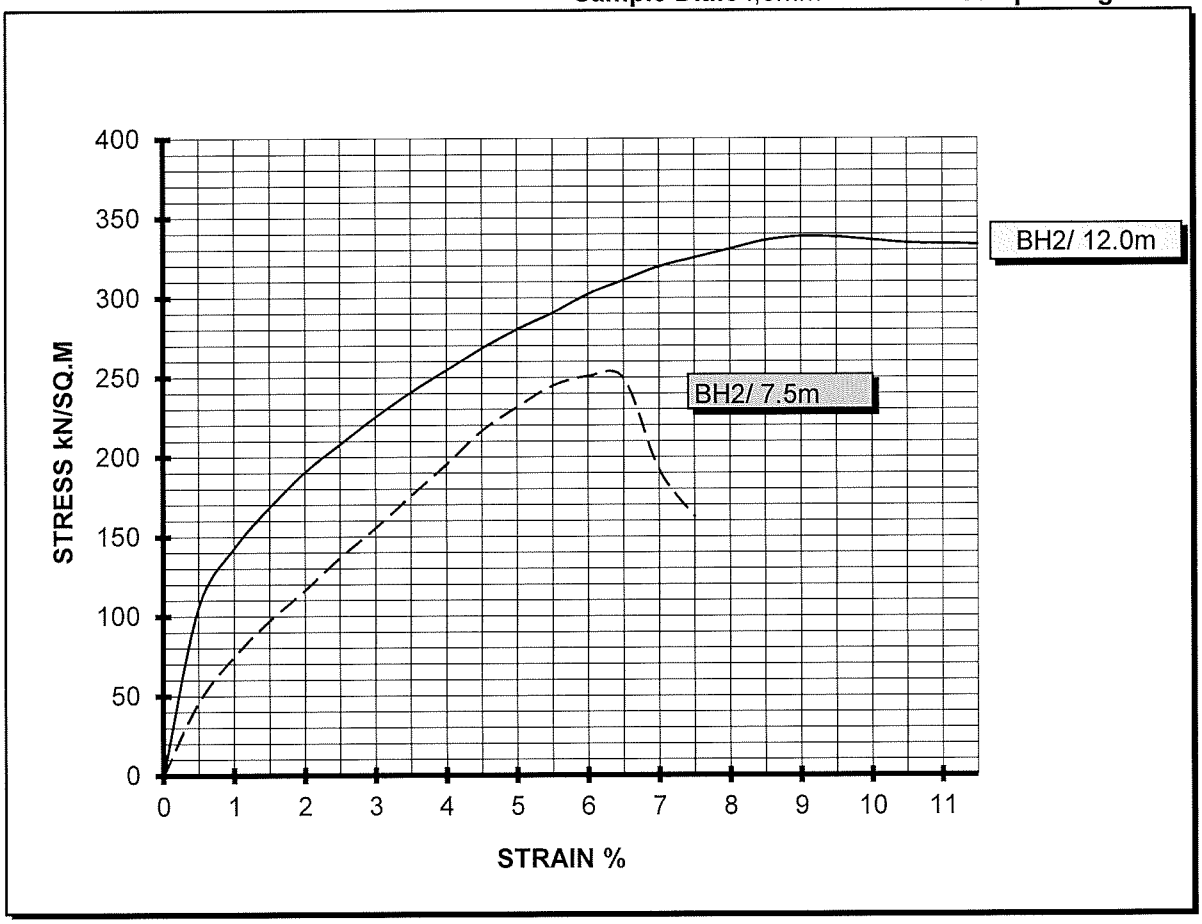
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 2 **Date:** 1/6/17

Site Location: University Campus **Depth:** 7.5&12.0m **Operator:**

Client: University of Cyprus **Soil:** 7.5m: Khaki silty Marl & 12.0m: Grey silty MARL

Sample Dia:34,3mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	2	7.50	19.7	20.43	125
2	2	12.00	19.4	31.25	169

FIG. 36

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

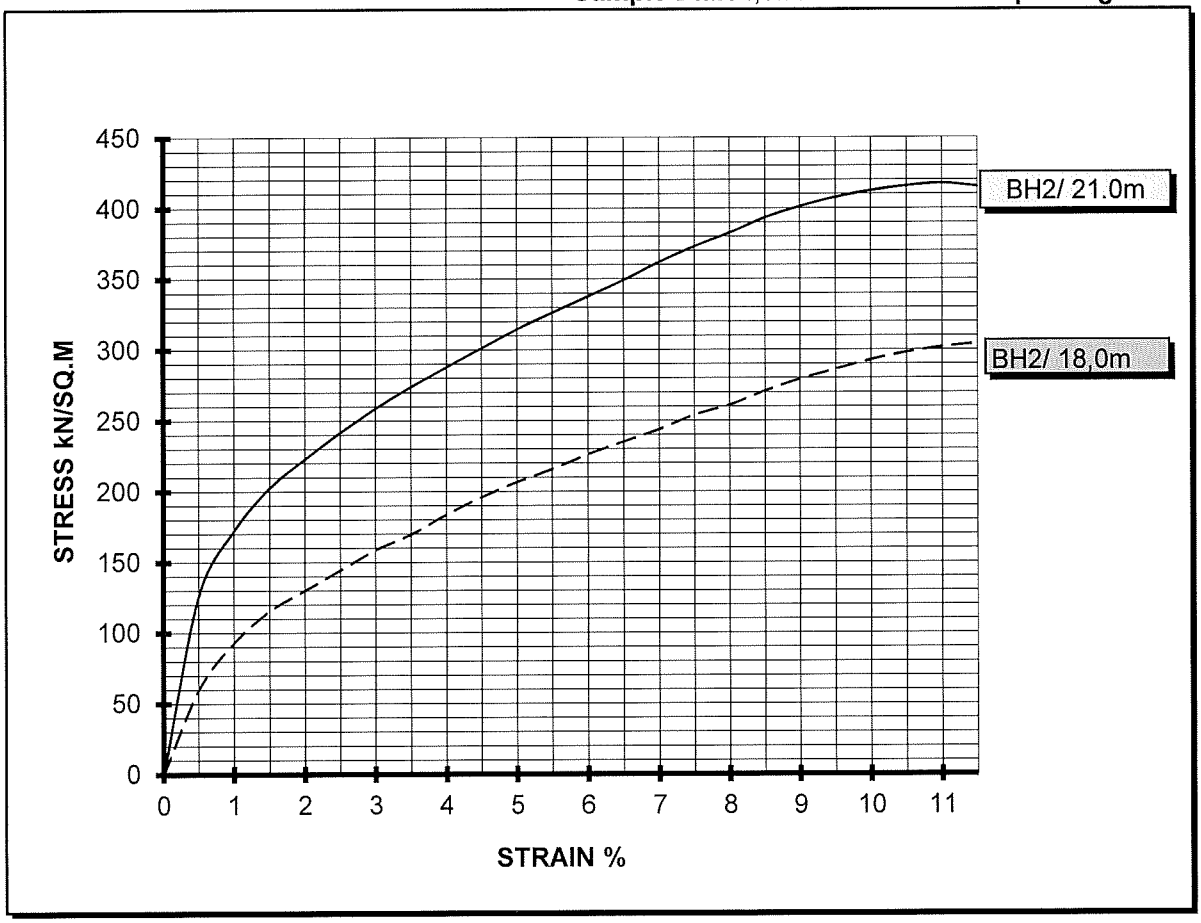
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 2 **Date:** 2/6/17

Site Location: University Campus **Depth:** 18 & 21m **Operator:**

Client: University of Cyprus **Soil:** Grey silty MARL

Sample Dia:34,3mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	2	18.00	19.2	33.23	152
2	2	21.00	19.5	33.19	207

FIG. 37

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

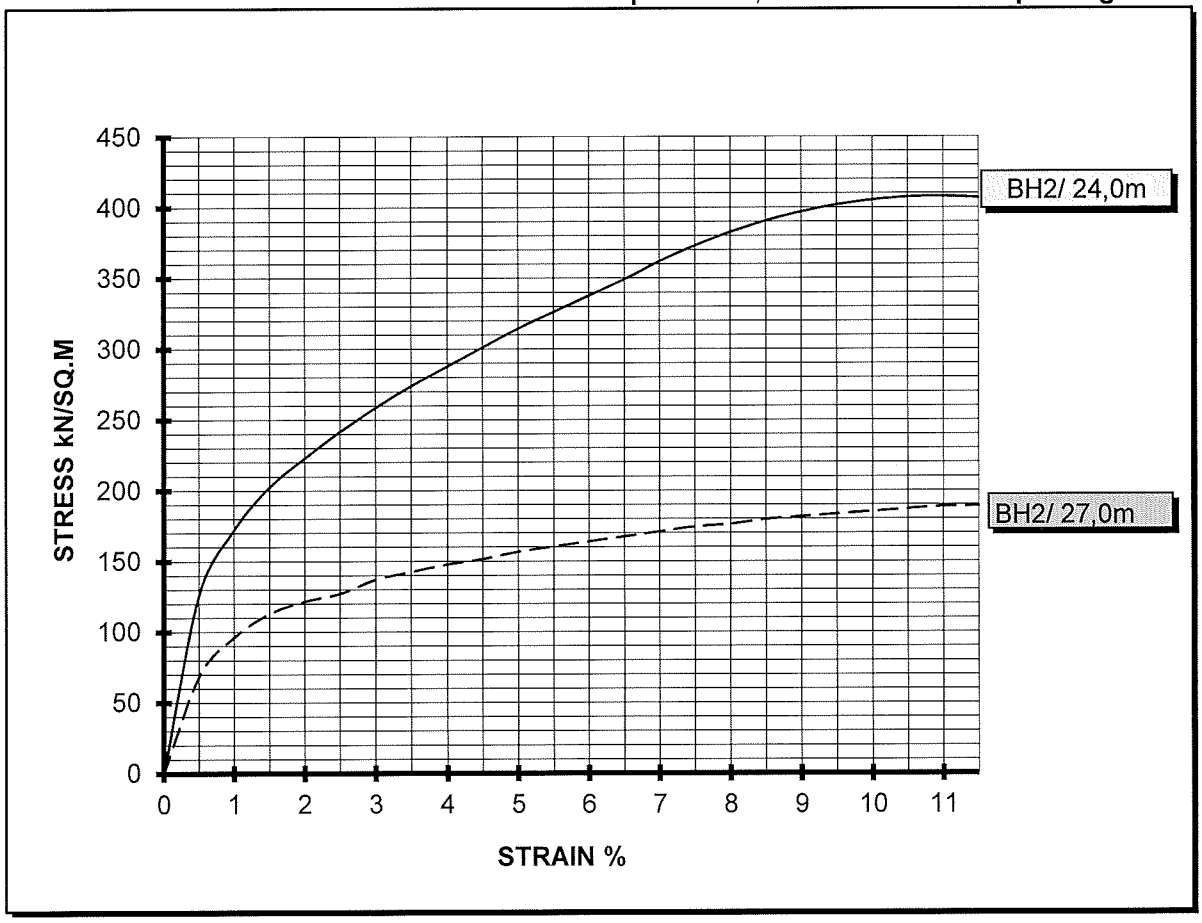
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 2 **Date:** 2/6/17

Site Location: University Campus **Depth:** 24 & 27m **Operator:**

Client: University of Cyprus **Soil:** Grey silty MARL

Sample Dia:34,0mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	2	27.00	19.1	32.98	95
2	2	24.00	19.5	32.43	204

FIG. 38

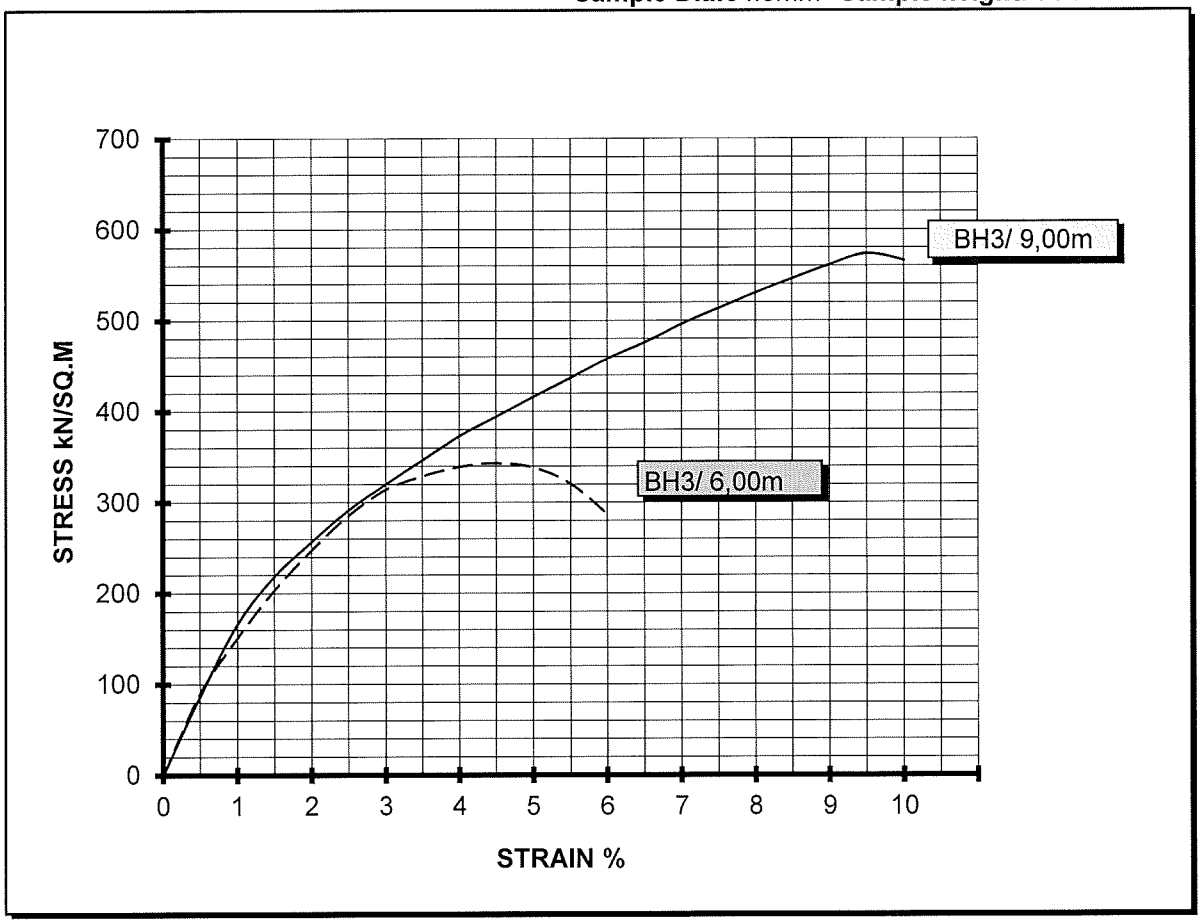
SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 3 **Date:** 29/5/17

Site Location: University Campus **Depth:** 6,0&9,0m **Operator:**

Client: University of Cyprus **Soil:** **6**,0m: Light brown sandy CLAY
9,0m: Khaki silty MARL
Sample Dia:34.3mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	3	6.00	21.0	24.41	170
2	3	9.00	20.1	28.92	286

FIG. 39

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

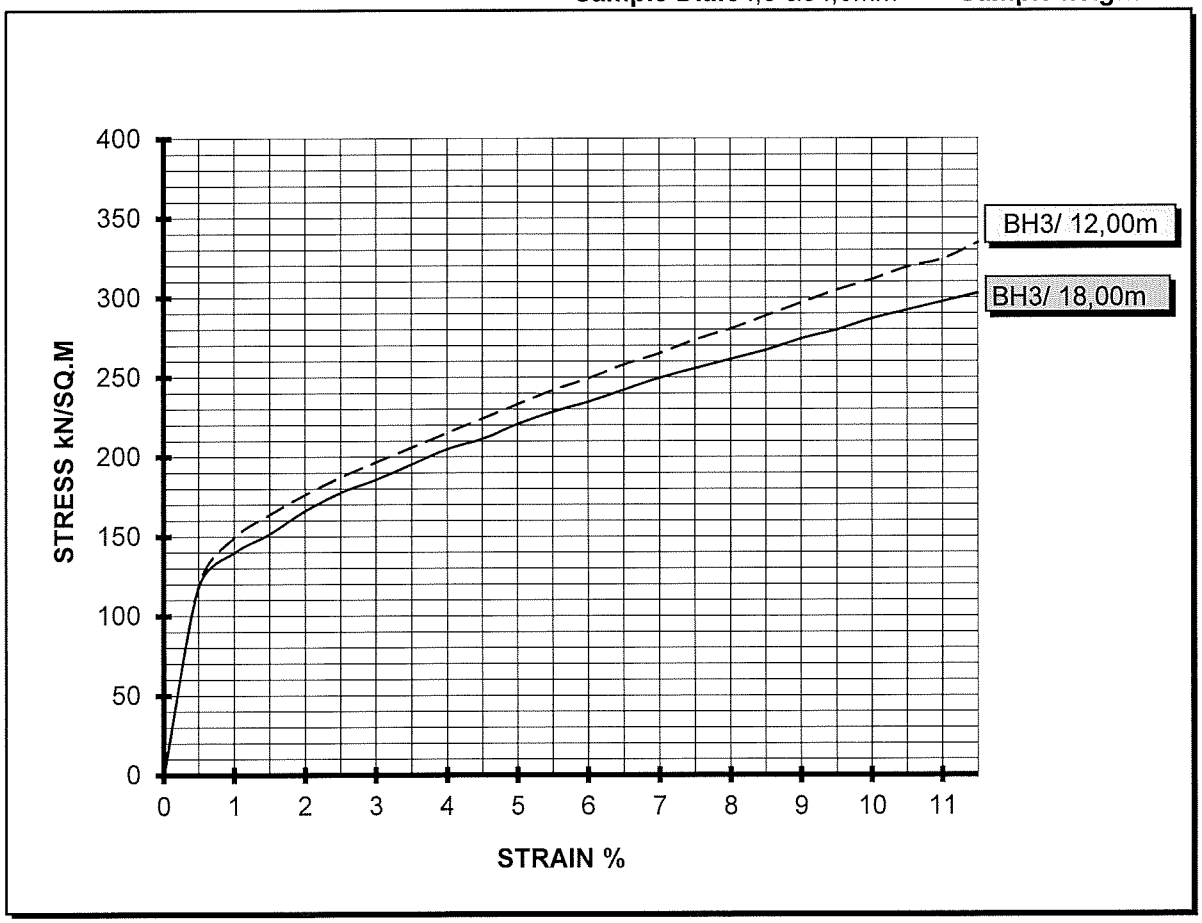
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 3 **Date:** 29/5/17

Site Location: University Campus **Depth:** 12,0&18,0m **Operator:**

Client: University of Cyprus **Soil:** 12 & 18m: Grey silty MARL

Sample Dia:34,5 &34,0mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	3	12.00	19.0	33.34	167
2	3	18.00	19.5	33.09	151

FIG. 40

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

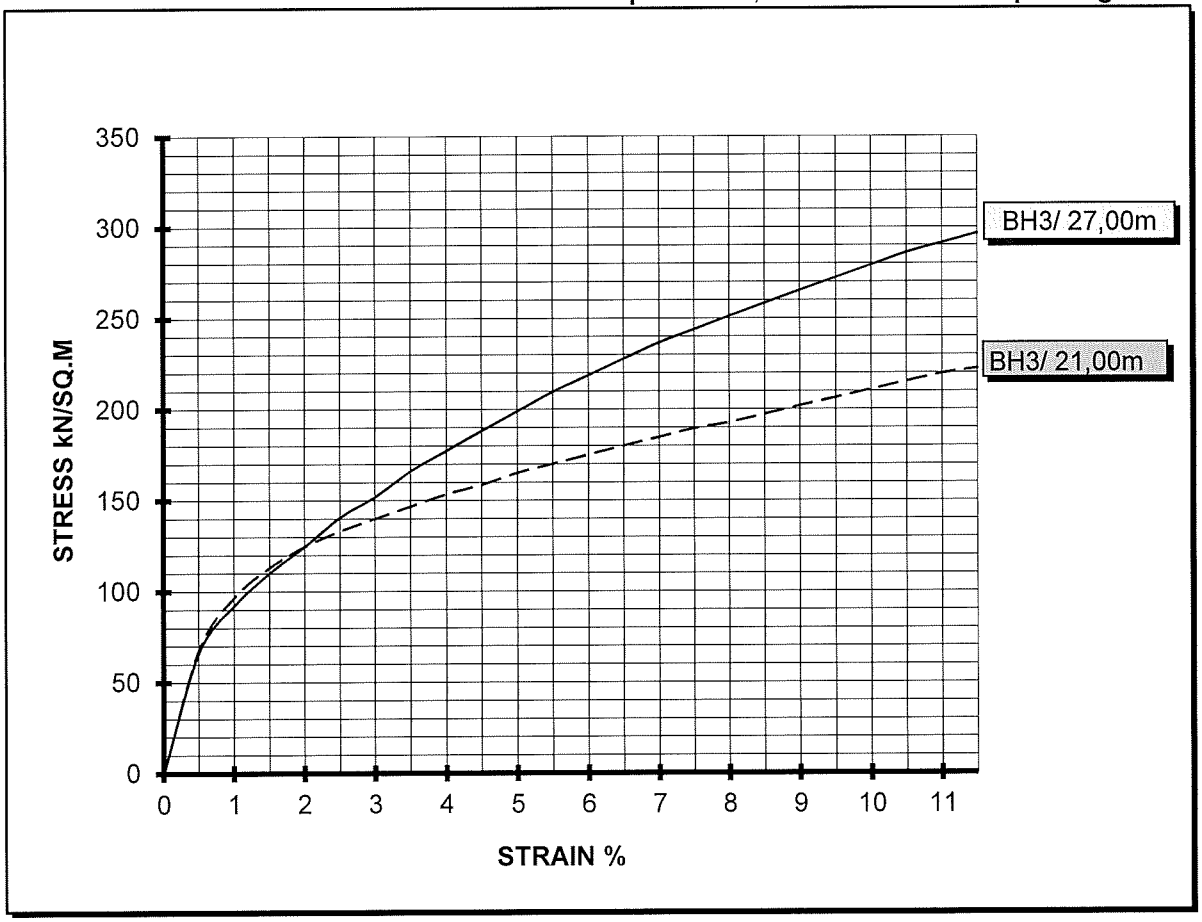
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 3 **Date:** 30/5/17

Site Location: University Campus **Depth:** 21,0&27,0m **Operator:**

Client: University of Cyprus **Soil:** 21 & 27m: Grey silty MARL

Sample Dia:34,2mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	3	21.00	19.5	34.09	111
2	3	27.00	19.4	32.51	148

FIG. 41

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

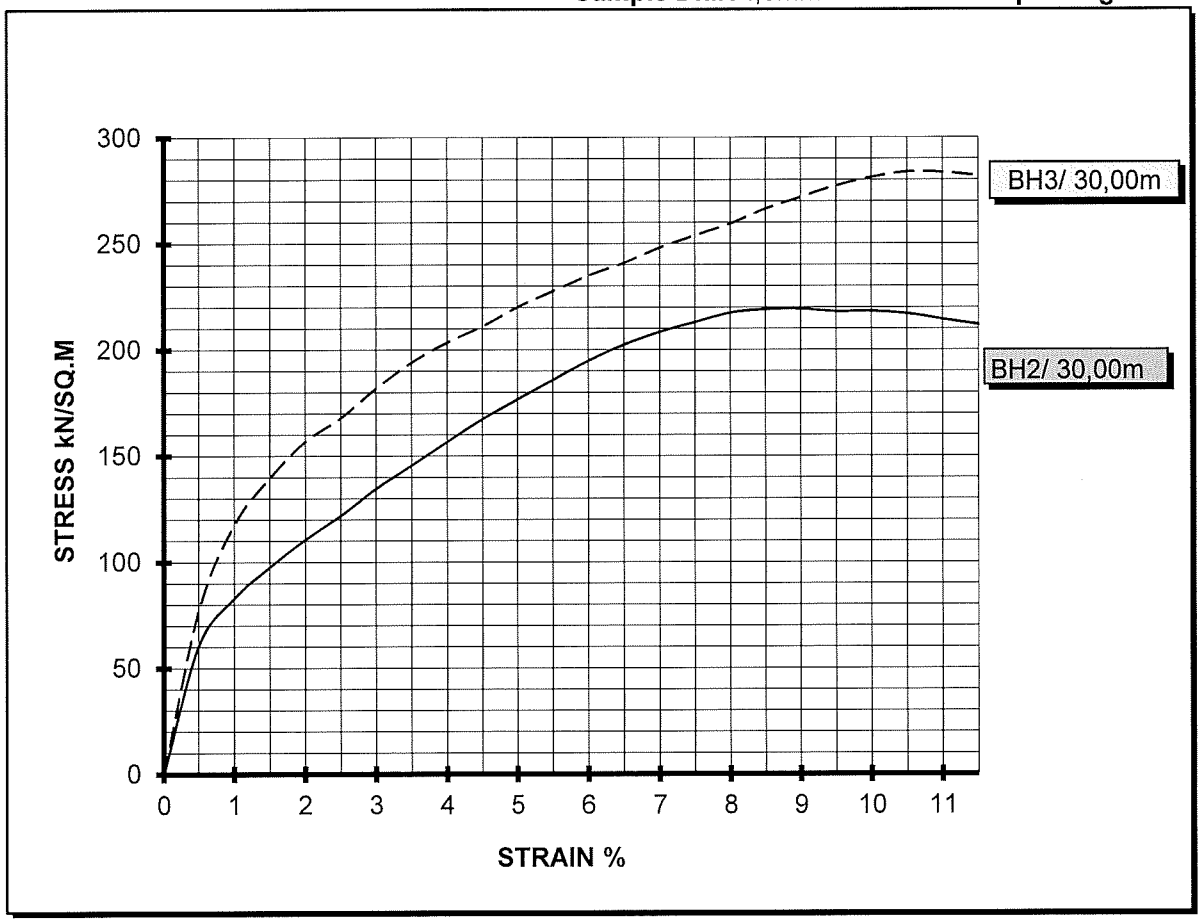
UNCONFINED COMPRESSION TEST

Project: Medical School **BH No.:** 3 & 2 **Date:** 31/5/17

Site Location: University Campus **Depth:** 30,0m **Operator:**

Client: University of Cyprus **Soil:** Grey silty MARL

Sample Dia:34,5mm **Sample height:** 70mm



Specimen No.	BH No.	Depth m	Bulk Density kN/m3	Natural Moisture Content %	Undrained Cohesion Cu kN/m2
1	3	30.00	19.4	33.31	142
2	2	30.00	18.8	33.54	109

FIG. 42

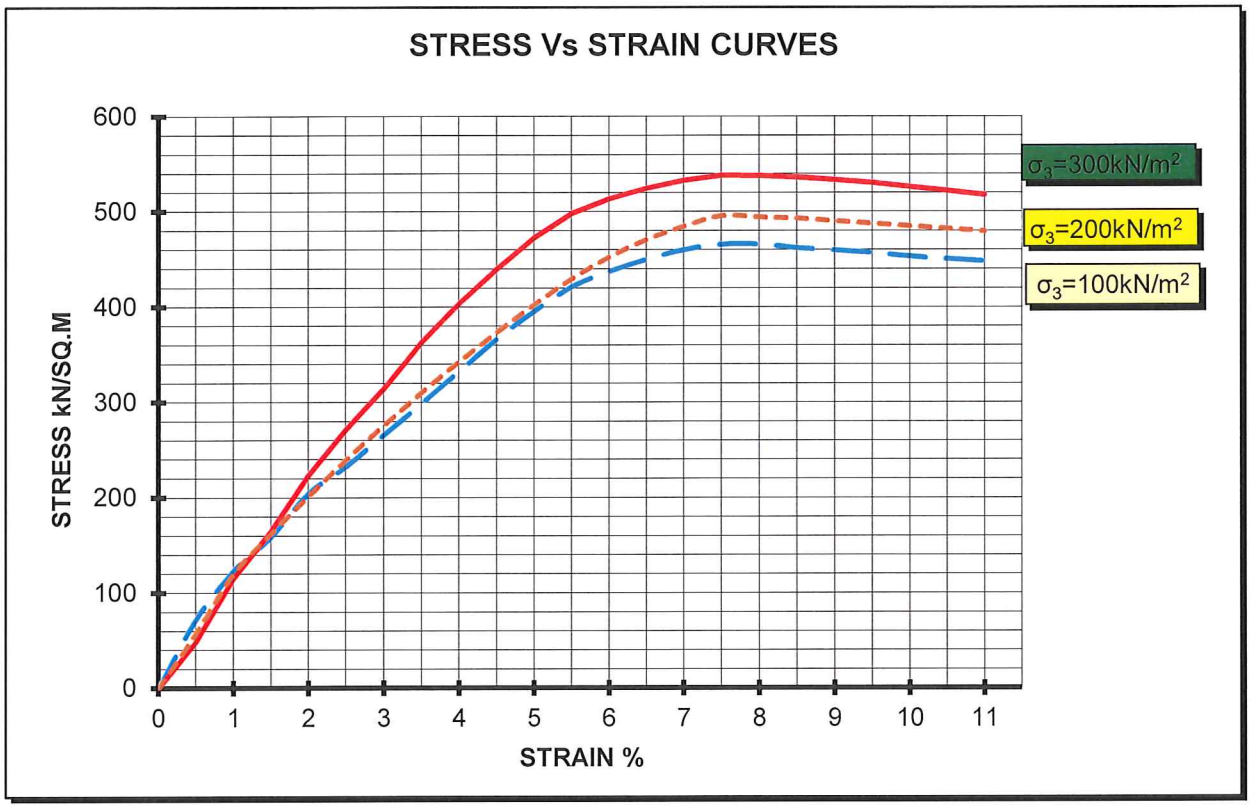
SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

UNDRAINED TRIAXIAL TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 1
Depth: 24,0m
Soil: Grey silty MARL
Sample Dia:35mm

Date:
Operator:
Sample height: 70mm



Specimen No.	Cell Pres. σ_3 kN/m^2	Bulk Dens. kN/m^3	Moist.Cont. %
1	100	19.5	33.15
2	200	19.5	32.99
3	300	19.4	32.87

FIG.43

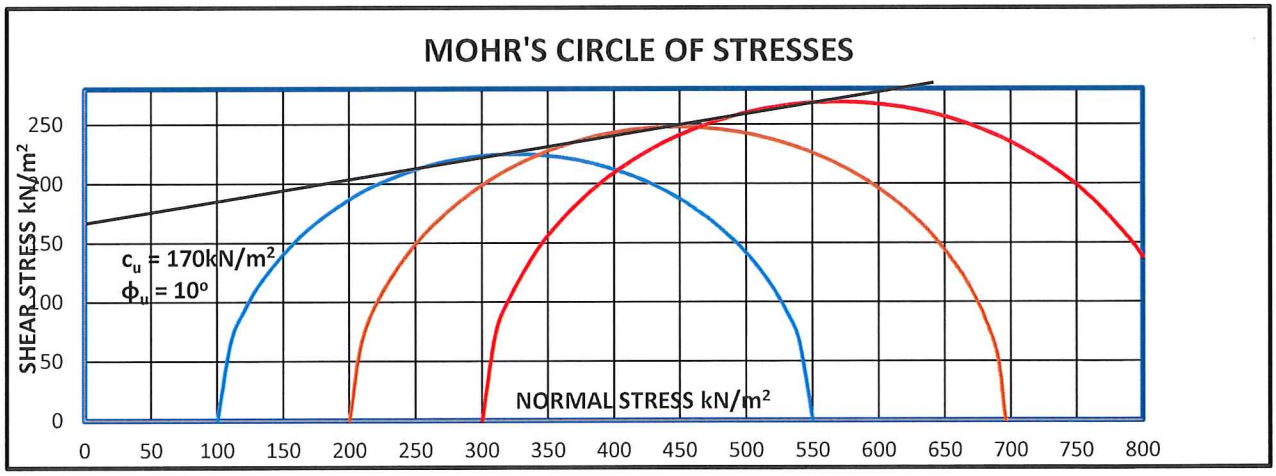


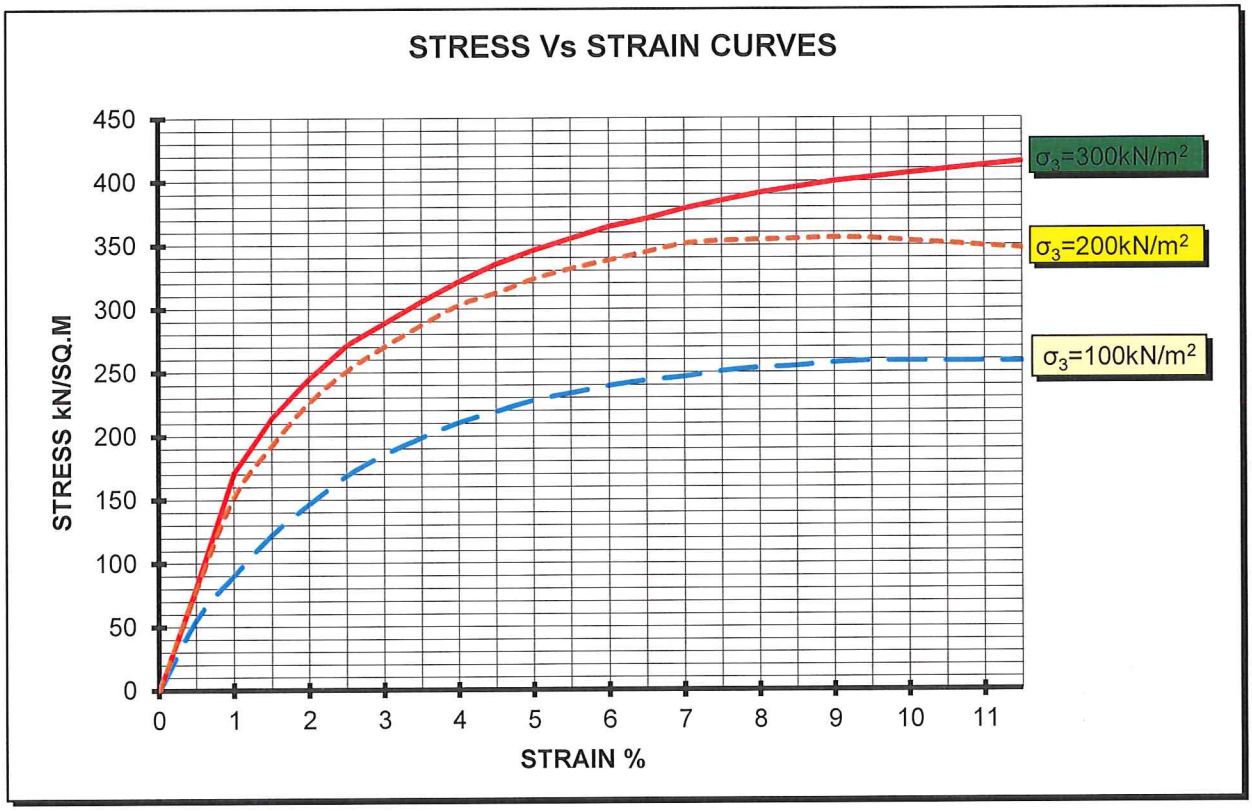
FIG. 44

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No. 22663191, Fax 22663192

UNDRAINED TRIAXIAL TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2 **Date:**
Depth: 9,0m **Operator:**
Soil: Khaki silty MARL
Sample Dia:35mm **Sample height:** 70mm



Specimen No.	Cell Pres. σ_3 kN/m^2	Bulk Dens. kN/m^3	Moist.Cont. %
1	100	19.8	27.73
2	200	19.8	29.21
3	300	19.7	29.12

FIG.45

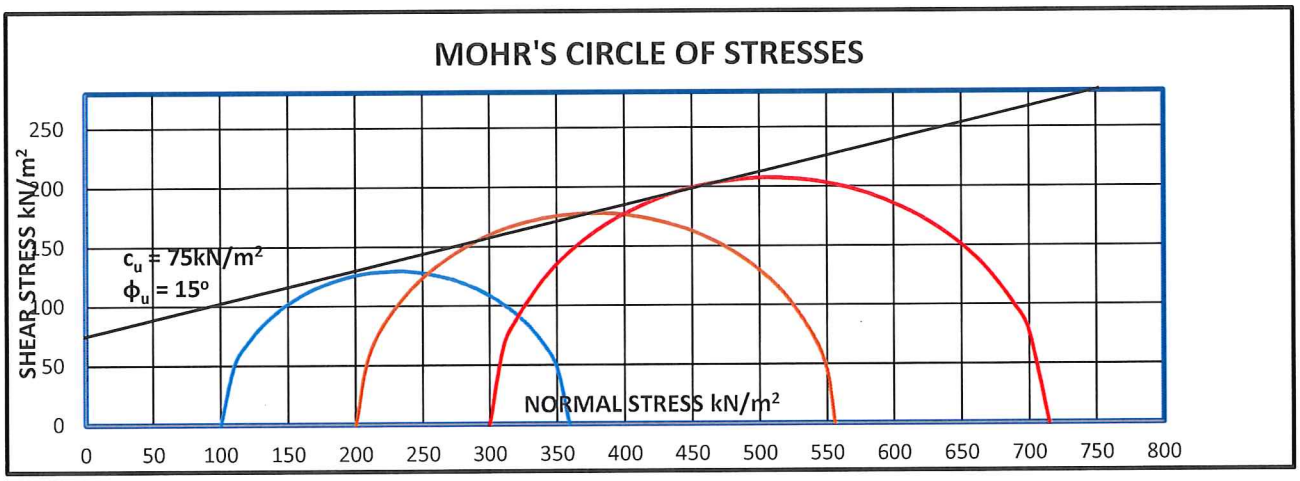


FIG.46

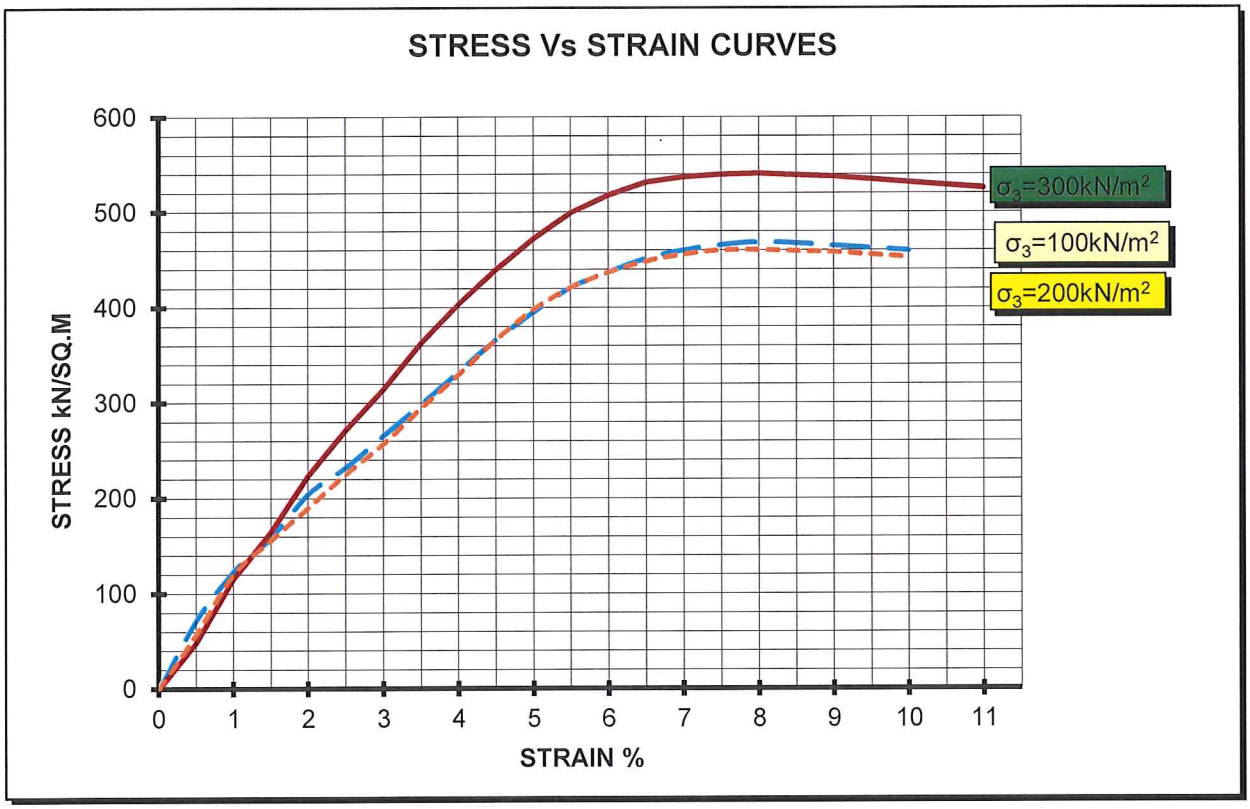
SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No. 22663191, Fax 22663192

UNDRAINED TRIAXIAL TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 15,0m
Soil: Grey silty MARL
Sample Dia:35mm

Date:
Operator:
Sample height: 70mm



Specimen No.	Cell Pres. σ_3 kN/m^2	Bulk Dens. kN/m^3	Moist.Cont. %
1	100	19.4	32.29
2	200	19.4	31.81
3	300	19.3	31.68

FIG.47

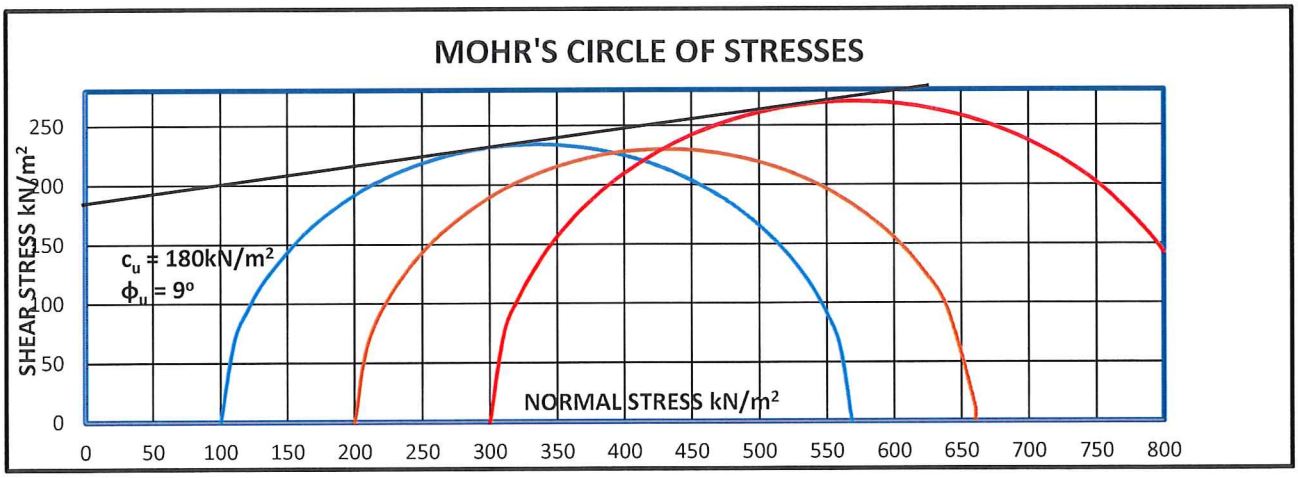


FIG. 48

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No. 22663191, Fax 22663192

CONSOLIDATION TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 1
Depth: 15,0m
Soil: Grey silty MARL

Date: 8 to 13/6/17
Operator:

e - log p curve

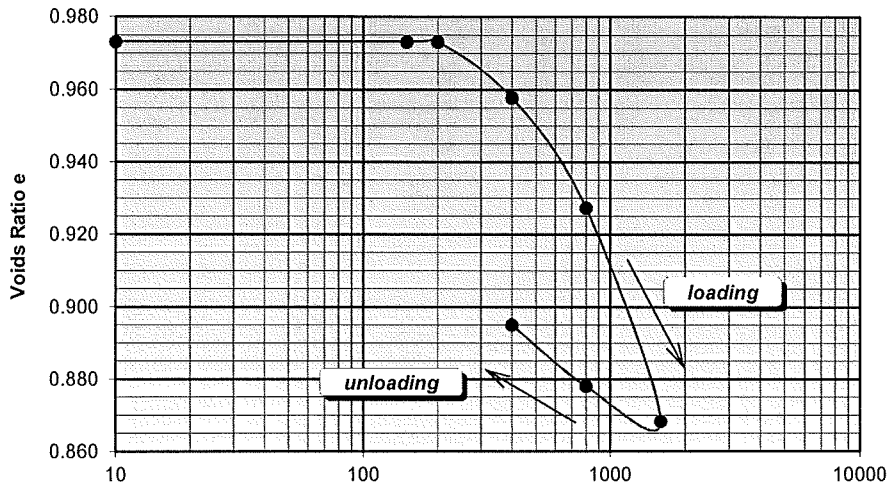


FIG. 49

m_v - log p curve

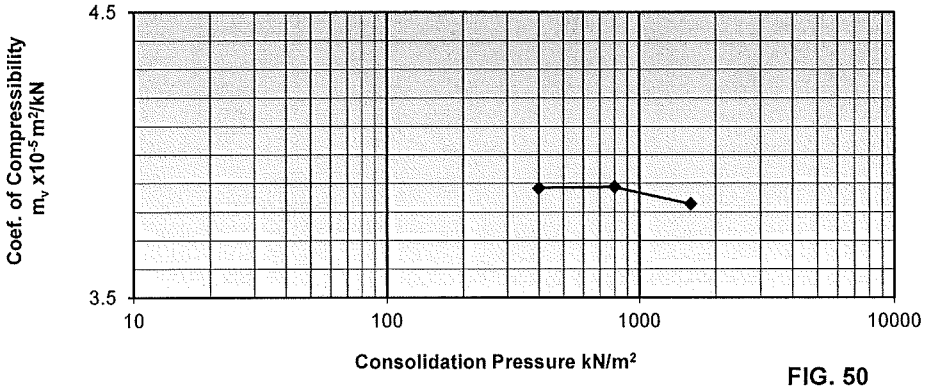


FIG. 50

Cv - log p

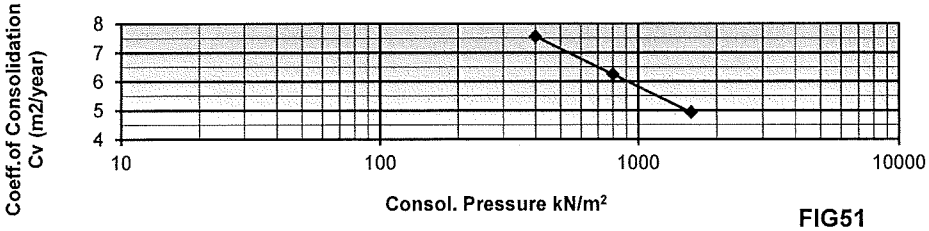


FIG51

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 1
Depth: 15,0m
Soil: Grey silty MARL

Date:8 to 13/6/17
Operator:

Pressure: 400kN/m2

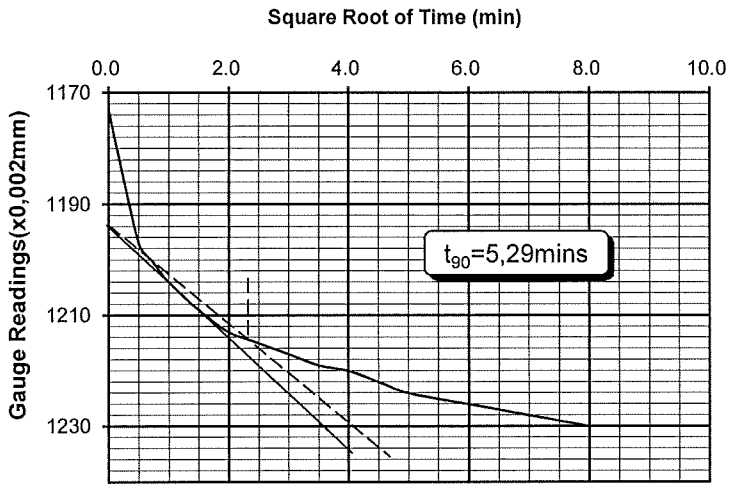


FIG. 52

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 15,0m
Soil: Grey silty MARL

Date: 24 to 29/5/17
Operator:

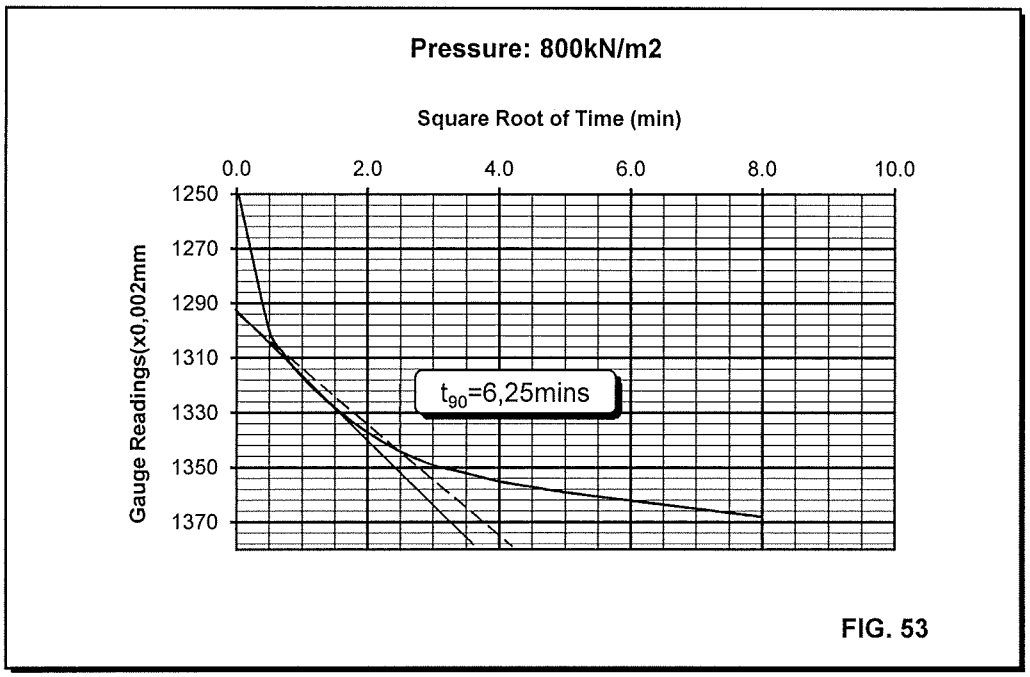


FIG. 53

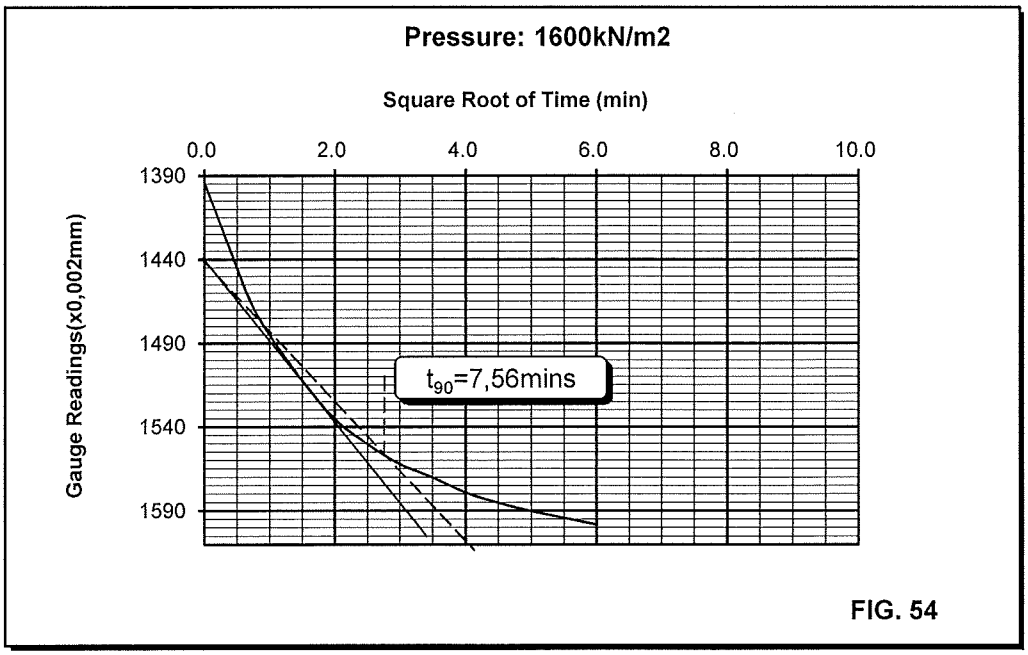


FIG. 54

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 1
Depth: 24,0m
Soil: Grey silty MARL

Date: 8 to 12/6/17
Operator:

e - log p curve

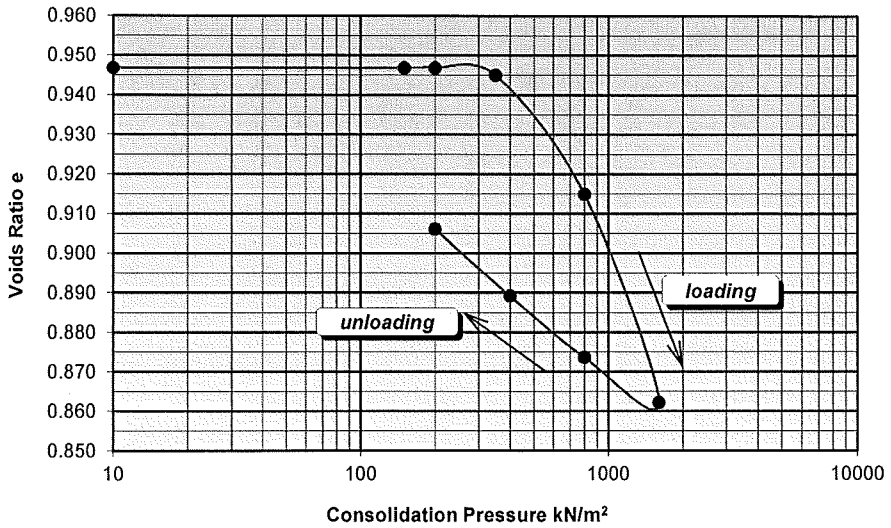


FIG. 55

m_v - log p curve

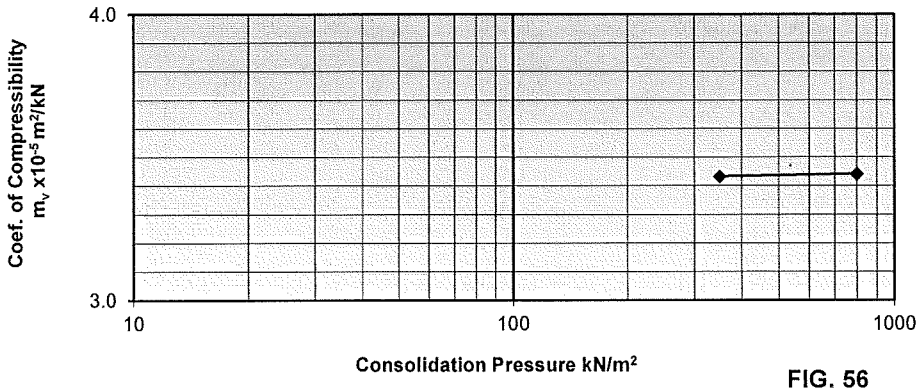


FIG. 56

Cv - log p

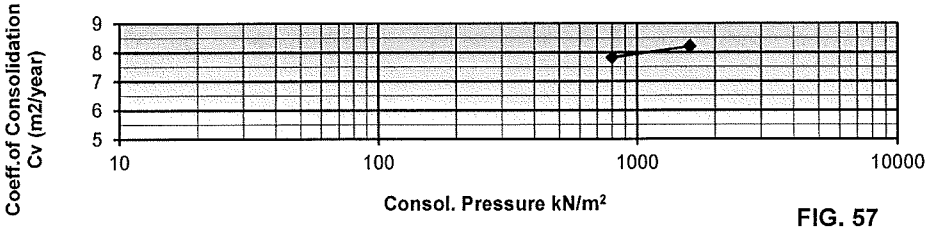


FIG. 57

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel.No.22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 1
Depth: 24,0m
Soil: Grey silty MARL

Date: 8 to 12/6/17
Operator:

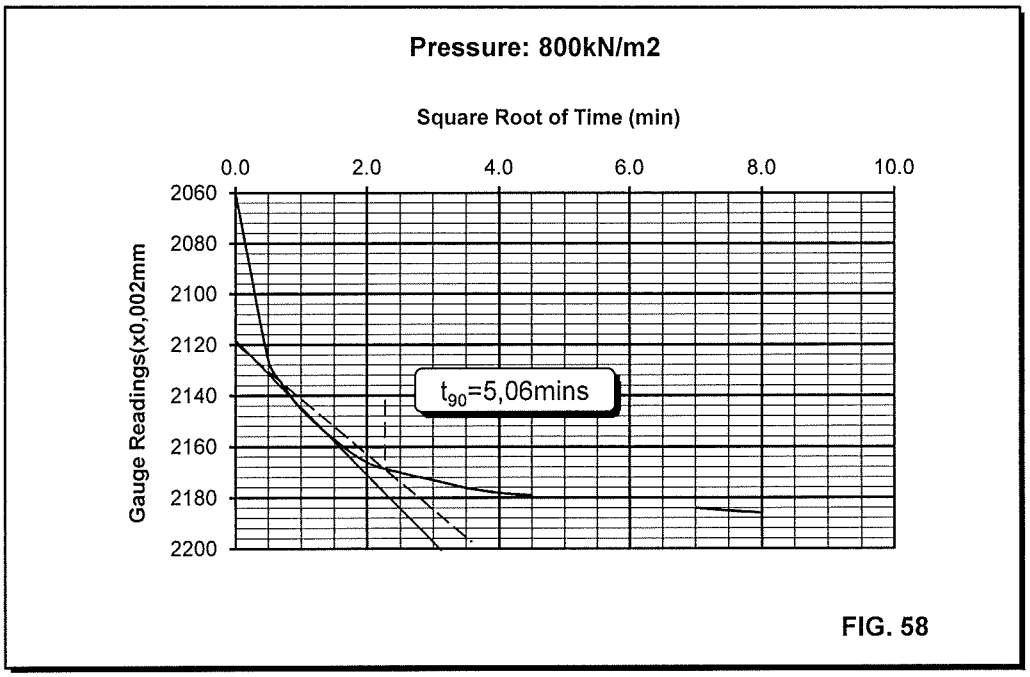


FIG. 58

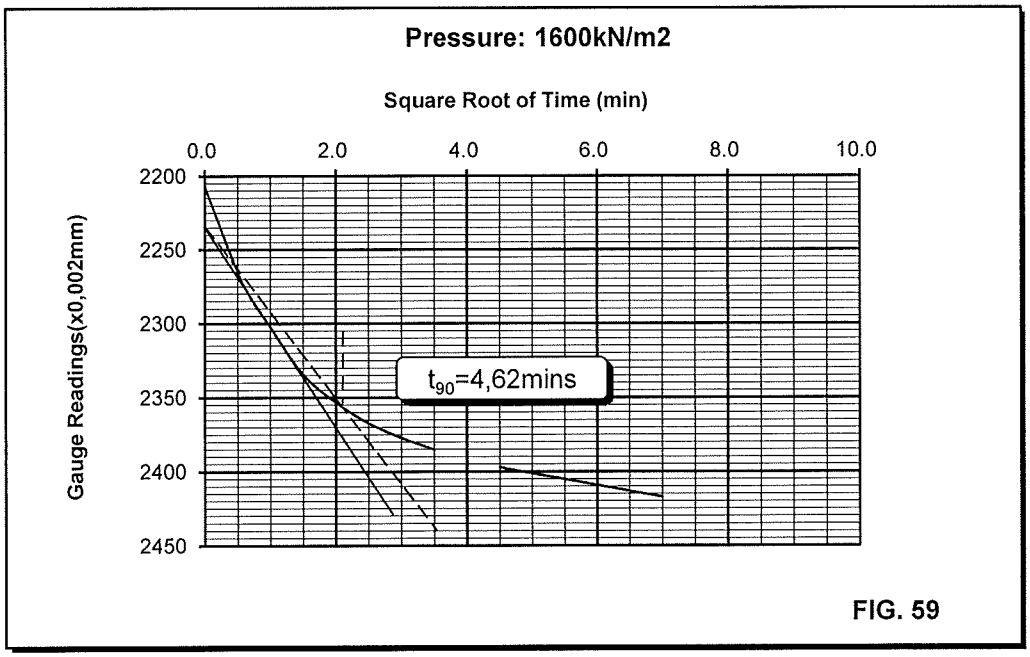


FIG. 59

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P.O.Box 25457, 1310 Nicosia
Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 9,0m
Soil: Khaki silty MARL

Date: 31/5 to 5/6/17
Operator:

e - log p curve

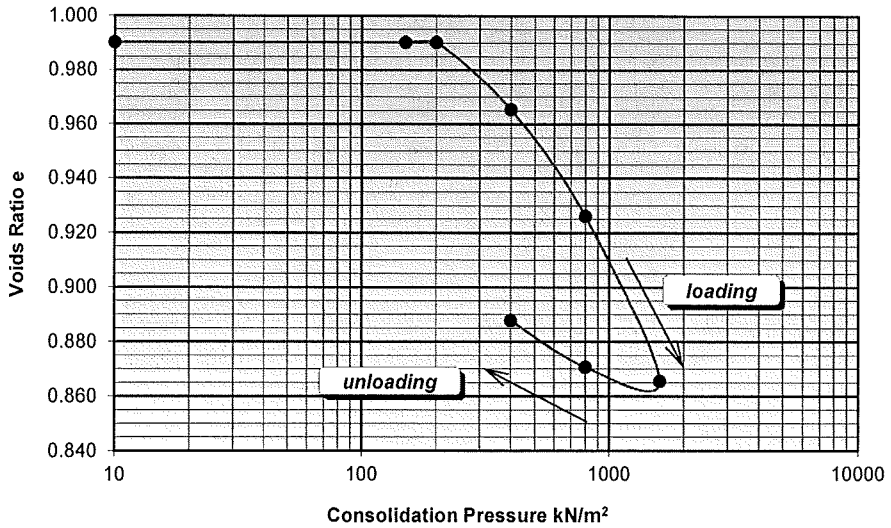

FIG. 60

m_v - log p curve

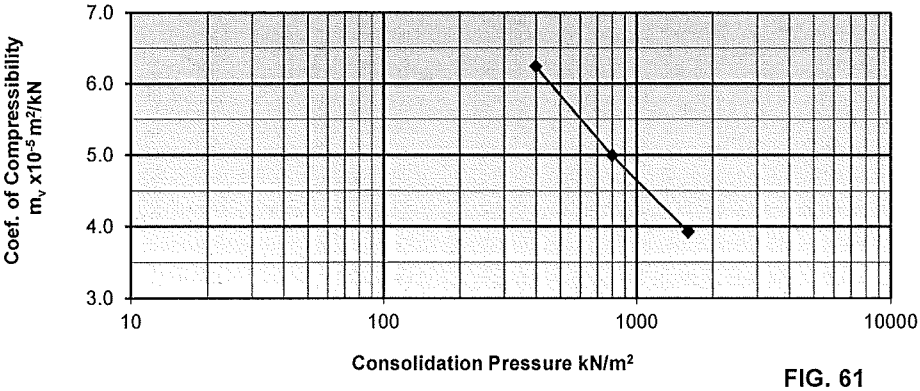

FIG. 61

Cv - log p

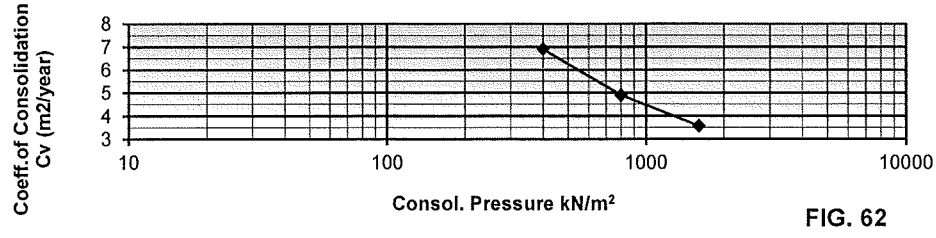

FIG. 62

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Tel.No.22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 9.0m
Soil: Grey silty MARL

Date: 31/5 to 5/6/17
Operator:

Pressure: 400kN/m2

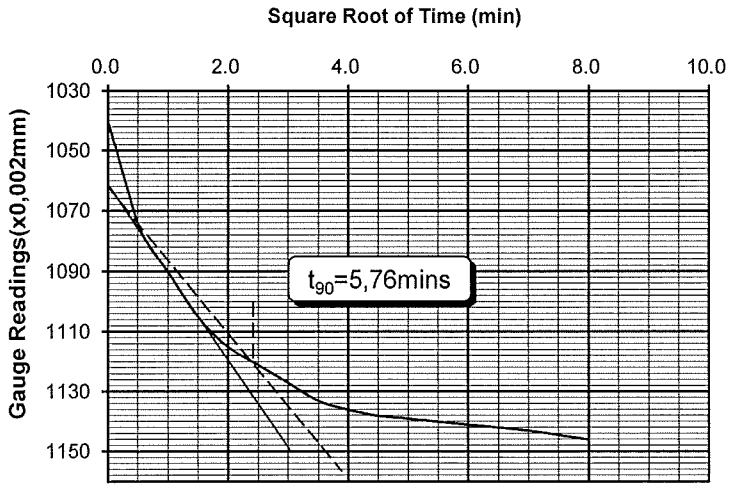

FIG. 63

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Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 9,0m
Soil: Grey silty MARL

Date: 31/5 to 5/6/17
Operator:

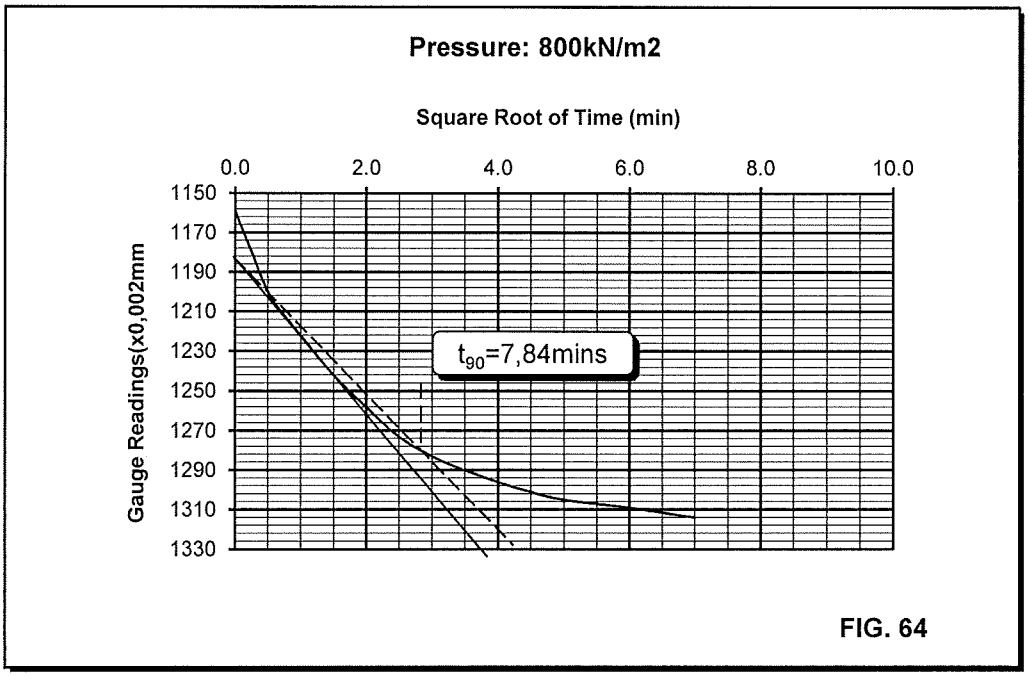

FIG. 64

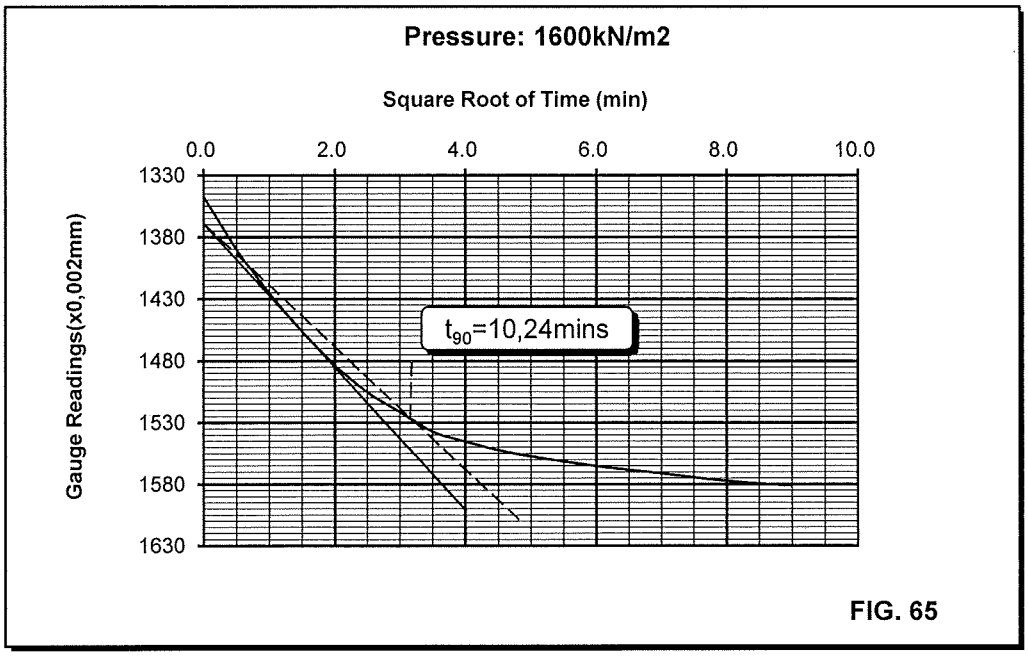

FIG. 65

SH Soil Engineering Ltd
P.O.Box 25457, 1310 Nicosia
Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 15,0m
Soil: Grey silty MARL

Date: 31/5 to 5/6/17
Operator:

e - log p curve

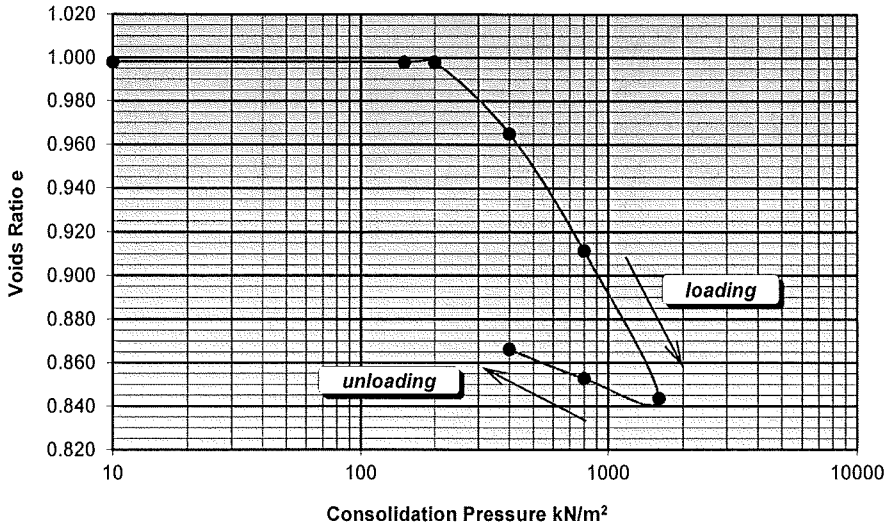

FIG. 66

m_v - log p curve

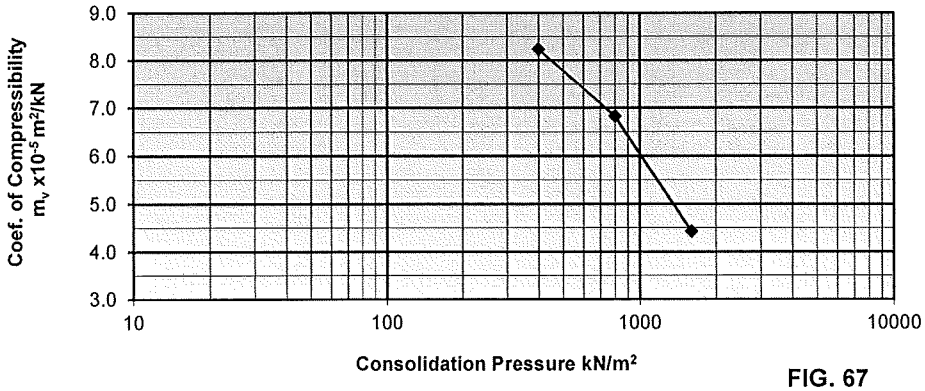

FIG. 67

Cv - log p

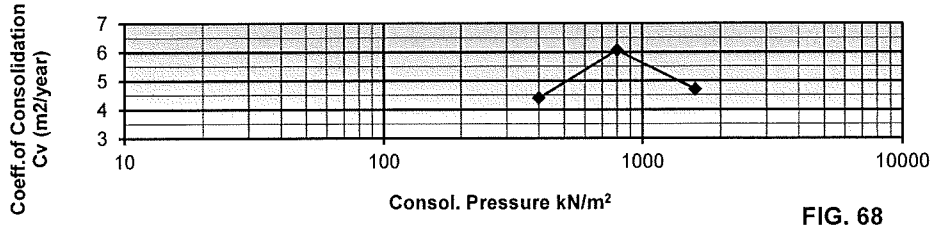

FIG. 68

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Tel.No.22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 15,0m
Soil: Grey silty MARL

Date: 31/5 to 5/6/17
Operator:

Pressure: 400kN/m2

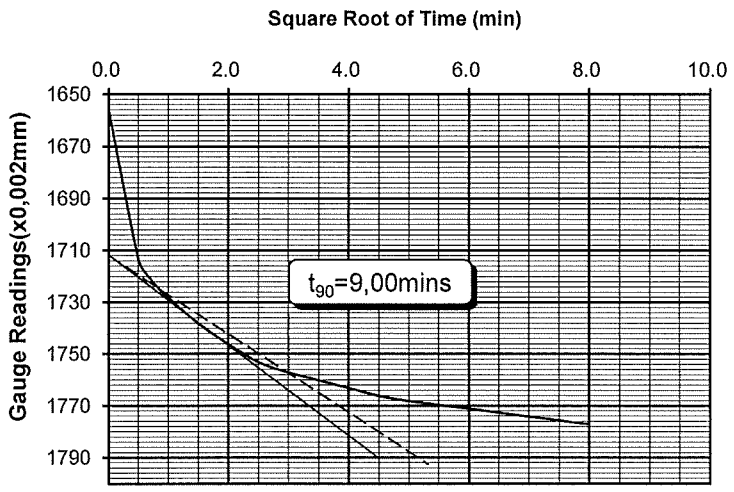

FIG. 69

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Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 15,0m
Soil: Grey silty MARL

Date: 31/5 to 5/6/17
Operator:

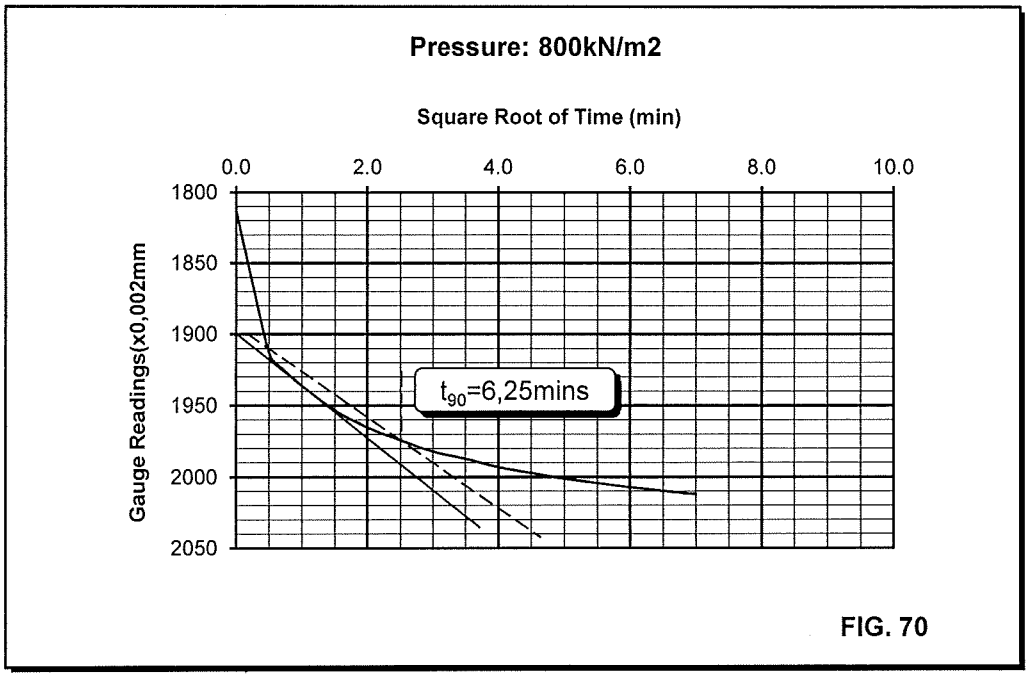

FIG. 70

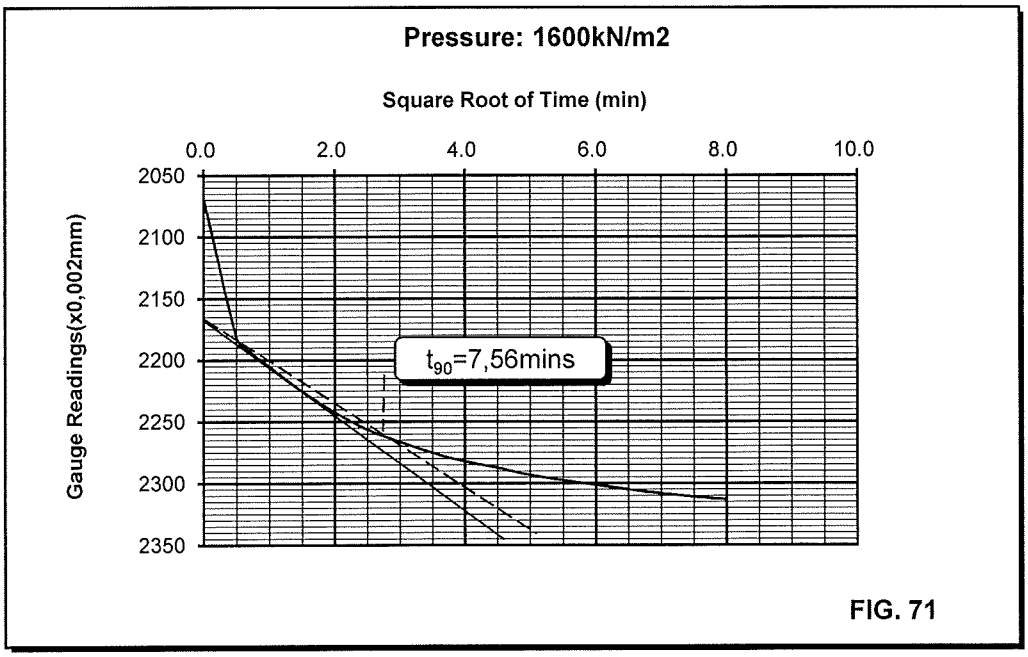

FIG. 71

SH Soil Engineering Ltd
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Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 15,0m
Soil: Grey silty MARL

Date: 24 to 29/5/17
Operator:

e - log p curve

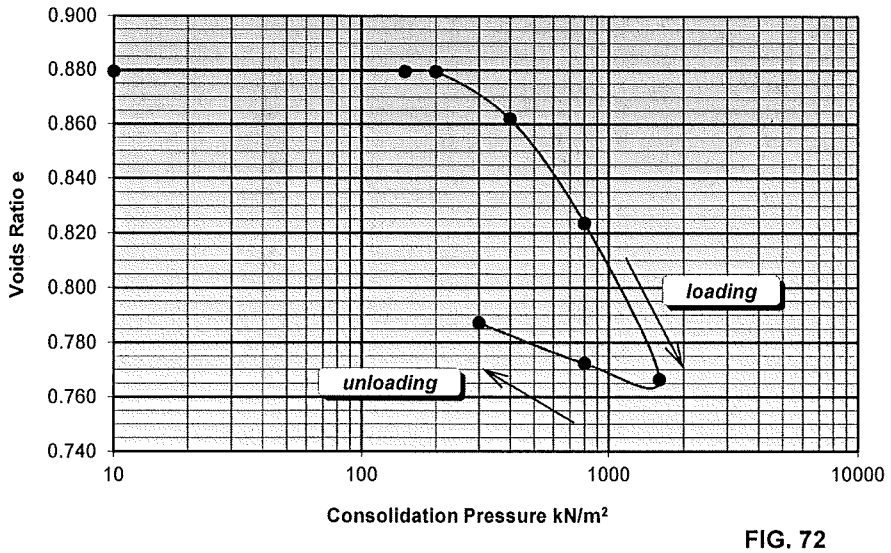

FIG. 72

m_v - log p curve

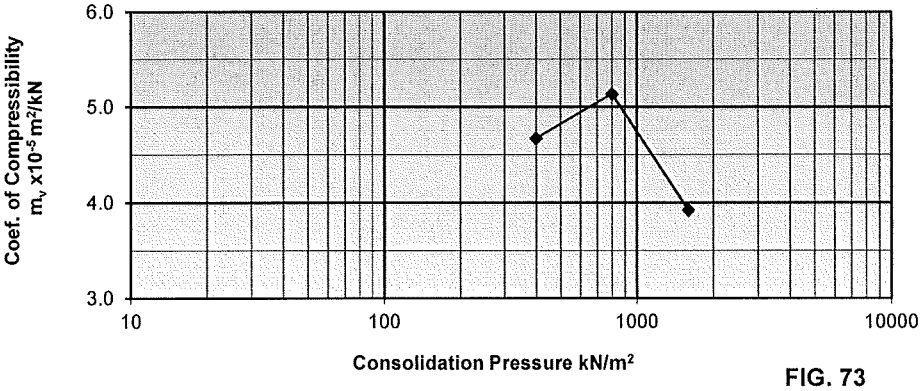

FIG. 73

Cv - log p

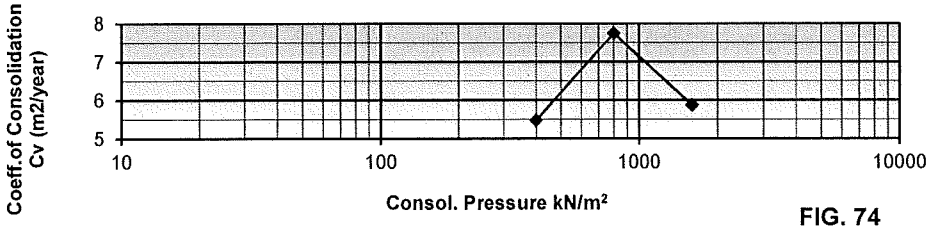

FIG. 74

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Tel.No.22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 15,0m
Soil: Grey silty MARL

Date: 24 to 29/5/17
Operator:

Pressure: 400kN/m2

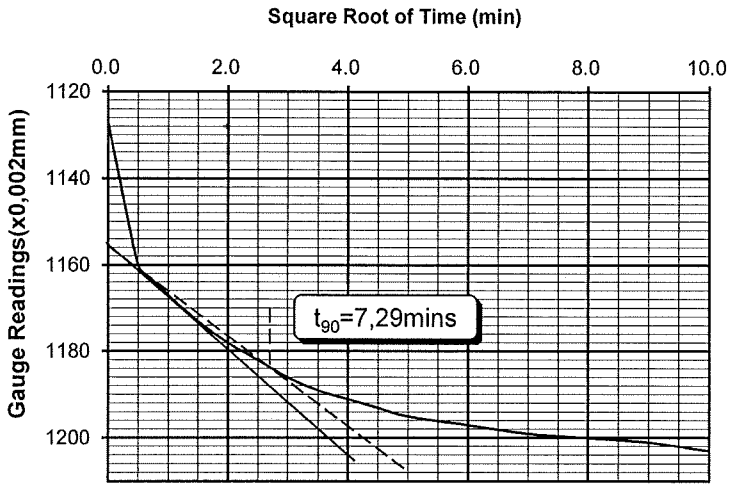

FIG. 75

SH Soil Engineering Ltd
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Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 15,0m
Soil: Grey silty MARL

Date: 24 to 29/5/17
Operator:

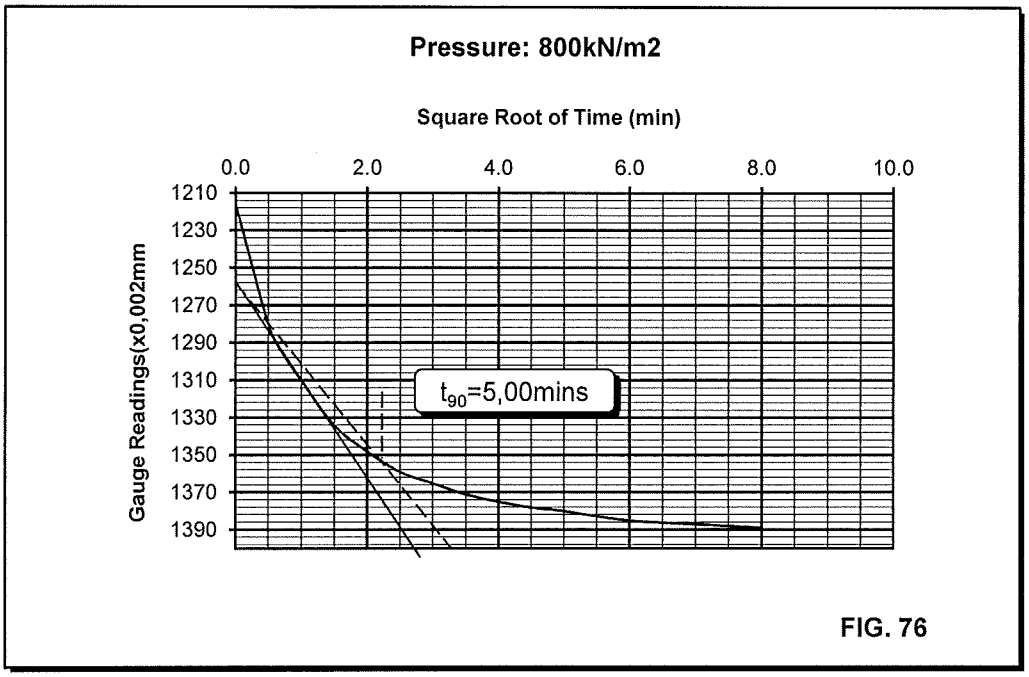

FIG. 76

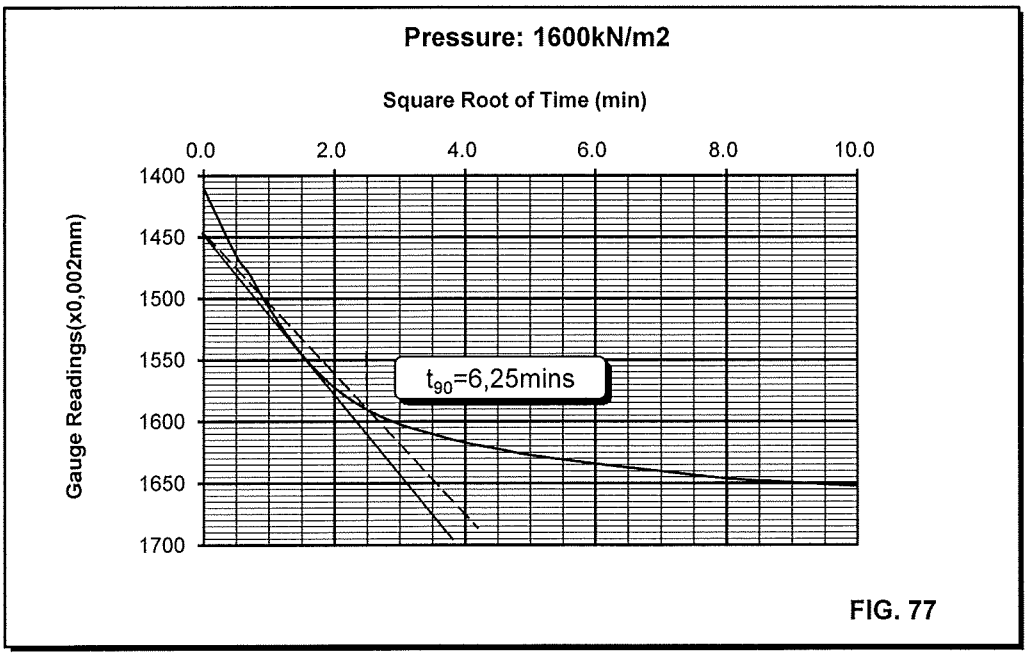

FIG. 77

SH Soil Engineering Ltd
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Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 24,0m
Soil: Grey silty MARL

Date: 24 to 29/5/17
Operator:

e - log p curve

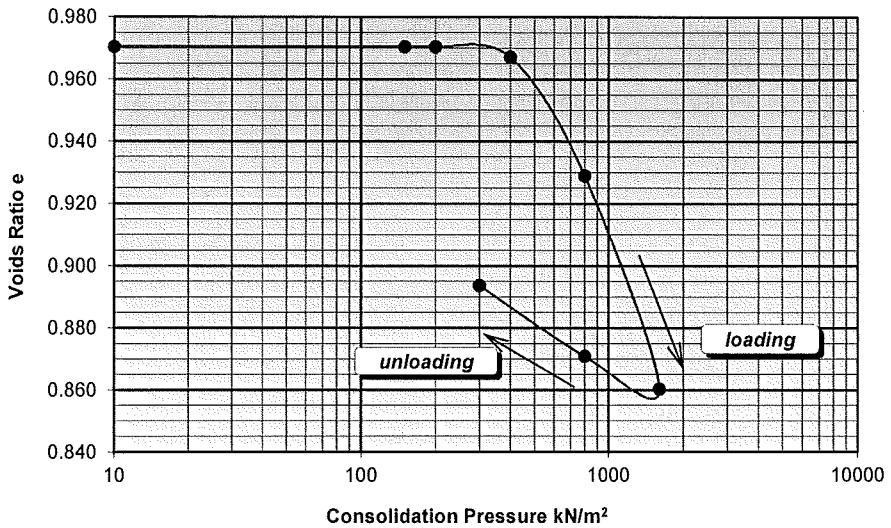

FIG. 78

m_v - log p curve

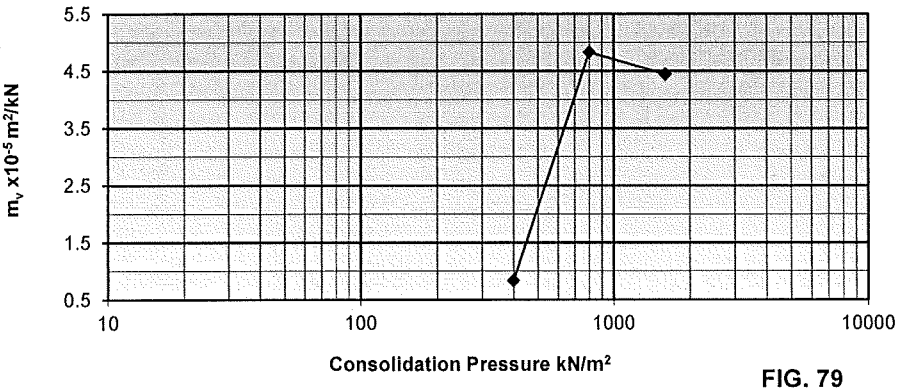

FIG. 79

Cv - log p

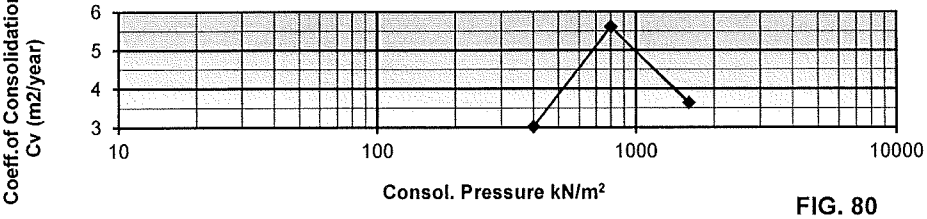

FIG. 80

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Tel.No.22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 24,0m
Soil: Grey silty MARL

Date: 24 to 29/5/17
Operator:

Pressure: 400kN/m2

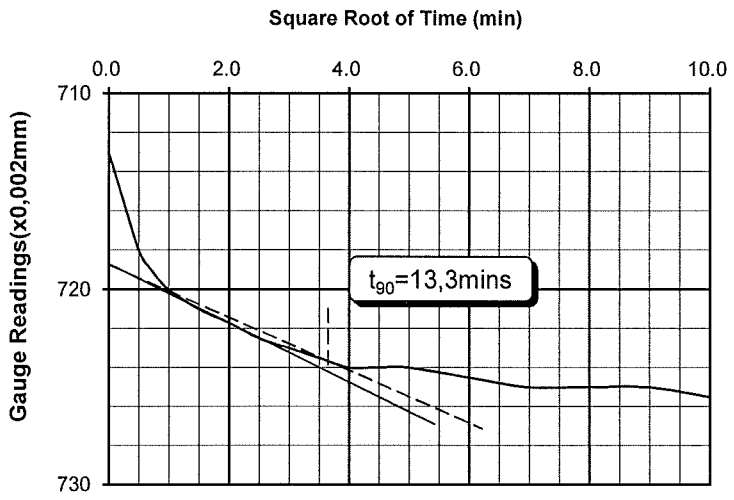

FIG. 81

SH Soil Engineering Ltd
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Tel. 22663191, Fax 22663192

CONSOLIDATION TEST

Consolidation Vs Sq.Root Time Curves

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 24,0m
Soil: Grey silty MARL

Date: 24 to 29/5/17
Operator:

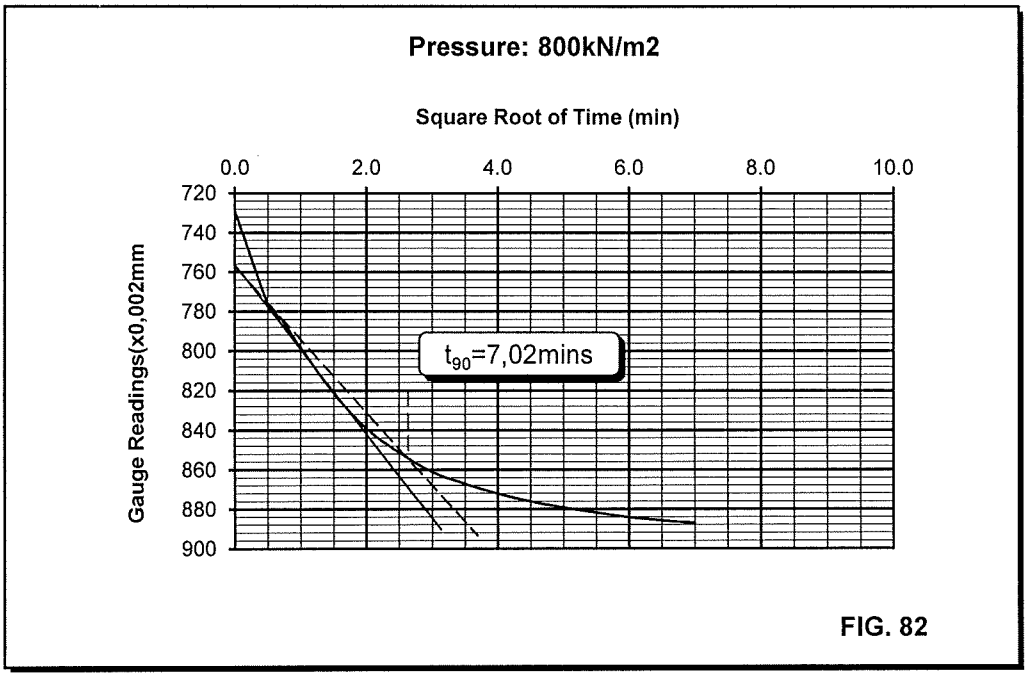

FIG. 82

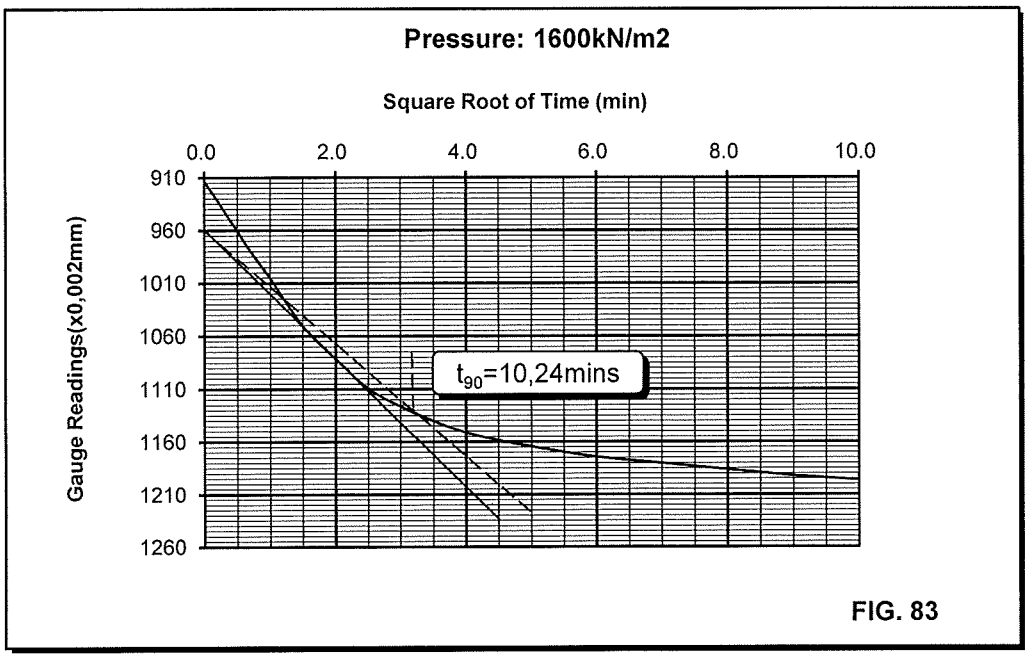

FIG. 83

SH Soil Engineering Ltd
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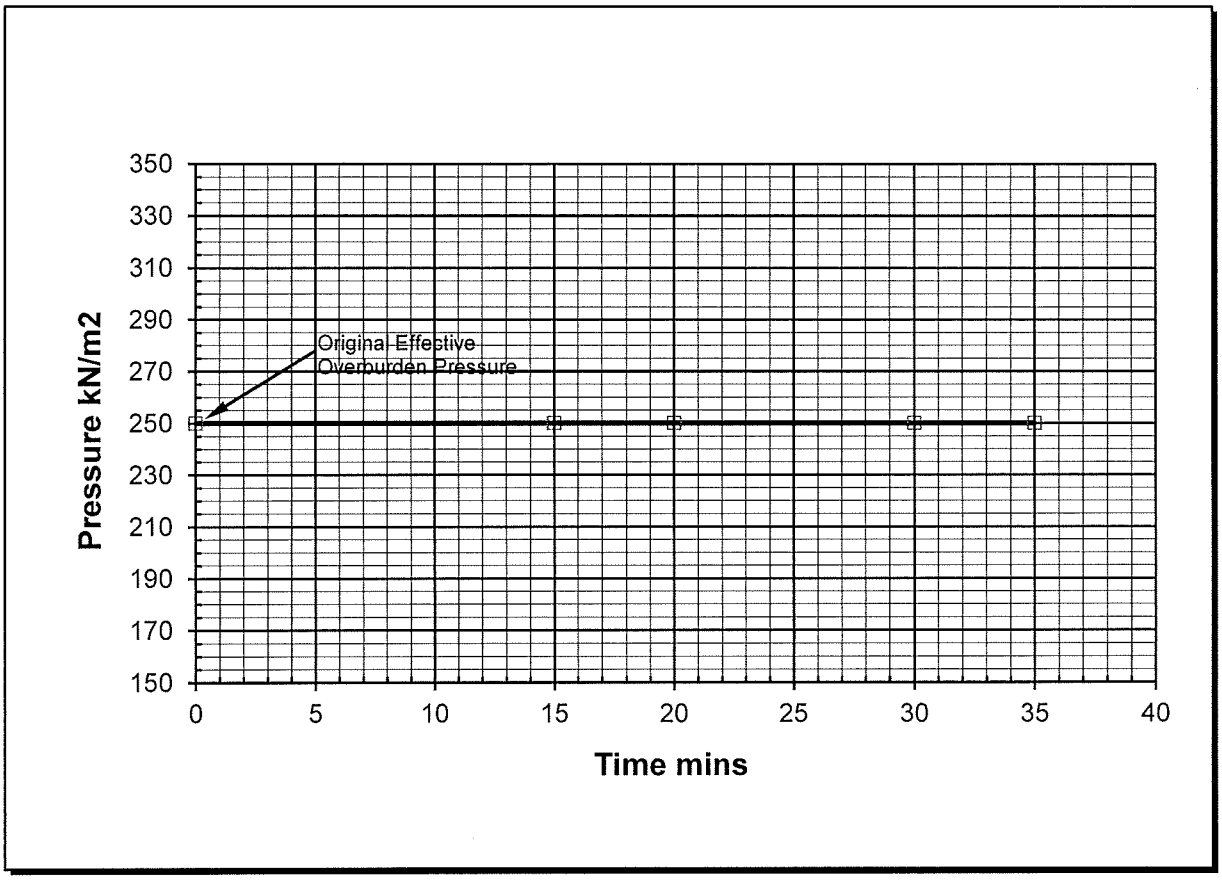
Tel. 22663191, Fax 22663192

SWELLING PRESSURE TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 1
Depth: 15,0m
Soil: Grey silty MARL

Date: 7/06/2017
Operator:



Maximum swelling pressure measured = 250-250 = **0,0 kN/m2**

NO SWELLING OBSERVED

FIG. 84

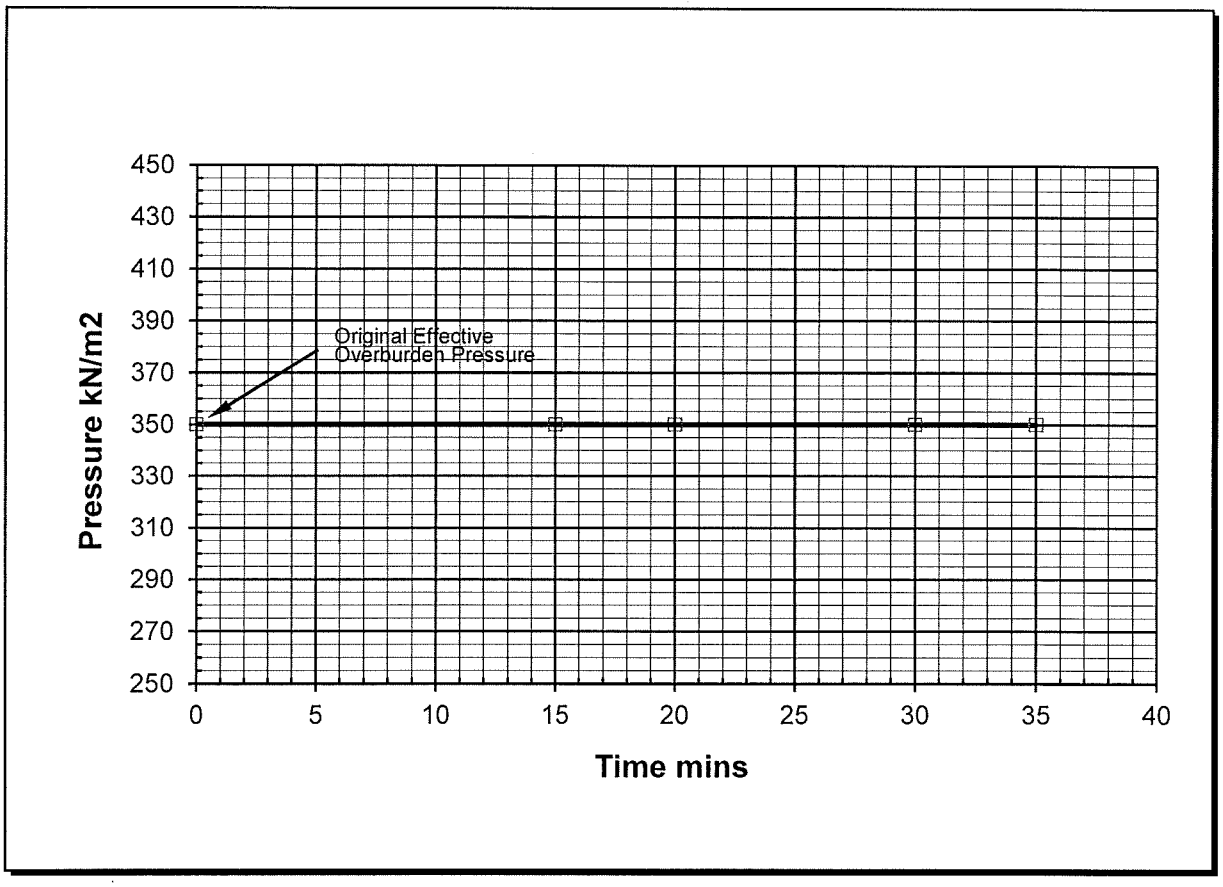
SH SOIL ENGINEERING LTD
P.O.Box 25457, 1310 Nicosia
Tel.No.22336191, Fax 22663192

SWELLING PRESSURE TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 1
Depth: 24,0m
Soil: Grey silty MARL

Date: 7/06/2017
Operator:



Maximum swelling pressure measured = 350-350 = **0,0 kN/m2**

NO SWELLING OBSERVED

FIG. 85

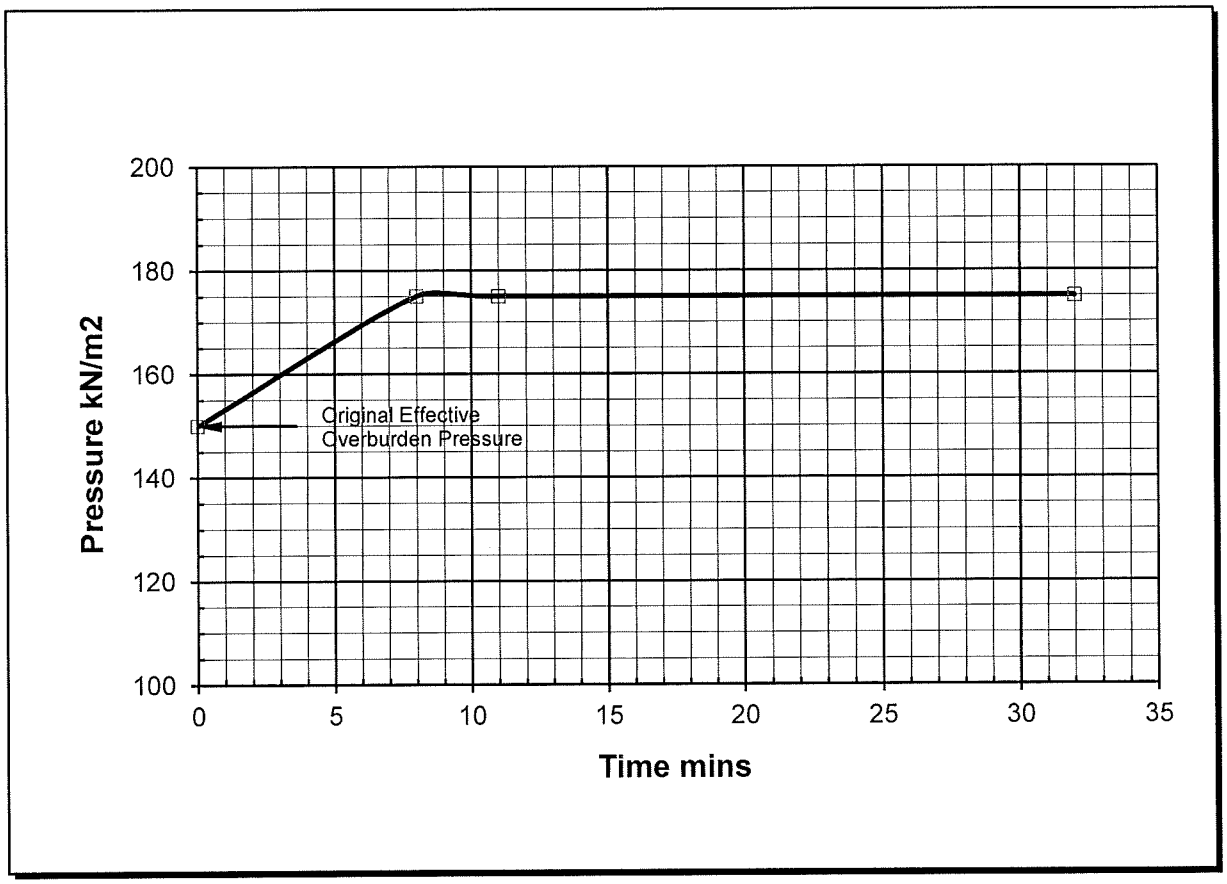
SH SOIL ENGINEERING LTD
P.O.Box 25457, 1310 Nicosia
Tel.No.22336191, Fax 22663192

SWELLING PRESSURE TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 9,0m
Soil: Khaki silty MARL

Date: 30/05/17
Operator:



Maximum swelling pressure measured = 175 -150= **25 kN/m2**

FIG. 86

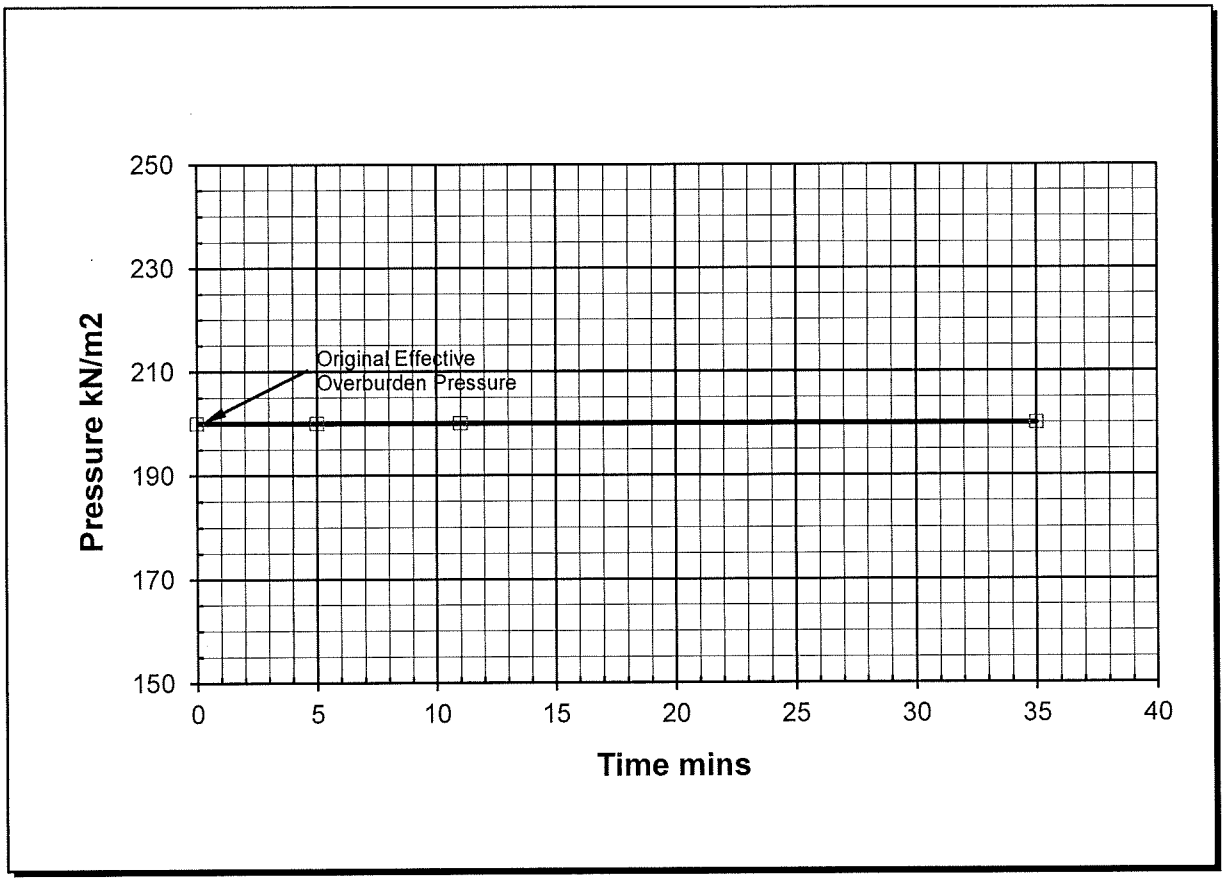
SH SOIL ENGINEERING LTD
P.O.Box 25457, 1310 Nicosia
Tel.No.22336191, Fax 22663192

SWELLING PRESSURE TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 2
Depth: 15,0m
Soil: Grey silty MARL

Date: 30/05/17
Operator:



Maximum swelling pressure measured = 200 -200= 0,00 **kN/m2**
NO SWELLING OBSERVED

FIG. 87

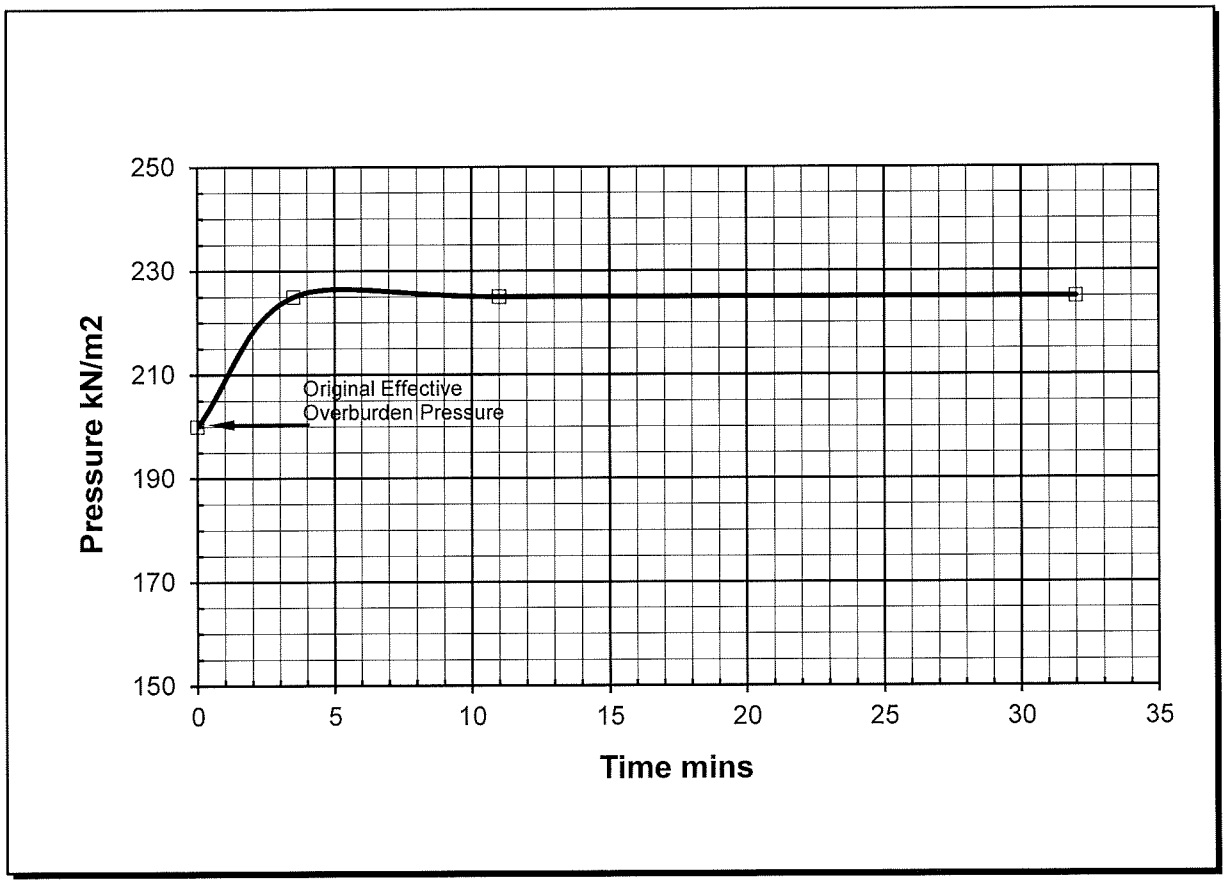
SH SOIL ENGINEERING LTD
P.O.Box 25457, 1310 Nicosia
Tel.No.22336191, Fax 22663192

SWELLING PRESSURE TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 24,0m
Soil: Grey silty MARL

Date: 24/05/17
Operator:



Maximum swelling pressure measured = 225 -200= **25 kN/m2**

FIG. 88

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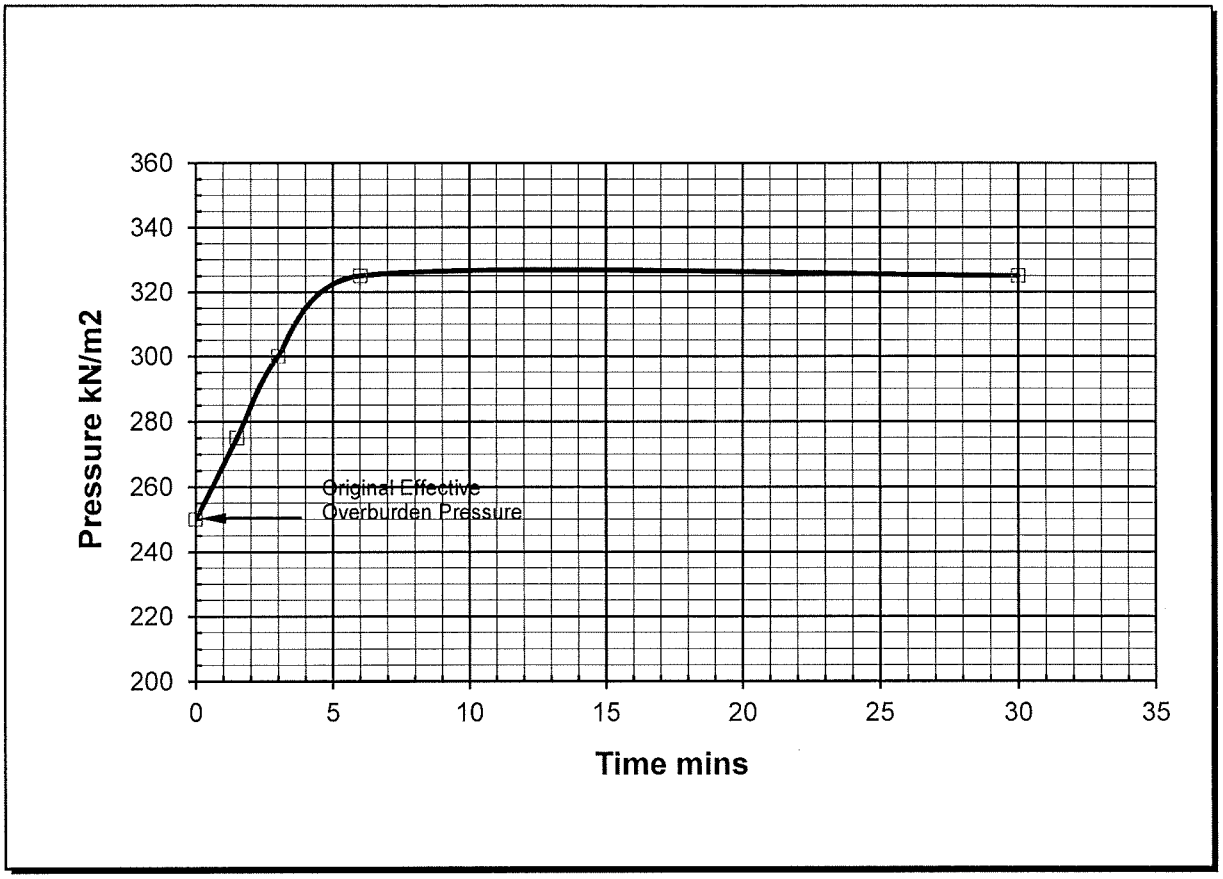
Tel.No.22336191, Fax 22663192

SWELLING PRESSURE TEST

Project: Medical School
Site Location: University Campus
Client: University of Cyprus

BH No.: 3
Depth: 24,0m
Soil: Grey silty MARL

Date: 24/05/17
Operator:



Maximum swelling pressure measured = 325-250 = **75 kN/m2**

FIG. 89

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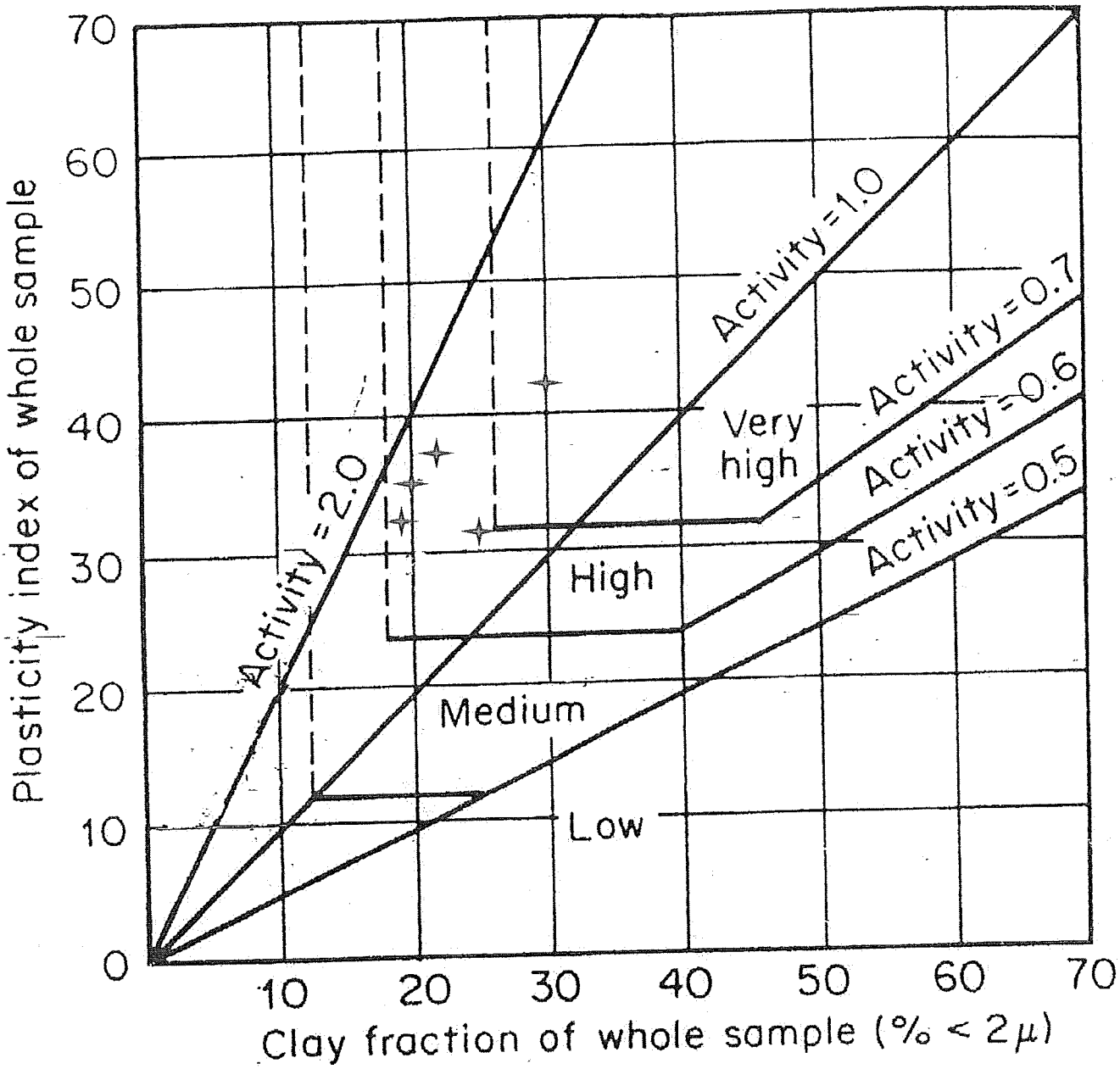
P.O.Box 25457, 1310 Nicosia
Tel.No.22336191, Fax 22663192



Potential expansiveness	Inch per foot of soil*
Very high	**1.0**
High	**0.5**
Medium	**0.25**
Low	**0**

*After Van der Merwe (1975).[65b]

FIG. 10.40 Proposed modified chart for determining expansiveness of soils. [*From Williams and Donaldson (1980)[65a]; after Van der Merwe (1975)[65b].*]