

CE.CA.P.
Analysis and Verification of
Foundations and Settlements

geo&soft[®]
international

Geo Soft di ing. Giorgio Scioldo

Summary

Chapter 1 - Introduction to the program	1
Introduction to the program	1
Bearing Capacity of Superficial Foundation	1
Settlement of Superficial Foundations.....	2
Bearing Capacity for Deep Foundations	4
Chapter 2 - System requirements and program installation	7
System requirements.....	7
Program Installation.....	7
Chapter 3 - The program protection.....	9
Hardware protection key.....	9
Hardware protection key - Parallel port	9
Windows 95, Windows 98 and Windows Me.....	9
Windows NT, Windows 2000 and Windows XP	9
Hardware protection key - USB port.....	9
Windows 95, Windows 98, Windows Me, Windows 2000 and Windows XP	10
Windows NT	10
Chapter 4 - Using the program in a local network	11
Using the program in a local network	11
Chapter 5 - General information	12
Usage Notations	12
Chapter 6 - User Interface	13
User Interface and Data Entering	13
User Interface: Menu Bar and Menus.....	13
The Graphical Output Preview Window.....	13
The Input Dialogue Windows.....	14
Data Input With Tables	15
Message Windows.....	16
Help On Line.....	16
Chapter 7 - Commands.....	17
Files Menu (ALT,F).....	17
New Command (ALT,F,N)	17
Open Command (ALT,F,O).....	17
Save Command (ALT,F,S)	17
Printer Setup Command (ALT,F,P).....	18
Edit Menu (ALT,E).....	19
Stratigraphy Command (ALT,E,S).....	19
The "Geotechnical parameters of the stratigraphy" Dialog Box	19
Foundation Command (ALT,E,F).....	21
Bearing capacity of foundation Command (ALT,E,F,C).....	21
The "Foundation geometry" Dialog Box - Superficial foundation	21
Settlement of Foundations Command (ALT,E,F,F).....	22
Description of Superficial Foundations Command (ALT,E,F,C,F).....	22
The "Foundation geometry" Dialog Box - Settlements	23
Multiple Foundations Command (ALT,M).....	24

Define Multiple Foundations Command (ALT,E,F,C,M,D)	24
The "Open" Dialog Box - Define Multiple Foundations	24
The "Multiple Foundations" Dialog Box	24
Disable Command (ALT,E,F,M,D)	25
Bearing Capacity of the Pile Command (ALT,E,F,P)	25
The "Pile characteristics" Dialog Box	25
The "Parameters of calculations" Dialog Box	26
Methods Command (ALT,E,M)	27
Terzaghi Method (1943)	27
Meyerhof Method (1963)	27
Hansen Method (1970)	28
Vesic Method (1974)	28
Titles Command (ALT,E,T)	28
Print Menu (ALT,P)	29
Graphic Outputs Command (ALT,P,G)	29
Bearing Capacity of Superficial Foundations Command (ALT,P,G,B)	29
Settlement of Foundations Command (ALT,P,G,F)	29
Bearing Capacity of the Pile Command (ALT,P,G,P)	29
Stratigraphy Command (ALT,P,G,S)	29
Listings Command (ALT,P,L)	29
Preview Listings Command (ALT,P,L,P)	29
Bearing Capacity of Foundations Command (ALT,P,L,P,C)	29
Settlement of Foundations Command (ALT,P,L,P,F)	30
Details Settlement Table Command (ALT,P,L,P,D)	30
Pile Bearing Capacity Command (ALT,P,L,P,P)	30
Listings Fast Print Command (ALT,P,L,F)	30
Bearing Capacity of Foundations Command (ALT,P,L,F,C)	30
Settlement of Foundations Command (ALT,P,L,F,F)	30
Details Settlement Table Command (ALT,P,L,F,D)	30
Bearing Capacity of the Pile Command (ALT,P,L,F,P)	30
Export Listings in DOC Format (ALT,P,L,E)	30
Bearing Capacity of Foundations Command (ALT,P,L,E,C)	30
Settlement of Foundations Command (ALT,P,L,E,F)	30
Details Settlement Table Command (ALT,P,L,E,D)	30
Bearing Capacity of the Pile Command (ALT,P,L,E,P)	31
Export Listings in TXT format (ALT,P,L,T)	31
Bearing Capacity of Foundations Command (ALT,P,L,T,C)	31
Settlement of Foundations Command (ALT,P,L,T,F)	31
Details Settlement Table Command (ALT,P,L,T,D)	31
Bearing Capacity of the Pile Command (ALT,P,L,T,P)	31
Export Listings in SLK Format (ALT,P,L,S)	31
Bearing Capacity of Foundations Command (ALT,P,L,S,C)	31
Settlement of Foundations Command (ALT,P,L,S,F)	31
Details Settlement Table Command (ALT,P,L,S,D)	31
Bearing Capacity of the Pile Command (ALT,P,L,S,P)	31
Configure Command (ALT,P,C)	32
Exit Menu (ALT,X)	33
Chapter 7 - Generation and modification of geological textures	34
The Editret program	34
Creation of a new pattern	34
How to modify a pattern	35
How to copy an existing pattern	35
How to delete an existing pattern	35
Patterns used in drawing stratigraphies	36

Chapter 1 - Introduction to the program

Introduction to the program

The CE.CA.P. program is a complete package related to the calculation of foundation interventions: bearing capacity of superficial foundations, settlements of superficial foundations, bearing capacity of deep foundations.

Bearing Capacity of Superficial Foundation

The calculation of the superficial foundation bearing capacity is characterized by the large amount of potential offered in terms of the calculation method. It enables one to calculate the data with the formulas presented by Terzaghi, Meyerhof, Hansen and Vesic. These formulae are distinguished by the geometric complexity of the situations dealt with and by the diverse approaches in the formulation of the hypothesis relative to soil failure mechanisms.

CE.CA.P. deals with geotechnical problems in homogeneous or stratified terrains; it automatically determines the average value in the area of interest of the foundation, it then shows those values on the screen permitting eventual modifications.

CE.CA.P. can also work under seismic conditions. It uses the pseudostatic method normally used in civil engineering calculations.

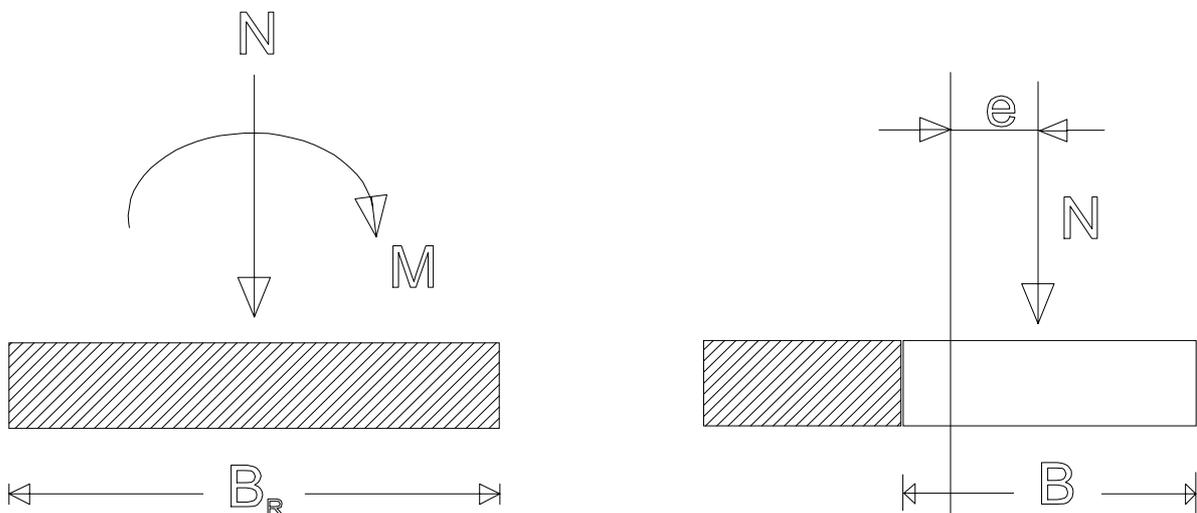
The calculation module for the bearing capacity of superficial foundations was derived and based on the work "Foundation Analysis and Design", by J.E. Bowles, edited by McGraw-Hill (fourth edition); it can verify foundations with various geometries: squared, rectangle, round and strip.

The general method used in this program consists in determining the "Qa" which is the allowable ground pressure corresponding to the foundation plane for a given geometry and stratigraphy.

"Qa" is derived from the last or failure pressure "Qlast" and the minimum safety factor required by regulations (SF).

The last tension or failure pressure is the strictly geotechnical result of the superficial foundation bearing capacity calculation. It represents the absolute maximum tension, and to surpass this will result in ground failure. Note that the loads must be calculated in correspondence with the foundation plane and so the vertical load must account for the weight of the foundation and the moments must cover the horizontal load's transportation moment for the entire distance between the groundlevel plane and the foundation plane.

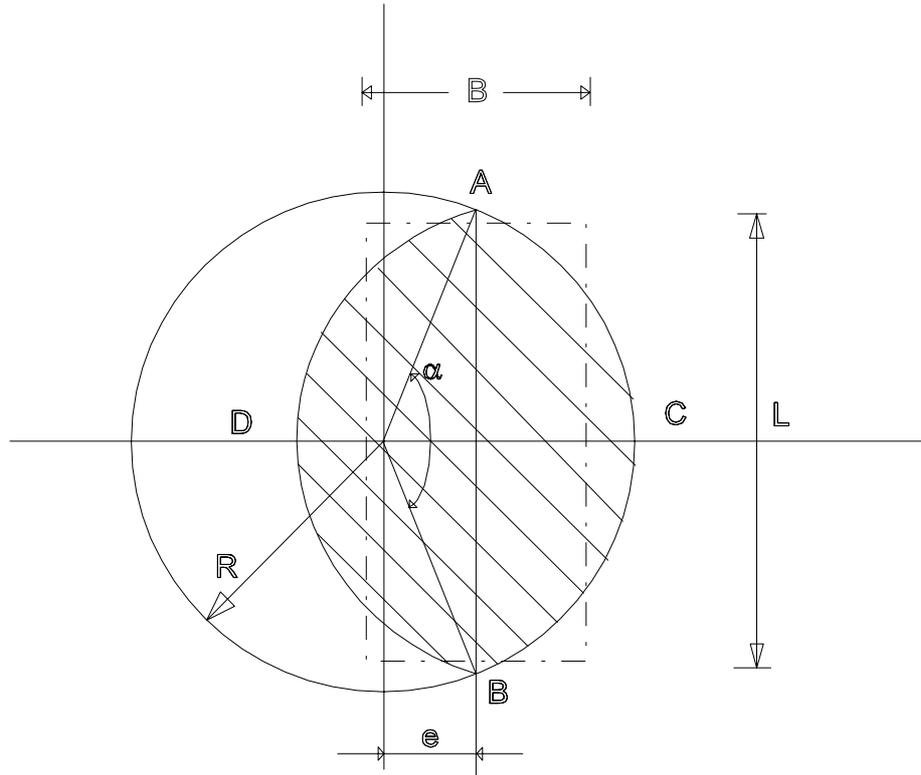
The safety factor relative to the actual load conditions is determined by comparing the effective vertical tension, that is the ratio between the normal load and the effective area, with the final failure pressure on the ground. Remember that the term effective area refers to an area that has been reduced to gain the effect of the presence of moments applied to the foundation which cause the vertical load to result eccentric. The useful area is symmetric with respect to the application point of the vertical load, therefore the dimensions of the foundation result as reduced two times the eccentricity of the same load.



B_R = width of the real foundation

e = eccentricity of the resultant of the loads = M/N

B = effective area = $B_R - 2 * e$



$$\frac{B}{L} = \frac{DC}{AB}$$

$$\text{AREA}(B * L) = 2 * \left[R^2 * \cos^{-1} \left(\frac{R-h}{R} \right) - (R-h) (2R * h - h^2)^{0.5} \right]$$

$$h = R - e$$

Settlement of Superficial Foundations

The module dedicated to settlement of superficial foundations allows calculations in homogeneous and stratified grounds. The foundation can be stressed by vertical loads and by moments so that it is possible to determine the foundation rotation due to differential settlement. The calculation procedure used allows the evaluation of settlement for square, rectangle, round and strip foundations.

The program is based on a numerical method with which the influence zone of the foundation is reconstructed. Then the deformations are calculated, separately considering the components of immediate elastic deformation and those of long term consolidation due to the drainage of layers of fine and very fine saturated materials. The flexibility of the method is such that by varying the type of data introduced the calculations can be carried out according to the more frequently used theories in addition to the standard numerical method proposed by the program.

The program allows also individually described foundations to be grouped, and the effect of tensions induced by the foundations surrounding the one currently being examined to be evaluated.

This allows more complicated cases to be analysed:

1. influence of neighbouring foundations;
2. foundations with various geometries (for instance, the breaking up of an L foundation into two separate foundations with the same stratigraphy);
3. foundations on non-homogeneous material (for example, the breaking up of a foundation into many elements and associating the corresponding stratigraphy to each).

Fundamentally, two texts were used for the realisation of this module:

J.E. Bowles, "Foundation Analysis and Design", ed. McGraw-Hill, fourth ed.

C. Cestelli Guidi, "Tecnica delle Fondazioni", ed. Hoepli, eighth ed.

General Method (Boussinesq)

The general method used in this program allows the separate evaluation of immediate settlement and long term settlement components in stratified terrains. Immediate settlement, due to the rapid elastic deformation of the solid ground skeleton, is determined for one elementary layer of H thickness through this general expression:

$$DH = (H \cdot Dp) / Es$$

where:

DH = reduction of elementary layer thickness

Es = elastic ground modulus

Dp = additional tension induced by the foundation in the examined point

Long term settlement, due to the slow drainage of fine and very fine grained soils, are determined for one elementary layer of H thickness through this general expression:

$$DH = H Cr' \log((p_0' + Dp1) / p_0') + H Cc' \log((pc' + Dp2) / pc')$$

where:

DH = reduction of elementary layer thickness

Cr' = recompression ratio

Cc' = compression ratio

p_0' = effective tension corresponding to the elementary layer

pc' = reconsolidation tension at the excavation plane. It is derived from the sum of the effective vertical tension from the ground level plane before excavations and from the reconsolidation tension applied at the ground level plane: the latter is the input value for the treatment of overconsolidated material.

Dp = additional tension induced by the foundation in the point examined.

Dp1 = minimum value between Dp and pc'

Dp2 = maximum value between $Dp - pc'$ and zero

In the case in which Cr' is zero (normal-consolidated terrain), the expression is simplified like this:

$$DH = H Cc' \log((p_0' + Dp1) / p_0')$$

The method is based on a general numerical calculation procedure subdivided in two phases.

In the first phase the foundation is subdivided into elementary sections and assigned to each one of these sections is the corresponding fraction of applied total load understood as the sum of the normal load and the vertical components derived from the moments.

Obtained in this way, the load is not considered as applied locally to the centre of the elementary areas, but homogeneously distributed on them: the integration by Newmark in the equation by Boussinesq permits therefore an excellent evaluation of the induced tensions, including the more superficial layers where the effect of the load's eccentricity, with respect to the calculation vertical, causes a slight underestimation of the tensions induced by the locally applied loads.

In manual calculations, the calculation was extended to such a depth that the increment of vertical tension, due to the presence of the foundation, resulted inferior to a determined percentage of the natural lithostatic load.

This is obviously an approximation tied to the necessity to accelerate the calculation, a necessity that is less important in automatic calculation.

So the distance settlement lost, due to settlement, in that situation, should be overlooked, but this is not mathematically true, specifically whenever layers that are potentially prone to settlement effects are found below that limit. The use of a finite number of elementary layers with constant thickness in which the terrain is subdivided, would discourage the arbitrary extension of the sample depth because the use of elementary layers of considerable thickness would bring about the loss of resolution in the more stressed superficial layers.

Thanks to the automatic subdivision of the terrain into thicker and thicker layers this is no longer a problem: even when the sample depths are multiplied by ten the superficial elementary layers remain extremely thin, allowing a very precise calculation.

The eight points (left, right, etc., other than the centre) on which the evaluation is carried out; points that as far as the integration by Newmark is concerned, form a geometric singularity, are not taken exactly on the border, but at a distance, though exceedingly small, from the border: this allows a more realistic estimation of the differential yielding that would result as overestimated if they were calculated on the borders.

The additional stresses induced in the ground by a scattered load are calculated with this formula:

$$Dp = (3 Q z^3) / (2 \pi R^5)$$

where:

Dp = additional stress induced upon the point of the ground under examination

Q = concentrated load applied at surface, quote of the total load associated to the elementary area of the foundation being examined

z = depth of the point under examination

R = distance of point under examination - application point of Q

The second phase consists in the separate calculation of the components formed by immediate and long term settlement and therefore obtains the total settlement as the sum of the indicated components.

Terzaghi Method

The Terzaghi method, also known as the edometric compressibility method, is dedicated to the settlement calculation of foundations on cohesive layers of limited thickness situated on an undeformable rock bed at a scarce depth, and is based on the hypothesis that the deformation induced varies linearly with the pressure induced according to the E_{ed} modulus

When defining the values of E_{ed} (edometric modulus) and Cc' (and eventually Cr'), they are exclude each other reciprocally as these two methods are to be used as an alternative.

The E_{ed} is obtained by this expression:

$$E_{ed} = (1-\nu') / ((1+\nu') (1-2 \nu')) E'$$

where:

E' = modulus of triaxial compression capability in terms of effective tensions

ν' = Poisson coefficient in terms of effective tensions

Cc' , expression of the compression ratio of the ground used in the general expression of the settlement calculation to determine the long term component, is correlated to the compression module Cc by way of this expression: $Cc' + Cc / (1+e_0)$

where:

Cc = compression modulus

e_0 = void index

The Terzaghi method uses the following expression to calculate the total deformation of an elementary layer of H thickness:

$$DH = H Dp / E_{ed}$$

where:

E_{ed} = edometric modulus

Dp = additional tension induced by the foundation in the examined point

Skempton and Bjerrum Method

The Skempton and Bjerrum method, also known as the method of interstitial pressure coefficients, uses the following expression for the total deformation calculation of an elementary layer of H thickness:

$$DH = H Dp / Eu + H (Dp \beta) / E_{ed}$$

where:

Dp = additional stress induced by the foundation

Eu = modulus of triaxial compression capability (total tensions)

E_{ed} = edometric modulus

$$\beta = 1/3 + 2/3 K_0$$

K_0 = coefficient of skin stress at rest

This is applied, above all, to the settlement calculation of foundations on saturated clay materials, by abandoning, in respect to the Terzaghi method, the restrictive edometric situation hypothesis. The module of elasticity Es assumes the significance of triaxial module Eu , while the edometric module Eed assumes the significance of ratio between the real edometric module and the Skempton β constant. The Skempton β coefficient used to determine settlement is derived from this expression:

$$\beta = 1/3 + 2/3 \alpha$$

where α can be considered equal to the coefficient of skin stress at rest (K_0).

Bearing Capacity for Deep Foundations

This module calculates the bearing capacity of piles axially stressed in cohesive and non-cohesive grounds. The program uses the calculation methods described in the "Raccomandazioni sui pali di fondazione" (Recommendations on foundation piles) by the A.G.I., (Associazione Geotecnica Italiana Italian Geotechnical Association).

It is an extremely flexible program, able to deal with small, medium and large diameter piles using the appropriate methods. It also uses different formulations for piles cast in steel or concrete and for drilled piles because different pile construction techniques induce different stress conditions in the ground, for example, while a hammered pile tends to compact the ground, intrinsically improving the characteristics, a drilling operation, in addition to consenting the relaxation of the hole walls with consequent alteration of the geotechnical characteristics, can leave a more deformable mud layer on the hole surface.

With this module it is possible to deal with homogeneous and stratified grounds in drained and undrained conditions. Formulae and experimental curves proposed by different authors are used for the different types of piles to enable a more conservative analysis.

Since the purpose of the pile bearing capacity calculation is not only the determination of the safety factor but above all the optimisation of the diameter-length ratio (for economical reasons), the program executes the calculations by diameter and length systems, and presents a diagram of the safety factors and bearing capacity values. In this way it is possible to choose immediately the optimal dimension set.

The general method used in this program separately evaluates, even in stratified grounds, the point resistance components "Qp" and the skin resistance components "Qs", the sum of which contributes to the determining of the ultimate load "Qlim".

In the output drawing the limit load and admissible load for each diameter-length couple is shown. The admissible load is equal to the ratio between the limit load and the requested safety factor, reduced by the weight of the pile, lightened by the eventual weight of displaced water.

The program also calculates the safety factor (SF) for load conditions foreseen by the design.

In the output drawing pertaining to the safety factors the limit load and the calculated safety coefficient are shown for each diameter-length couple: the safety coefficient is equal to the ratio between the limit load and the sum of the project load and the weight of its pile, lightened by the eventual weight of displaced water.

In this program the piles are subdivided as follows:

- small diameter: < 0.3 m
- medium diameter: < 0.7 m
- large diameter: > 0.7 m

The program allows the execution of multiple calculations for systems of variable diameters: it is not advisable to perform calculations with groups of values contained within more than one of the above indicated classes, but to perform several calculations subdividing the diameters by homogeneous classes since the use of different experimental curves can cause slight differences in the values obtained in the "boundary" zone between adjacent diameter classes.

For small and medium diameter piles in non-cohesive grounds, the point resistance of the pile "Qp" is calculated with the area of the point "Ap", by way of this expression:

$$Q_p = (N_c \cdot c + N_q \cdot Q_l) \cdot A_p$$

where:

c = cohesion

Ql = effective vertical tension at the depth of the point. The effective tension at a certain depth is derived by the sum of the natural unit weights multiplied by the thicknesses of the layers for the drained zone, and of the dry saturated unit weights for the submerged zone.

Nq = factor depending on the friction angle phi

Nc = (Nq-1) ctg(phi) Is a bearing capacity factor directly correlated to the Nq factor

For large diameter drilled piles the relation proposed by Berezantzev is used.

$$Q_p = N_q \sim \cdot Q_l$$

where Nq~ is a function of the friction angle defined by an experimental curve.

In cohesive grounds it is expressed by this relation:

$$Q_p = (Q_t + 9 \cdot c_u) \cdot A_p$$

where:

Qt = total tension at the depth of the point. The total tension at a certain depth is derived by the sum of the natural or saturated unit weights multiplied by the layers lying above.

cu = cohesion undrained

For piles with lateral surface area "As" in cohesive grounds, the skin resistance of the pile "Qs" is calculated with this expression:

$$Q_s = (Q_a + m \cdot k \cdot Q_l) \cdot A_s$$

where:

Qa (<= cohesion) = coefficient of adhesion between ground and pile

Ql = effective vertical tension at the given depth. The effective tension at a certain depth is derived by the sum of the natural unit weights multiplied by the thickness of the layers for the dry zone, and of the dry saturated unit weights for the submerged zone.

m = coefficient of friction between the ground and pile

k = skin stress coefficient

In cohesive grounds this relation is used instead:

$$Q_s = Q_a \cdot A_s$$

where:

Qa (<= cohesion) = coefficient of adhesion between the ground and pile. It is derived from the undrained cohesion value and the type of pile.

The Qs is calculated numerically as the sum of the contributions of the single elementary pile sections. The ultimate load Qlim is calculated based on the geometry of the pile and characteristics of the ground. It is derived from the sum of the point resistance Qp and the skin resistance Qs.

The safety factor SF is derived from this expression:

$$SF = Q_{lim} / (N + P_p)$$

where:

Qlim = ultimate load of pile

N = vertical load imposed

Pp = pile weight, product of the pile volume multiplied by the unit weight of the concrete, calculated automatically by the program.

Non Cohesive Grounds

It is necessary to remember that in non cohesive, permeable grounds the conditions are drained, therefore the tensions must be expressed in terms of effective tensions. The program foresees the insertion of the natural and saturated unit weight and is able to calculate in drained and undrained conditions; in fact, an option for the choice of conditions is provided to allow an accurate analysis in stratified grounds with successions of predominantly sandy or clay layers.

For the point resistance calculation it is also necessary to remember that:

- The N_q value, used in point resistance Q_p calculation, presents a strong gradient depending on the friction angle, so small variations in the friction angle can bring about great variations in the point resistance value obtained;
- the friction angle is strongly influenced by the execution method of the pile (it is reduced with respect to the natural conditions for the effect of remanagement in particular in the case of large diameter drilled piles);
- different theories induce different N_q values.

" N_q " is the bearing capacity factor that depends on the friction angle ϕ according to the experimental relations proposed by different authors. In this program the curves used are proposed by Terzaghi, Berezantzev, Skempton, Meyerhof and De Beer, listed in decreasing order of caution in the results obtained.

To simplify the work of the designer, the Ce.Ca.P. program allows the selection of different " N_q " calculation methods and different levels of caution in determining the " k " parameter (ratio between the horizontal and vertical tension at the given depth), it also carries out calculations for groups of depth and diameter, arriving at an excellent design with a limited number of calculations.

For small diameter piles the program uses the complete expression for the " Q_{lim} " calculation, since the friction and the skin adhesion both contribute significantly to the bearing capacity. As an option, it is also possible to ignore the point resistance for small diameter piles because its contribution is very limited. For medium diameter piles the program assumes different values for the " k " and " m " (coefficient of friction between pile and ground) coefficients according to the pile method used (cast in place concrete, in pre-cast concrete, in steel, or drilled). It is presumed that the adhesion term " Q_a " does not make any contribution.

For large diameter piles the evaluation of the point resistance must be based on considerations relative to the allowable settlement rather than the breakage at the base of the pile. Therefore the relation proposed by Berezantzev is used in the point resistance " Q_p " calculation. However, for determining the k and m parameters the relations for medium diameter piles are used.

Cohesive Grounds

In saturated clay and silt grounds the ultimate load is calculated in terms of total tensions. The layers of that type must be characterised by the undrained cohesion value " c_u " and by an undrained friction angle as zero.

The point resistance " Q_p " is expressed depending on the total tension corresponding to the point and the c_u , while the skin resistance " Q_s " depends on the adhesion that is determined according to pile type.

The program foresees the insertion of the natural and saturated unit weight, and is therefore able to calculate in drained and undrained conditions; in fact there is an option for the choice of conditions which gives an accurate analysis in stratified grounds with successions of predominantly sand or clay layers.

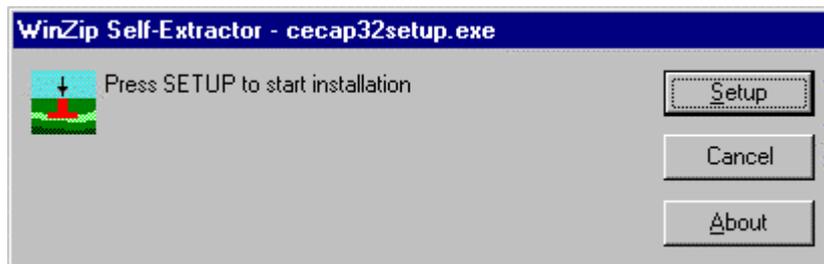
Chapter 2 - System requirements and program installation

System requirements

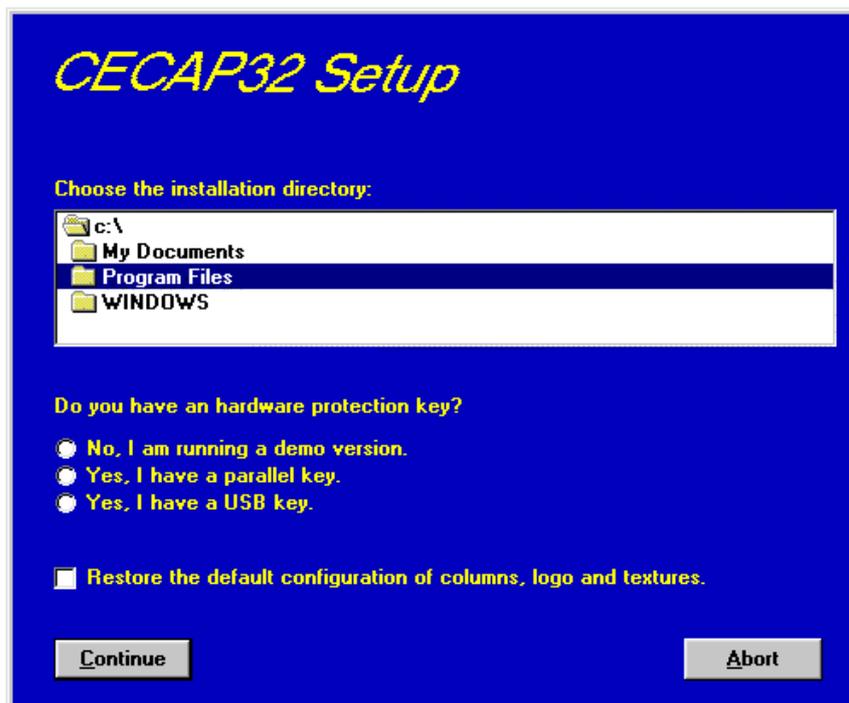
- Pentium® class processor
- Microsoft® Windows® 95 OSR 2.0, Windows 98, Windows Me, Windows NT®* 4.0 with Service Pack 5 or 6, Windows 2000, or Windows XP
- 64 MB of RAM (128 MB recommended)
- 100 MB of available hard-disk space
- CD-ROM drive
- A printer driver must be installed, even if the printer itself is not connected to the PC.

Program Installation

To install CECAP run the **cecap32setup.exe** installation package from the CD-ROM or from the download directory.



Press the **Setup** button...



...and select the directory to create the **CECAP32** folder.
Click the **Continue** button and the program is automatically installed.

The first time you run the program the window that allows you to select your preferred language appears. Simply click on the flag of the language you prefer.



The language selection will be saved in the "LANGUAGE.CFG" file, which is found in the program directory. To select another language, it is sufficient to exit the program and delete this file. The language selection window is shown once more at the next run of the program.

Chapter 3 - The program protection

Hardware protection key

This section should instead be carefully read if the program was bought through the Internet.

Hardware protection key - Parallel port

Plug the hardware protection key that is supplied with the program into the parallel port connector of your PC. The hardware key should be plugged directly into the PC, before any other device, to avoid hardware conflict with other keys.



The printer cable can then be connected to the hardware protection key, as it does not interfere with the printing operation. If the hardware key has not been correctly installed, the program will start in demo mode.

Windows 95, Windows 98 and Windows Me

Windows 95, Windows 98 and Windows Me automatically recognize the hardware key, so no other operation is required.

Windows NT, Windows 2000 and Windows XP

Windows NT, Windows 2000 and Windows XP require the installation of a software driver to enable access to the hardware key. To install the software driver, follow this procedure:

1. start Windows, and login as Administrator
2. install the package
3. browse the program directory, and run the program SKEYADD.EXE in the folder HardKeyDrivers\Parallel_NT-2000-XP
4. restart the computer

To uninstall the software driver, follow this procedure:

1. start Windows, and login as Administrator
2. browse the program directory, and run the program SKEYRM.EXE in the folder HardKeyDrivers\Parallel_NT-2000-XP
3. restart the computer

For further information about the hardware key, please visit the Web site <http://www.eutron.com>

Hardware protection key - USB port

Plug the hardware protection key, supplied with the program, into one of the USB connectors of your PC.



For further information about the hardware key, please visit the Web site <http://www.eutron.com>

Windows 95, Windows 98, Windows Me, Windows 2000 and Windows XP

All Windows versions, except Windows NT, automatically recognize the PnP hardware key, and require the path to load the driver from. To install the driver, follow this procedure:

1. start Windows, and login as Administrator (if necessary)
2. install the package
3. browse the program directory, and select the folder HardKeyDrivers\ USB_9x-Me-2000-XP

Windows NT

Windows NT requires the installation of a software driver to enable the access to the hardware key. To install the software driver, follow this procedure:

1. start Windows, and login as Administrator
2. install the package
3. browse the program directory, and run the program SKEYUSBADD.EXE in the folder HardKeyDrivers\USB_NT4
4. restart the computer

To uninstall the software driver, follow this procedure:

1. start Windows, and login as Administrator
2. browse the program directory, and run the program SKEYUSBRM.EXE in the folder HardKeyDrivers\USB_NT4
3. restart the computer

For further information about the hardware key, please visit the Web site <http://www.eutron.com>

Chapter 4 - Using the program in a local network

Using the program in a local network

The programs can be used in a local network without moving the hardware key from one computer to another. It is also possible to purchase multiple licenses to use the program on several computers at once.

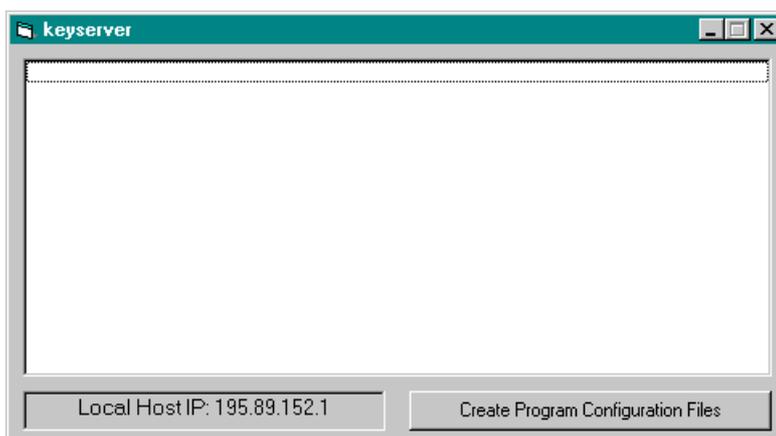
Using the program in a local network

The computer to which the hardware key is physically connected is defined as the “Server”, and the computer that requests the authorisation to run in fully operational mode from the Server is defined as the “Client”. The program must be installed on the Server (with the proper hardware key drivers if necessary), and on each Client (in demo mode).

The program *keyserver.exe* should also be installed on the Server. The installation file of this program can be found on the distribution CD-ROM, or on the Internet, at the URL:

<http://www.geoandsoft.com/download/KeyServerSetup.exe>

Run *keyserver.exe* and the hardware key management window appears.



Click the “Create Program Configuration File” button, and browse your network to select the executable file you want to remotely activate (for example \\computer03\c\program files\cecap32\cecap32.exe). Now, with the *keyserver.exe* program running, *cecap32.exe* can also be run from the PC “computer03”.

NOTE: the contemporary use of the program on more than one computer is allowed only if a multiple license has been purchased.

Chapter 5 - General information

Usage Notations

Some typographical notations and keyboard formats are used in this manual to help locate and interpret information more easily.

Bold print is used to indicate command names and related options. Characters appearing in bold print should be typed exactly as printed, including spaces.

Words written in *italics* indicate a request for information.

CAPITAL letters are used to indicate computer, printer, directory, and file names.

Keyboard formats are used as follows:

- KEY1+KEY2 - indicates press and hold down key1 and then, at the same time, press key2. For example, alt+c means one should press and hold the alt key down and, at the same time, press the c key. The keys are always indicated with capital letters.
- key1,key2 - A comma (,) between key names means that the keys must be pressed in sequence. For example, ALT,C means one should press and release the ALT key and then press and release the C key.

Because of the differences in keyboard layouts, the names of the keys on the keyboard may not correspond with those described in this manual. The word ARROW (LEFT, UP, RIGHT, DOWN) indicates the use of the arrow keys.

Chapter 6 - User Interface

User Interface and Data Entering

The user interface is designed to be easy to use and powerful and is supported by complete on-line help. This help contains practical hints and the theoretical background, where applicable. It should reduce the requirement of frequently consulting the printed manuals.

All the commands are located inside a menu bar. Each menu contains a list of commands that one can select with the mouse or the keyboard. The arrangement of the menus, designed with ergonomic criteria, follows the logical order of the operations, inhibiting the access to further operations until all the necessary data have been entered.

The interface layout is maintained in all of our programs, to simplify, as much as possible, the transition from one program to another to avoid having to learn different commands and procedures for similar functions (such as entering data or managing files).

Let us examine the general components that are available in the user interface of geo&soft programs.

User Interface: Menu Bar and Menus

The Menu Bar manages the access to all the program commands. The goal of the menu design is to offer an ergonomic, simple, and understandable arrangement of the commands.

The menus used to perform a complete operation are normally ordered left to right and top to bottom. When possible, the following scheme is used: definition of the name of the project, entering the required data, performing the calculation, and generating the output as a preview or final print.



The programs automatically disable some menus or commands when the execution of such menus or commands is not yet feasible. Typical examples are: a calculation menu is disabled when not all the data needed for the calculation have been completely entered, or a print menu is disabled if not all the calculations have been executed.

To choose a command from a menu, use the following procedures:

- ☞ Point the menu that is to be activated, click the left button of the mouse, then point the command to be activated, and click the left button of the mouse again. If one does not wish to select any command from the menu that is open, exit the area of the menu before releasing the mouse button.
- ☞ Press the ALT key to activate the menu bar. Press, on the keyboard, the underlined character in the menu name or press ENTER or the DOWN arrow, to select the first menu. Press on the keyboard the underlined character in the menu name or select it using the arrow key and then press ENTER, to execute a command in the selected menu. Press ESC to close the menus without executing any command.

The Graphical Output Preview Window

The Toolbar is located in the upper side of the preview window.

The Toolbar allows fast access to the commands with the mouse. Click the corresponding icon, to select one of the commands that belong to the Toolbar. The Toolbar displays the following commands:



- **Zoom +** : clicking the first icon activates the ZOOM function (it can only be used with the mouse) that permits the enlargement of part of the drawing. The function remains active until the Zoom - icon is selected. To enlarge a part of the drawing:
 - ☞ click the icon, and then select the area to be enlarged by clicking the upper-left corner and dragging the mouse pointer to the lower-right corner. At this point, release the mouse button. Note: due to the low resolution of the screen, the texts could appear in a slightly different scale at different zoom levels. This does not affect the quality of the final printouts.
- **Zoom -** : click this icon to return to the original scale of the preview.
- **Arrows**: click the arrow icons, in "Zoom +" mode, to pan the on-screen preview.
- **Print**: click the print icon to send the drawing to the default printer.
- **Resized print**: click this icon to send the drawing to the default printer. The image will be resized to fit the current paper size.
- **DXF**: one can export the graphic output as a DXF file by clicking this icon; it gives access to a dialogue window that enables one to assign a different name to the DXF file, which has, by default, the same name as the current project.
- **EMF/W**: This icon allows the graphic output to be exported to a version of the Enhanced Windows Metafile which is compatible with Microsoft Word. Clicking this icon gives access to a dialogue window that enables one to assign a different name to the EMF file, which has, by default, the same name as the current project.
- **EMF/D**: This icon allows the graphic output to be exported to a version of the Enhanced Windows Metafile which is compatible with Corel Draw. Clicking this icon gives access to a dialogue window that enables one to assign a different name to the EMF file, which has, by default, the same name as the current project.
- **Exit**: click this icon to close the preview window and return to the main menu.

The Input Dialogue Windows

The different menu commands can perform an immediate action, or display a dialogue window in order to input or edit the various data sets.

When a dialogue window is visible, all the actions that do not pertain to it are ignored. Hence, it is necessary to close the dialogue window to resume the normal use of the program.

FOUNDATION GEOMETRY

Foundation shape	Strip
Subtraction of the ground weight	Don't execute
Start of calculation for vertical tension	Ground
Method of calculation of the vertical stress	Effective tensions
Hydraulic pressure	Hydrostatic

Foundation width [m]	0
Foundation length [m]	0
Depth foundation level [m]	0
Normal load [kN]	0
Moment width [kN*m]	0
Moment length [kN*m]	0
Watertable depth [m]	0
Preconsolidation stress [kN/m ²]	0

Definition of the foundation geometry seen in plan. The foundations can be of four types: rectangular, square, circular and strip.

Some fundamental tools are used inside the dialogue windows: data fields such as text and list boxes, and buttons.

The text boxes are used to input numerical values and text strings. Most of the editing keys (HOME, END, INS,

DEL, etc.) can be used inside these fields. If one sees a small arrow pointing down on the right side of the data field, one has a list box.

To scroll the list box and select an item, do as follows:

 click the arrow, and then click the item to be selected.

 press the DOWN arrow until one arrives at the item to be selected. It is also possible to press a letter to directly reach the first item that begins with that letter.

There are three buttons in the dialogue window:

- <Ok> - this button saves the entered information and goes on to the next phase.
- <Cancel> - this button closes the Dialogue window without saving the just entered data, or without executing the command.
- <Help> - this opens a window that contains general information on how to use the dialogue windows.

To use the buttons:

 click the button

 press alt+underlined letter

To edit the data inside the dialogue window, use the following keys:

- TAB - moves the cursor to the next field; when the cursor is inside the last visible field the cursor goes to the first control button of the Dialogue window. To return to the previous field, press SHIFT+TAB.
- ENTER - moves the cursor to the next field. If the cursor is positioned on one of the window buttons, the corresponding command is executed.
- BACKSPACE - cancels the last character that has been entered.
- DEL - cancels the character to the right of the cursor.
- ESC - closes the Dialogue window without saving the entered values or without executing the command. The <Cancel> button will do the same.
- UP ARROW/ DOWN ARROW - these are used in multiple fields, or those fields that have a list box.
- LEFT ARROW/ RIGHT ARROW - moves the cursor to the previous or next field.
- HOME - moves the cursor to the beginning of the field.
- END - moves the cursor to the end of the field.

A yellow box with a short text that explains the meaning of the value to be entered, can be seen in the lower part of the window. If the text is not completely visible, click the yellow box to read the complete text.

Data Input With Tables

Tables are used to enter long sequences of numerical values and/or text strings. The keys to be used are the following:

- TAB - moves the cursor to the first button in the window. When one presses this key again, the cursor is moved to the next button.
- SHIFT+TAB - moves the cursor to the previous button.
- ENTER - moves the cursor into the next input field. If the cursor is positioned on one of the window buttons, the corresponding command is executed.
- PAGE UP - moves the cursor up 15 lines.
- PAGE DOWN - moves the cursor forward 15 lines.
- UP ARROW - moves the cursor to the input field directly above.
- DOWN ARROW - moves the cursor to the input field directly below.
- LEFT ARROW / RIGHT ARROW - moves the cursor to the field respectively to the left or to the right of the current position.
- HOME - moves the cursor to the beginning of the line.
- END - moves the cursor to the end of the line.
- F2 - copies the field contents to the extended editing field under the title bar in order to facilitate the editing

of the long strings. When working in this editing field, please **REMEMBER** to press ENTER, even before clicking the <Ok> button. Double-clicking a field has the same effect as pressing the F2 key.

N.	Depth [m]	GN [kN/m ³]	GS [kN/m ³]	Phi [°]	C' [kPa]	Su [kPa]	Es [MPa]	Eed [MPa]	Cc' [-]	Cr' [-]	u [kPa]	Pattern
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Depth from surface level to the bottom of the stratum

The tables have two additional buttons:

- <Insert> - creates an empty line before the one in which the cursor is positioned.
- <Delete> - deletes the line in which the cursor is positioned.

IMPORTANT SUGGESTION: you can copy data to or from other programs such as Microsoft Excel:

The data entered in the table can be copied in order to be pasted into another table.
To copy the table's contents:

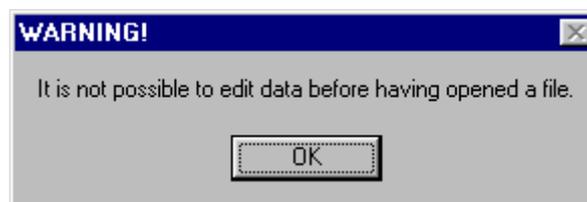
 press the key combination CTRL+C. The contents will be copied into the Clipboard of Windows.
To paste the Clipboard contents into the table:

 press the key combination SHIFT+INS, or CTRL+V.

A yellow box with a short text that explains the meaning of the value to be entered, can be seen in the lower part of the window. If the text is not completely visible, click the yellow box to read the complete text.

Message Windows

The function of these windows is to give information to the user concerning the system status, as in the case of an error due to an improper use of the program.



Help On Line

A complete Help On Line is available. It is possible to ask for information or suggestions related to the commands or the use of the program. In order to access the help on line, proceed as follows:

1. Position the cursor on a field of a dialogue window and press F1.
2. Use the Summary from the Help menu.

Chapter 7 - Commands

Files Menu (ALT,F)

This menu contains the commands for opening and saving files, that contain all the information relative to the project.



New Command (ALT,F,N)

To open a new file:

- ☞ from the menu choose New by first clicking on the name of the menu then on the New command.
- ☞ from the File menu choose New by using the combination of the keys ALT,F,N.

Open Command (ALT,F,O)

To be able to work with the program one should, first of all, create a new file or open a pre-existing file.

To open a file:

- ☞ from the menu choose Open by first clicking on the name of the menu then on the Open command. In the File Name field type the name of the file to be opened or double click on the name of the desired document which can be found in the list underneath the File Name field.
- ☞ from the File menu choose Open by using the combination of the keys ALT,F,O. In the File Name cell, type the name of the file to be opened or press TAB and then the UP ARROW or DOWN ARROW to select the name from the list underneath the File Name field and press ENTER.

The name of the file being used is shown inside the title bar of the main window and inside a window referable by selecting the Help menu.

The name of the file should not contain spaces and/or punctuation marks. It is not necessary to indicate extensions, since the extension ".CEC" is added automatically: for example, if one enters the name "TEST1" the file name will be "TEST1.CEC".

Save Command (ALT,F,S)

During the work session the program uses a copy of the file which is temporarily loaded into the computer's RAM. To save the work on the hard disk it is necessary to use the Save command; otherwise all the data entered will be lost when one exits from the program. If an electrical problem or any other type of problem interrupts the computer's functioning, the data not yet saved will be lost, so it is advisable to save the work often.

To save a file:

- ☞ select Save from the file menu by clicking first on the name of the menu and then on the Save command. In the File Name field, the name given to the file when it was originally opened appears. To confirm that name click on the <Ok> button. To assign a new name to the file, type the new name in this field.



select Save from the File menu by using the key combination ALT,F,S. To confirm the name given to the file when it was opened press ENTER. To assign a new name, type the name in the File Name field and press ENTER.

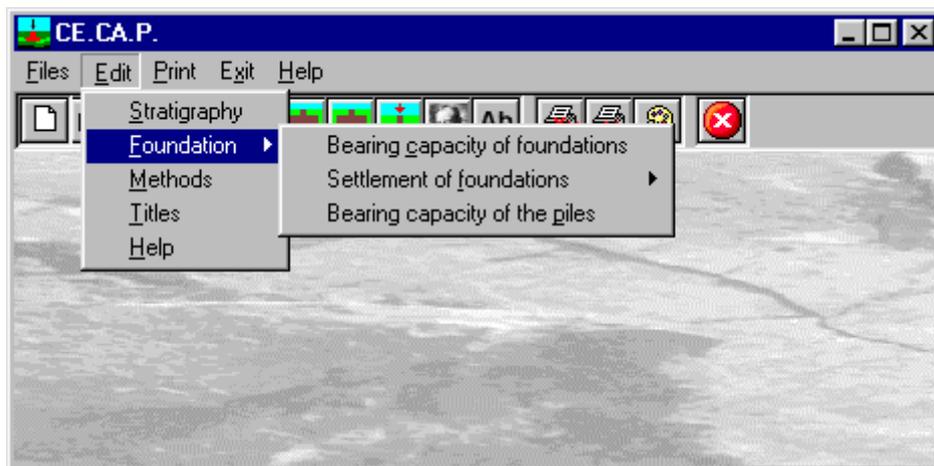
The program will save the file in the current disk unit and directory unless specified otherwise. To save the file on a different disk unit or in a different directory, type the full path in the File Name field. For example, to save the document in the root of disk C: type *c:\filename* or select a different unit or directory.

Printer Setup Command (ALT,F,P)

By selecting this command one goes to "Print" dialog box. Here one can verify and modify the Default printer's Setup or select another printer from those installed one ones system.

Edit Menu (ALT,E)

Through this menu is possible to enter the data relative to the ground stratigraphy and the geometric characteristics of the project to be verified.



Stratigraphy Command (ALT,E,S)

Through this command one can enter the lithotype values, that may be vertically non-homogeneous, intersected by the foundation. The window contains a table where one can enter the soil's geotechnical parameters. Obviously only the soil parameters necessary for the calculations are required have to be entered

Bearing capacity of a superficial foundation

The cohesion, friction angle and unit weight average values are calculated as weighted average in respect to the thickness of the single vertical ground layers comprised between depth D of the foundation plane and $D+0.5xBxtg(45+\phi/2)$ with B = foundation width. The effective tension at the foundation plane is calculated based on the unit weight between the groundlevel plane and "D".

Note that the average unit weight and the effective tension are determined based on the dry unit weight of the material below the watertable.

With this program it is possible to carry out calculations with the Vesic and Hansen methods in both drained (long term) and undrained (short term) conditions.

If the influence zone extends below the bed of the last layer, the program presumes that the geotechnical characteristics start from the bed level and continue indefinitely downwards with constant values.

Bearing capacity of Deep Foundations

The average geotechnical parameters for determining the point resistance are automatically calculated based on the stratigraphy by carrying out a weighted average calculation with respect to the thickness of the single layers in the strip of ground between the groundlevel plane and a depth between -4 and $+2$ times the diameter from the pile base.

The skin load coefficients are calculated based on the stratigraphy for the entire length of the pile.

When entering the geotechnical description of the stratigraphy it is necessary to remember that when in the pile bearing capacity calculation the final depth of the pile surpasses the bed depth of the last layer the corresponding values will be extended with a constant value until the depth necessary for correct calculations is reached.

The "Geotechnical parameters of the stratigraphy" Dialog Box

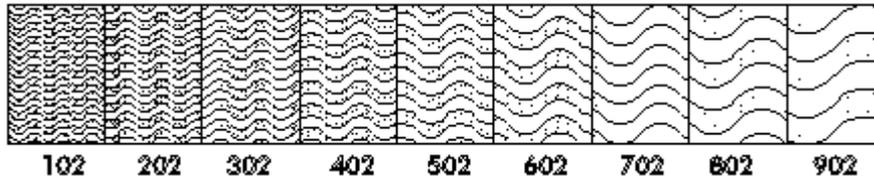
The window shown contains a table in which the following values are to be inserted:

GEOTECHNICAL PARAMETERS OF THE STRATIGRAPHY												
N.	Depth [m]	GN [kN/m ³]	GS [kN/m ³]	Phi [°]	C' [kPa]	Su [kPa]	Es [MPa]	Eed [MPa]	Cc' [-]	Cr' [-]	u [kPa]	Pattern
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

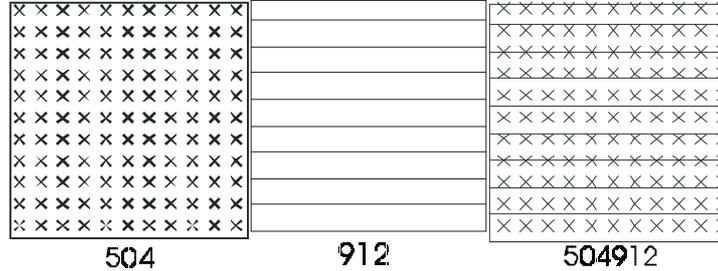
Depth from surface level to the bottom of the stratum

OK Cancel Insert Delete Help

- *Depth of the bed of ground layer* from the groundlevel plane;
 - *Natural unit weight*;
 - *Saturated unit weight*;
 - *Friction angle*;
 - *Drained cohesion* (long term) of the layer (c');
 - *Undrained shear strength* (for cohesive soils) of the layer (Su);
 - *Modulus of elasticity of the layer (Es)*, to estimate of immediate linear settlement;
 - *Edometric modulus of the layer (Eed)*, to estimate the long term linear settlement. It can be used instead of the compression ratio Cc';
 - *Compression ratio of the ground (Cc')*: It is correlated, for preconsolidated soils, to the compression Cc modulus by way of this expression: $Cc' = Cc / (1 + e_1)$ where Cc = compression module and e_1 = void index to the pressure p_c . For normal-consolidated soils, the compression ratio is $Cc' = Cc / (1 + e_0)$ where: Cc = compression module, e_0 = initial void index of the terrain layer; the Cr' value does not have to be entered. Is reserved as for the calculation of long term yielding. It must be used as an alternative to the edometric module;
 - *Recompression ratio Cr'*: recompression ratio $Cr' = Cr / (1 + e_0)$ (for preconsolidated soils) where: Cr = recompression index, e_0 = initial void index of the terrain layer, used to calculate the long term settlement. This value is optional and does not have to be entered when the terrain is normal consolidated. It must be used as an alternative to the edometric modulus.
- Please note that when one uses both the Cr' and Cc' values the fact that an amount of soil above the foundation plane is removed, is automatically taken into account. Hence during the calculation the option for the subtraction of weight of soil that was excavated, should not be activated.
- *Water pressure scheme (u)*: the program allows to assign manually the scheme for the water pressure, assuming a linear variation starting from a value $u = 0$ from the ground level surface. The value entered is associated to the relative stratum.
 - *Code of the pattern* to be used in the stratigraphy. The CE.CA.P. program allows calculation in the presence of stratified terrain that can be represented in the form of drawings or listings. The patterns used for filling the column that graphically describes the stratigraphy is formed by a 3 digit code: the first one is the scale factor comprised between 0 and 9, the other two form the true pattern code. It is therefore possible to re-use the pattern with different scales, in this way pattern 2 will correspond to code 902 with a sparse outline, and to code 102 with a remarkably dense outline.



When it is necessary to superimpose two patterns, insert the codes of the two textures one after the other (ex. 912504).



Give a colour to the pattern by adding the indication "Cn" con n= number between 1 and 15, to the pattern number (ex. 904C5 or 305712C7). The number indicated refers to the colour definition used in the Configuration command of the Print menu. The program also offers the possibility to enter a brief description of the lithotype; it is entered after the texture code with a space (ex. 902C3 Sandy silt).

Foundation Command (ALT,E,F)

With this command a sub-menu is activated where one can select the type of calculation to use.

Bearing capacity of foundation Command (ALT,E,F,C)

This command manages the insertion and the modification of the geometric parameters relative to the foundation.

The "Foundation geometry" Dialog Box - Superficial foundation

The following data is requested:

FOUNDATION GEOMETRY

Foundation shape

Hydraulic pressure

Level of horizontal seismic forces

Foundation width [m]

Foundation length [m]

Depth foundation level [m]

Foundation plane dip [°]

Groundlevel plane dip [°]

Normal load [kN]

Transv. load parallel to width [kN]

Transv. load parallel to length [kN]

Moment width [kN*m]

Moment length [kN*m]

Horizontal seismic coeff. [-]

Vertical seismic coeff. [-]

Watertable depth [m]

Safety factor [-]

Definition of the foundation geometry seen in plan. The foundations can be of four types: rectangular, square, circular and strip.

→ *Foundation Shape*: definition of the foundation geometry seen in plan. The foundations can be of four types:

rectangular, square, round, strip.

- *Hydraulic pressure*: the program enables one to select the calculation type for the hydraulic pressure presenting, apart from the case of an absent water table, the calculation under hydrostatic conditions and the possibility to manually enter a hydraulic scheme. In the last case the pressure scheme should have been defined in the stratigraphical parameters.
- *Height of application of horizontal seismic forces*: here the height is defined at which the horizontal seismic forces are applied. When this is the surface level a horizontal moment of transport is generated with, as a consequence, the reduction of the effective foundation surface, this does not happen when the application point is foundation level.
- *Foundation Width*: the width of the foundation indicates, depending on the shape of the foundation, the side (square), the diameter (round), or the width (strip). In rectangular foundations this side must be smaller: if the width is superior to the length the program automatically exchanges the two values. It must be expressed in meters.
- *Foundation Length*: the length of the foundation is only necessary for rectangular foundations.
- *Foundation plane depth*: this is the depth (minimum for inclined foundations) of the foundation plane. To be expressed in meters.
- *Foundation plane dip*: the foundation plane dip is considered positive when the elevation decreases in the direction of the horizontal load component. To be expressed in degrees.
- *Groundlevel plane dip*: the groundlevel plane dip is considered positive when the elevation increases in the direction of the horizontal load component. To be expressed in degrees.
- *Normal Load*: this is the vertical load acting on the foundation plane. The vertical load is always applied in the centre of the foundation. If the load is eccentric it will be necessary to separate the load in its vertical component, which is to be entered in this field, and in the width-wise and length-wise moments, to be entered in their respective fields, the sum of the external moments are to be indicated by the designer. Note that the loads must be expressed in the form of total loads applied to the foundation in all cases except for that of a band-like foundations, in which case the loads are entered by linear meter of foundation.
- *Transversal Load (directed parallel to the width)*: it is the horizontal load acting on the foundation plane and applied length-wise in the centre of the foundation, directed parallel to the shortest side (left to right in the foundation plan view).
- *Transversal Load (directed parallel to the length)*: is the horizontal load acting on the foundation plane; it is applied length-wise in the centre of the foundation directed parallel to the longest side (from the bottom to the top in the planimetric view of the foundation).
- *Moment Width*: is the moment (the vector or rotation axis of which is oriented parallel to the width or shortest side, from left to right in plan view) acting on the foundation plane; it must include the eventual moment of transfer from the ground level plane to the foundation plane of the horizontal component parallel to the longest side. It is ignored in the case of strip foundations.
- *Moment length*: the moment (the vector of which is perpendicular to the previous) acting on the foundation plane must include the transport moment.

Note that since the moments are expressed as vectors, the length-wise moment is shown in the front view which contains the width, and the additional moments of transport M^* will be derived by:

$$M^*_{\text{length}} = \text{Choriz}_{\text{width}} * \text{depth}$$

$$M^*_{\text{width}} = \text{Choriz}_{\text{length}} * \text{depth}$$

- *Watertable depth*: depth of the phreatic watertable expressed in meters from the groundlevel plane.
- *Horizontal and vertical seismic coefficients* of the zone being examined. These coefficients must be expressed with absolute values (ex.: to express a coefficient of 7%, 0.07 is to be entered). If the analysis is carried out under seismic conditions, the loads and transport moments derived from these coefficients will be incremented following the usual procedure and will be reported incremented in the graphic and/or tabular form results.
- *Required safety factor*.

Settlement of Foundations Command (ALT,E,F,F)

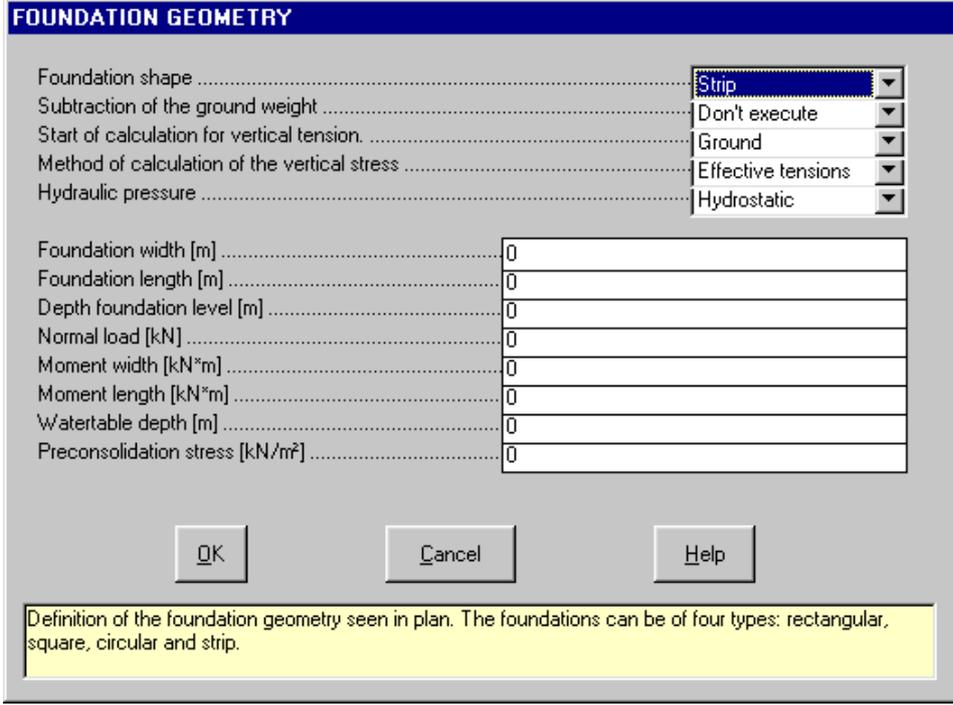
With this command a sub-menu is activated where one can select the type of calculation to use.

Description of Superficial Foundations Command (ALT,E,F,C,F)

With this command one can enter and edit of the geometric parameters relative to the foundation. Depending on the data entered the program automatically determines the type of methods to be used.

The "Foundation geometry" Dialog Box - Settlements

The following data is requested:



- *foundation shape*: allows the selection of the foundation geometry, seen in plan. The foundations can be round, rectangular, square or strip.
- *subtraction of the ground weight* from the applied load at the foundation floor. This allows one to choose whether or not to subtract the weight of the removed terrain. In the second case where it is assumed that in a load and unload cycle the terrain returns to its initial conditions without permanent residual deformation (non-linear elastic behaviour), the result would be a more conservative one.
- *start of the vertical pressure*: allows one to begin the calculation of the natural vertical tension starting from the ground level plane or the foundation floor. The second case is more conservative since it is presumed that the ratio between the width of the foundation and the depth of the deformable layers is sufficiently reduced to annul the effects of the surrounding terrain due to the lateral transfer of the tensions.
- *calculation method of the vertical tension*: this allows one to calculate the vertical tension in terms of effective tensions or total tensions (normally this calculation is carried out in effective terms for cohesive material as well).
- *hydraulic pressure*: the program enables one to select the calculation type for the hydraulic pressure presenting, apart from the case of an absent water table, the calculation under hydrostatic conditions and the possibility to manually enter a hydraulic scheme. In the last case the pressure scheme should have been defined in the stratigraphical parameters.
- *foundation width*: indicates, depending on the shape of the foundation, the side (square), the diameter (round) or the width (strip). It must be expressed in meters.
- *foundation length*: this parameter is necessary for rectangular foundations only.
- *foundation plane depth*: it is the minimum depth of the foundation plane. To be expressed in meters.
- *normal load*: this is the vertical load acting on the foundation plane. The vertical load is always applied in the centre of the foundation. If the load is eccentric it will be necessary to separate the load in its vertical component, which is to be entered in this field, and in the width-wise and length-wise moments, to be entered in their respective fields, the sum of the external moments are to be indicated by the designer. Note that the loads must be expressed in the form of total loads applied to the foundation in all cases except for that of a band-like foundations, in which case the loads are entered by linear meter of foundation.
- *moment width*: is the moment (the vector or rotation axis of which is oriented parallel to the width or shortest side, from left to right in plan view) acting on the foundation plane; it must include the eventual moment of transfer from the ground level plane to the foundation plane of the horizontal component parallel to the longest side. It is ignored in the case of strip foundations.
- *moment length*: the moment (the vector of which is perpendicular to the previous) acting on the foundation

plane; must include the transport moment.

Note that since the moments are expressed as vectors, the length-wise moment is shown in the front view which contains the width, and the additional moments of transport M^* will be derived by:

$$M^*_{\text{length}} = \text{Choriz}_{\text{width}} * \text{depth} \qquad M^*_{\text{width}} = \text{Choriz}_{\text{length}} * \text{depth}$$

- *watertable depth*: depth of the phreatic watertable expressed in meters from the groundlevel plane.
- *horizontal and vertical seismic coefficients* of the zone being examined. These coefficients must be expressed with absolute values (ex.: to express a coefficient of 7%, 0.07 is to be entered). If the analysis is carried out under seismic conditions, the loads and transport moments derived from these coefficients will be incremented following the usual procedure and will be reported incremented in the graphic and/or tabular form results.
- *pressure of preconsolidation*: optional value for the preconsolidation pressure at the foundation plane. The preconsolidation tension used in the calculation is obtained as the sum of the this value plus the natural tension (effective or total) calculated from the ground level plane.

Multiple Foundations Command (ALT,M)

The program allows the presence of surrounding foundations to be considered in the calculation phase. By selecting the Multiple Foundations command a sub-menu is shown with which it is possible to select files containing the foundations to be considered in the calculation of the settlement or one can also deactivate this option.

Note that the settlement calculations are only carried out for the current foundation, and that it must be in the list of the foundations to be considered.

Define Multiple Foundations Command (ALT,E,F,C,M,D)

This command is used to indicate to the program the foundations that will influence the settlement of the foundation. First of all one must open a new or already existent file in which the program must save the information relative to the surrounding foundations, information that is necessary for the calculation to be carried out.

The "Open" Dialog Box - Define Multiple Foundations

To open a file:

-  in the File Name field type the name of the file to be opened or, if the file already exists, double click on the name of the desired document which can be found in the list underneath the File Name field.
-  in the File Name cell, type the name of the file to be opened or, if the file already exists, press TAB and then the UP ARROW or DOWN ARROW to select the name from the list underneath the File Name field and press ENTER.

The name of the file being used is shown inside the title bar of the main window and inside a window referable by selecting the Help menu.

The name of the file should not contain spaces and/or punctuation marks. It is not necessary to indicate extensions, since the extension ".FMP" is added automatically: for example, if one enters the name "TEST1" the file name will be "TEST1.FMP".

When the file's name has been confirmed the "Multiple Foundations" dialog box is shown with which the files containing the surrounding foundations can be selected.

The "Multiple Foundations" Dialog Box

The dialog box has four buttons:

- <New>: by clicking on this button the "Open" dialog box is shown with which file names can be selected. When the selected name has been confirmed it is added to the list present in the "Multiple Foundations" dialog box.
- <Remove>: deletes the presently selected file from the list.
- <Confirm>: terminates the selection phase and returns to the main menu, after having saved any modifications made, and passes on to the next window.
- <Abort>: terminates the selection phase and returns to the main menu after having abandoned any modifications.

When one clicks on the <Confirm> button the program presents the "Planimetric positioning of foundations" dialog box with which the centres of the foundations are positioned with respect to an arbitrary origin and their counter clockwise rotation.

To confirm the data entered click on the <Confirm> button.

Disable Command (ALT,E,F,M,D)

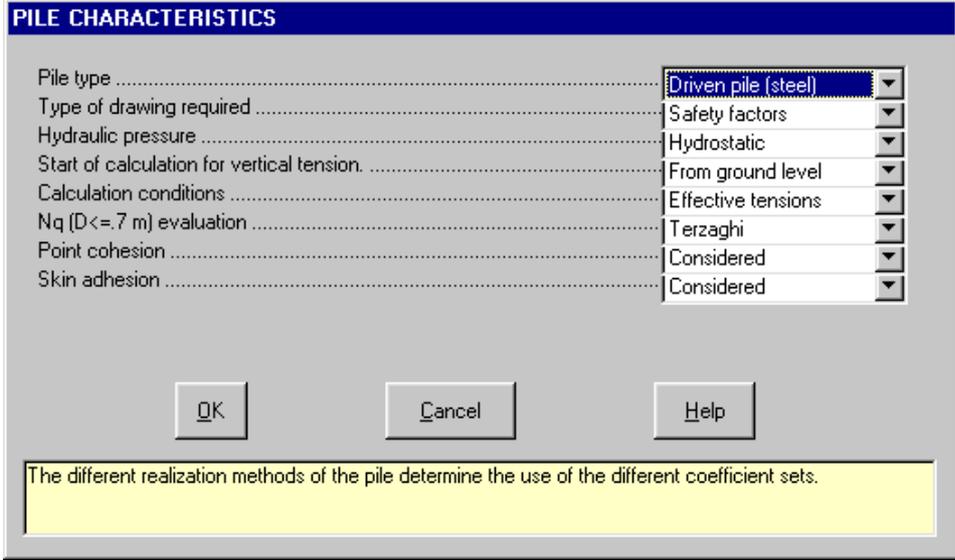
With this command it is possible to deactivate the multiple foundations option.

Bearing Capacity of the Pile Command (ALT,E,F,P)

With this command the data pertaining to the pile geometry and watertable depth are entered.

The "Pile characteristics" Dialog Box

The following data is requested:



PILE CHARACTERISTICS

Pile type Driven pile (steel) ▾

Type of drawing required Safety factors ▾

Hydraulic pressure Hydrostatic ▾

Start of calculation for vertical tension From ground level ▾

Calculation conditions Effective tensions ▾

Nq (D ≤ 7 m) evaluation Terzaghi ▾

Point cohesion Considered ▾

Skin adhesion Considered ▾

OK Cancel Help

The different realization methods of the pile determine the use of the different coefficient sets.

- *pile type*: it is possible to analyse piles in steel, in pre-cast concrete, in concrete cast in place, and drilled piles. The different pile construction methods determine the request of different sets of coefficients.
 - *type of drawing required*: with this field one can select the type of drawing to be printed, one can choose between the safety factors and the load diagram.
 - *hydraulic pressure*: the program enables one to select the calculation type for the hydraulic pressure presenting, apart from the case of an absent water table, the calculation under hydrostatic conditions and the possibility to manually enter a hydraulic scheme. In the last case the pressure scheme should have been defined in the stratigraphical parameters.
 - *start vertical tension calculation*: enables one to select whether the calculation of the natural vertical tension starting from the surface level or the depth of the pile head. The second case is more conservative, and assumes that the ratio between foundation width and depth of deformable strata is sufficiently small as to null the effects of the terrain around it due to the lateral transfer of tensions.
 - *calculation conditions*: it is possible to calculate in drained and no drained conditions.
 - *Nq evaluation (D ≤ 0.7)*: Nq evaluation criteria for piles with a diameter of ≤ 0.7. The methods available are: TERZAGHI (cautious), BEREZANTZEV (medium-cautious), SKEMPTON (medium), MEYERHOF (medium-optimistic), DE BEER (optimistic). For the point resistance calculation of a large diameter drilled pile, the relation proposed by Berezantzev is used: $Q_p = N_{q\sim} \cdot Q_l$ where $N_{q\sim}$ is derived based on the friction angle crossing an experimental curve proposed by Berezantzev.
- The curve proposed by Berezantzev for large diameter piles is more conservative than all the curves used for small and medium diameter curves. The choice of the calculation method is carried out depending on the minimum diameter among those requested. This is done to avoid an illogical reduction in the bearing capacity of the pile, due to the use of less cautious experimental curves, in the passage from small diameter piles (diameters less than 0.7 m) to medium and large diameter piles (diameters greater than 0.7 m). Considering it is determined that the same pile with a diameter of more than 0.7 can have two different ultimate load values, in the same conditions, depending on the minimum diameter used, since two different experimental curves are used in both cases. For the calculation of large diameter piles where the minimum diameter is ≤ 0.7 m the program offers the choice of which calculation method to be used since the correlation by Berezantzev is considered by many to be extremely conservative.
- *point cohesion*: it is possible to select whether to take into account the point cohesion or not. In terms of effective tensions it is possible to select whether to consider or ignore the contribution of the cohesion (drained) in the point resistance calculation of the pile. In terms of total tensions this parameter is ignored.

→ *skin adhesion*: it is possible to choose whether or not to consider the skin adhesion.

The "Parameters of calculations" Dialog Box

The following data is requested:

PARAMETERS OF CALCULATION	
Depth of the top of the pile [m]	0
Minimum depth of pile bottom [m]	0
Maximum depth of pile bottom [m]	0
Calculation step of pile bottom depth [m]	0
Minimum diameter [m]	0
Maximum diameter [m]	0
Diameter calculation step [m]	0
Imposed vertical load [kN]	0
Lateral safety factor required [-]	3
Safety factor at the point required [-]	3
Watertable depth [m]	0
Vertical seismic coefficient [-]	0
Unit weight of the pile [kN/m ³]	0
Coeff. of thrust k [-]	0
Multiplication factor of K [-]	1
Shear limit [kN/m ²]	0

Depth of the top of the pile from ground level expressed in meters.

→ *depth of the pile head*: the depth of the pile head should be referred to the ground level surface.

→ *minimum depth of pile bottom* from surface level expressed in meters.

→ *maximum depth of pile bottom* from surface level expressed in meters.

→ *calculation step of pile bottom depth* expressed in meters.

→ *minimum diameter* (m)

→ *maximum diameter* (m)

→ *diameter calculation interval* (m)

The previous six parameters allow the program to calculate for groups of depth and diameter to arrive at an excellent design with a limited number of calculations. For example, obtained by entering the first three values as 10,16,2 are piles with lengths of 10,12,14,16, while entering 12,12,0 obtains a single length, possibly with other diameters.

→ *vertical work load*: It is the load applied to the pile's head, exclusive of the pile's own weight; the latter is automatically calculated by the program as a function of diameter and length.

→ *lateral safety factor required*: required lateral safety factor to determine the admissible load, applied only to the lateral load component.

→ *safety factor required at the point*: safety factor required to determine the admissible load, applied only to the bearing component of the point.

→ *watertable depth*: depth of the phreatic watertable expressed in meters from the groundlevel plane.

→ *vertical seismic coefficient*: the vertical seismic coefficient of the area being examined.

→ *unit weight of the pile*: the weight of the pile (lightened by the eventual weight of moved water) is added to the project load to determine the safety factor, and is subtracted from the limit load to determine the admissible load.

→ *thrust coefficient k*: it is an a-dimensional coefficient that represents the ratio between the normal tension that acts at a determined depth on the lateral surface of the pile and the vertical tension at the same depth. It is used to calculate the lateral bearing load; if set to zero the program will calculate automatically as $k=1$ -

$\sin(\phi')$. The A.G.I. suggests for steel driven piles $k=0.5-1$; in pre-fabricated concrete $k=1-2$; for in-situ cast concrete $k=1-3$; drilled piles $k=0.4-0.7$. To calculate the lateral bearing load for drilled piles, the value entered is considered constant for the whole pile length.

- *multiplication factor for k*: it is used to calculate the lateral bearing load so as to take into account the material moved, of the initial density, the degree of over-consolidation and so on. Bowles suggests to set this factor equal to one as a precaution against long term effects.
- *shear limit*: it is the limit value of resistance against lateral friction. It enables one to take into account that said resistance can not increase indefinitely with depth but, after a certain critical depth, it will increase quite slowly and hence can be considered constant and equal to the limit value. When assigning to this parameter a value different than zero, the resistance will not be able to exceed the value entered. The A.G.I. suggests to limit the shear resistance values to a 150-200 kN/m², Reese and O'Neill to 200 kN/m².

Please note that the pile is considered as closed solid: the hydraulic lifting force is given by the surface of the section multiplied with the hydraulic pressure at the point of the pile.

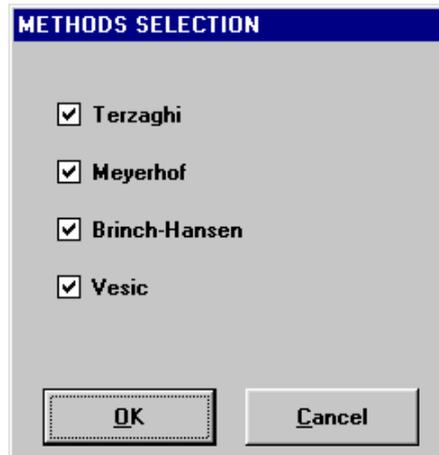
Methods Command (ALT,E,M)

By selecting this command a window is shown containing the list of methods used in the calculation phase of superficial foundation. All are usually selected.

To remove a method from the selection:

 click on the box next to the name of the method.

 with the DIRECTIONAL ARROWS, place the cursor on the box next to the name of the method then press the SPACE BAR.



Terzaghi Method (1943)

The Terzaghi equations use the plasticity theory to analyse the rigid base force plug in a softer material (the ground).

The expression proposed by Terzaghi is the following:

$$Q_{last} = c N_c s_c + q N_q + 0.5 g B N_g s_g$$

where:

Q_{last} = failure stress

B = foundation width

c = cohesion

q = effective vertical tension to the foundation plane

g = unit weight of the ground

N_c, N_q, N_g = bearing capacity factors

s_c, s_g = correction form factors

The bearing capacity factors are tied to the geometry of the failure surface in the ground hypothesised by diverse authors, while the correction factors have been introduced to allow the study of a more ample case history of foundation forms, geometries and types of external loads applied.

This type of equation is common to all of the methods, which are distinguished by the presence of additional correction factors and by the formulations of the bearing capacity factors.

In this program the more modern analytical formulation proposed by Spangler and Handy (1982), $N_g = 1.1 (N_q - 1) \tan (1.3 \phi)$, is used for the determining of the N_g factor instead of the experimental table originally proposed by Terzaghi.

Meyerhof Method (1963)

The expression proposed by Meyerhof is similar to the previous:

$$Q_{last} = c N_c s_c d_c + q N_q s_q d_q + 0.5 g B N_g s_g d_g$$

or, for inclined loads:

$$Q_{last} = c N_c i_c d_c + q N_q i_q d_q + 0.5 g B N_g i_g d_g$$

where:

Q_{last} = failure strength

B = foundation width

c = cohesion

q = effective vertical tension at the foundation plane

g = ground unit weight

N_c, N_q, N_g = bearing capacity factors

s_c, s_q, s_g = correction factors for the form

d_c, d_q, d_g = correction factors for the depth

i_c, i_q, i_g = correction factors for the dip

As can be seen, this more complex formula foresees the presence of correction factors that keep track of the foundation plane depth and the load dip (presence of horizontal components) and therefore allows a more detailed analysis than the previous.

Hansen Method (1970)

The expression proposed by Hansen expands on the previous:

$$Q_{last} = c N_c s_c d_c i_c g_c b_c + q N_q s_q d_q i_q g_q b_q + 0.5 g B N_g s_g d_g i_g g_g b_g$$

where:

Q_{last} = failure strength

B = foundation width

c = cohesion

q = effective vertical tension at the foundation plane

g = unit weight of the ground

N_c, N_q, N_g = bearing capacity factors

s_c, s_q, s_g = correction factors for the form

d_c, d_q, d_g = correction factors for the depth

i_c, i_q, i_g = correction factors for the dip

g_c, g_q, g_g = correction factors for the ground

b_c, b_q, b_g = correction factors for the base

This formula foresees the possibility to keep track of the foundation base and ground dips, and it is therefore the most complete formula presented here. For a complete description of the coefficients used with the Hansen and Vesic methods, refer to the text quoted in the introduction chapter.

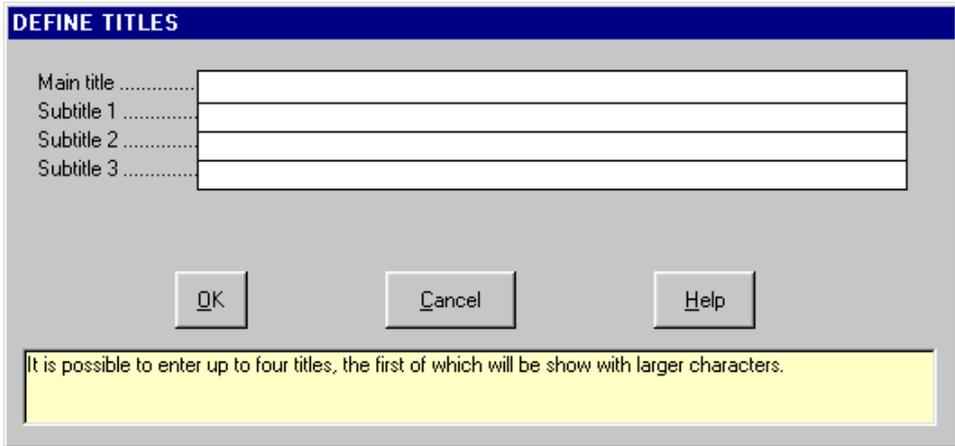
Vesic Method (1974)

The Vesic method is substantially similar to that presented by Hansen. Its differs in the calculation of the N_g factor and some of the correction factors, of which some result less conservative than the previous.

Detailed descriptions of the correction factors used in the formulae proposed by Hansen and Vesic are available in the literature. However it should be remembered that normally the combined use of the correction factors s_i and the correction factors for the inclination i_i (cfr. "*Foundation Analysis and Design*", J.E. Bowles, McGraw-Hill, fourth edition, Tab. 4-5) is not encouraged.

Titles Command (ALT,E,T)

The program allows the insertion of up to four lines of text of the final elaborations, tabular or graphic, that will then be reported as titles. A slightly larger character will be used for the main title.



DEFINE TITLES

Main title

Subtitle 1

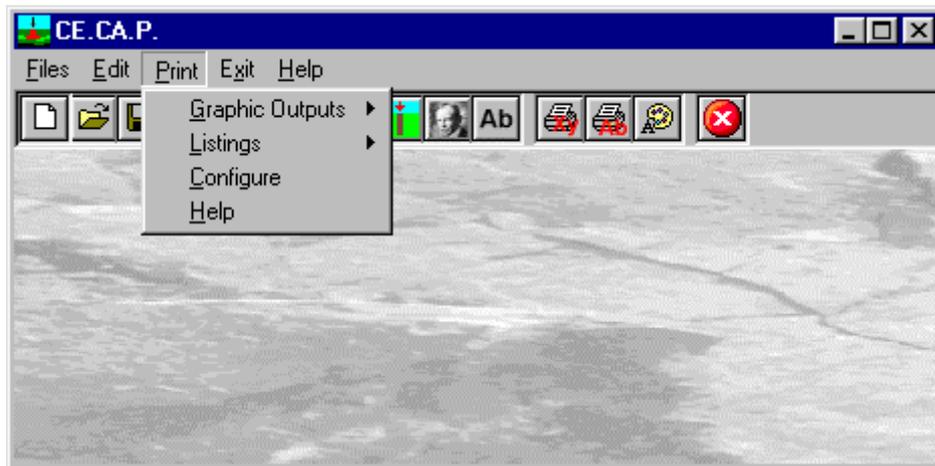
Subtitle 2

Subtitle 3

It is possible to enter up to four titles, the first of which will be show with larger characters.

Print Menu (ALT,P)

With this menu it is possible to produce graphic or listings of all the data by selecting directly from the menu titles.



Graphic Outputs Command (ALT,P,G)

With this command a sub-menu is activated where one can select the type of drawing to visualise and print.

Bearing Capacity of Superficial Foundations Command (ALT,P,G,B)

By selecting this command the program will first of all show the "Verify the parameters to be used in the calculation" dialogue window through which the mean geotechnical parameters calculated by the program can be modified.

Once the values have been verified and eventually modified, the program will perform the calculations and draw the calculated foundation, showing the results obtained.

Settlement of Foundations Command (ALT,P,G,F)

By selecting this command the program carries out the calculations, then draws the graph. The foundation is (by definition) positioned with the width parallel to the direction of left to right, to uniformly identify the nine significant points corresponding to which the calculations are executed, that are the centre, vertexes and middle points of the sides. In the histogram and tables the immediate (linear deformation) and long term (logarithmic deformation) settlement are reported separately.

Bearing Capacity of the Pile Command (ALT,P,G,P)

By selecting this command the program carries out the calculations, then draws the relevant graph. The safety factors diagram shows for each diameter/length combination, the load limit and the safety factors obtainable with the load conditions imposed by the project, while the load diagram shows the loads limit and the maximum admissible loads for each diameter/length combination.

Stratigraphy Command (ALT,P,G,S)

With this command one can draw the stratigraphical-geotechnical description. On the drawing the depth of the layers, the watertable depth, the stratigraphy and the description of the lithotype is shown. Furthermore, for each geotechnical parameter, a diagram is drawn showing on the abscissa the maximum and minimum range of the value relative to the parameter of the object and, on the ordinate at bottom of the bed, the value entered.

Listings Command (ALT,P,L)

By selecting this command the program opens a sub-menu where one can select the preview mode, and whether to print or export the listing.

Preview Listings Command (ALT,P,L,P)

With this command a sub-menu is activated where one can select the listing to be visualised.

Bearing Capacity of Foundations Command (ALT,P,L,P,C)

With this command it is possible to visualise the listing created by program after the calculation of the superficial

foundation. To move vertically through the text use the scroll bar or UP and DOWN arrow keys and the PAGE UP e PAGE DOWN keys. To exit press ESC.

The file, containing the listing, is saved in the same directory where the data file resides and has the same name but with the ".TAB" extension. The file is in ASCII format, and uses an internal pagination system where its commands are characterised by an initial # sign.

Settlement of Foundations Command (ALT,P,L,P,F)

With this command it is possible to visualise the listing created by the program after the calculation of the settlement of the superficial foundation. To move vertically through the text use the scroll bar or UP and DOWN arrow keys and the PAGE UP e PAGE DOWN keys. To exit press ESC.

The file containing the listing is saved in the same directory where the data file resides and has the same name but with the ".TAB" extension. The file is in ASCII format, and uses an internal pagination system where its commands are characterised by an initial # sign.

Details Settlement Table Command (ALT,P,L,P,D)

With this command it is possible to visualize the summary table including induced tension values and settlement values.

Pile Bearing Capacity Command (ALT,P,L,P,P)

With this command it is possible to visualise the listing created by the program after the calculation of the settlement of the deep foundation. To move vertically through the text use the scroll bar or UP and DOWN arrow keys and the PAGE UP e PAGE DOWN keys. To exit press ESC.

The file containing the listing is saved in the same directory where the data file resides and has the same name but with the ".TAB" extension. The file is in ASCII format, and uses an internal pagination system where its commands are characterised by an initial # sign.

Listings Fast Print Command (ALT,P,L,F)

With this command a sub-menu is activated where one can select the listing to be printed.

Bearing Capacity of Foundations Command (ALT,P,L,F,C)

With this command the listing pertaining to the calculation of the superficial foundation is sent directly to the default printer.

Settlement of Foundations Command (ALT,P,L,F,F)

With this command the listing pertaining to the calculation of the settlement of the superficial foundation is sent directly to the default printer.

Details Settlement Table Command (ALT,P,L,F,D)

With this command it is possible to print the summary table including induced tension values and settlement values.

Bearing Capacity of the Pile Command (ALT,P,L,F,P)

With this command the listing pertaining to the calculation of the deep foundation is sent directly to the default printer.

Export Listings in DOC Format (ALT,P,L,E)

With this command a sub-menu is activated where one can select the listing to be exported in the format used by Microsoft Word 97.

Bearing Capacity of Foundations Command (ALT,P,L,E,C)

With this command the listings pertaining to the calculation result are exported in the format used by Microsoft Word 97.

The file will have the same name but with the ".DOC" extension and will be saved in the same directory where the data files reside.

Settlement of Foundations Command (ALT,P,L,E,F)

With this command the listings pertaining to the calculation result are exported in the format used by Microsoft Word 97.

The file will have the same name but with the ".DOC" extension and will be saved in the same directory where the data files reside.

Details Settlement Table Command (ALT,P,L,E,D)

With this command the listings pertaining to the calculation result are exported in the format used by Microsoft

Word 97.

The file will have the same name but with the ".DOC" extension and will be saved in the same directory where the data files reside.

Bearing Capacity of the Pile Command (ALT,P,L,E,P)

With this command the listings pertaining to the calculation result are exported in the format used by Microsoft Word 97.

The file will have the same name but with the ".DOC" extension and will be saved in the same directory where the data files reside.

Export Listings in TXT format (ALT,P,L,T)

With this command a sub-menu is activated where one can select the listing to be exported in the "Text only" format.

Bearing Capacity of Foundations Command (ALT,P,L,T,C)

With this command the listings pertaining to the calculation result are exported in the "Text only" format.

The file will have the same name but with the ".TXT" extension and will be saved in the same directory where the data files reside.

Settlement of Foundations Command (ALT,P,L,T,F)

With this command the listings pertaining to the calculation result are exported in the "Text only" format.

The file will have the same name but with the ".TXT" extension and will be saved in the same directory where the data files reside.

Details Settlement Table Command (ALT,P,L,T,D)

With this command the listings pertaining to the calculation result are exported in the "Text only" format.

The file will have the same name but with the ".TXT" extension and will be saved in the same directory where the data files reside.

Bearing Capacity of the Pile Command (ALT,P,L,T,P)

With this command the listings pertaining to the calculation result are exported in the "Text only" format.

The file will have the same name but with the ".TXT" extension and will be saved in the same directory where the data files reside.

Export Listings in SLK Format (ALT,P,L,S)

With this command a sub-menu is activated where one can select the listing to be exported in the format used by Microsoft Word 97.

Bearing Capacity of Foundations Command (ALT,P,L,S,C)

With this command the listings pertaining to the calculation result are exported in the format used by Microsoft Excel.

The file will have the same name but with the ".SLK" extension and will be saved in the same directory where the data files reside.

Settlement of Foundations Command (ALT,P,L,S,F)

With this command the listings pertaining to the calculation result are exported in the format used by Microsoft Excel.

The file will have the same name but with the ".SLK" extension and will be saved in the same directory where the data files reside.

Details Settlement Table Command (ALT,P,L,S,D)

With this command the listings pertaining to the calculation result are exported in the format used by Microsoft Excel.

The file will have the same name but with the ".SLK" extension and will be saved in the same directory where the data files reside.

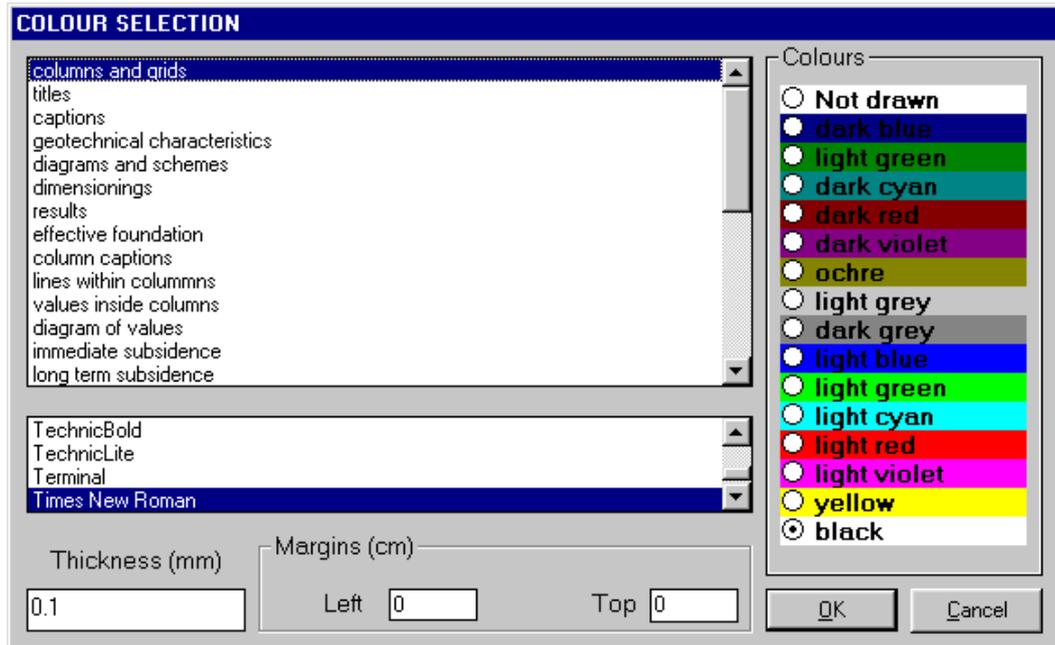
Bearing Capacity of the Pile Command (ALT,P,L,S,P)

With this command the listings pertaining to the calculation result are exported in the format used by Microsoft Excel.

The file will have the same name but with the ".SLK" extension and will be saved in the same directory where the data files reside.

Configure Command (ALT,P,C)

With this command, one can define the graphical properties of the different objects in the graphical output.



One can associate a colour, a line thickness and a character font to each object. Notice that not all the objects have both a line thickness and a character font: for example, a *title* only requires the colour and the character font to be defined.

- Click an object to select it (use the scroll bar to see the entire list)
- Click one of the option buttons, in the “colours” frame, to select the colour that has to be associated to the selected object. The *Not drawn* option hides the object of the graphical output.
- If the object contains texts, one can choose a character font from the list (use the scroll bar to see the entire list)
- If the object contains lines, one can assign a thickness to the lines (in mm). If the value is zero, the program uses the thinnest line on the output device.
- It is possible, as an option, to assign a left and a top margin (in cm) to the whole graphical output.

NOTE: although the available set is limited to fifteen colours, they can be manually customised; double-click the coloured bar to open the Colour Dialogue Box and choose a different RGB value associated to the selected colour.

Exit Menu (ALT,X)

This command allows one to exit the program.

If the file being used contains modifications that have not yet been saved the program will propose the file saving window, if you would like to save these modifications.

To save a file:

-  click on the <OK> button. It is possible to assign a new name to the file by typing the new name in the File Name field before clicking the <OK> button.
-  Press enter. To assign a new name to the file type the new name in the File Name field and then press enter.

To abandon the modifications:

-  click on the <Cancel> button: the file will be abandoned and the modifications will be lost.
-  press esc to select the <Cancel> button, this closes the file without saving.

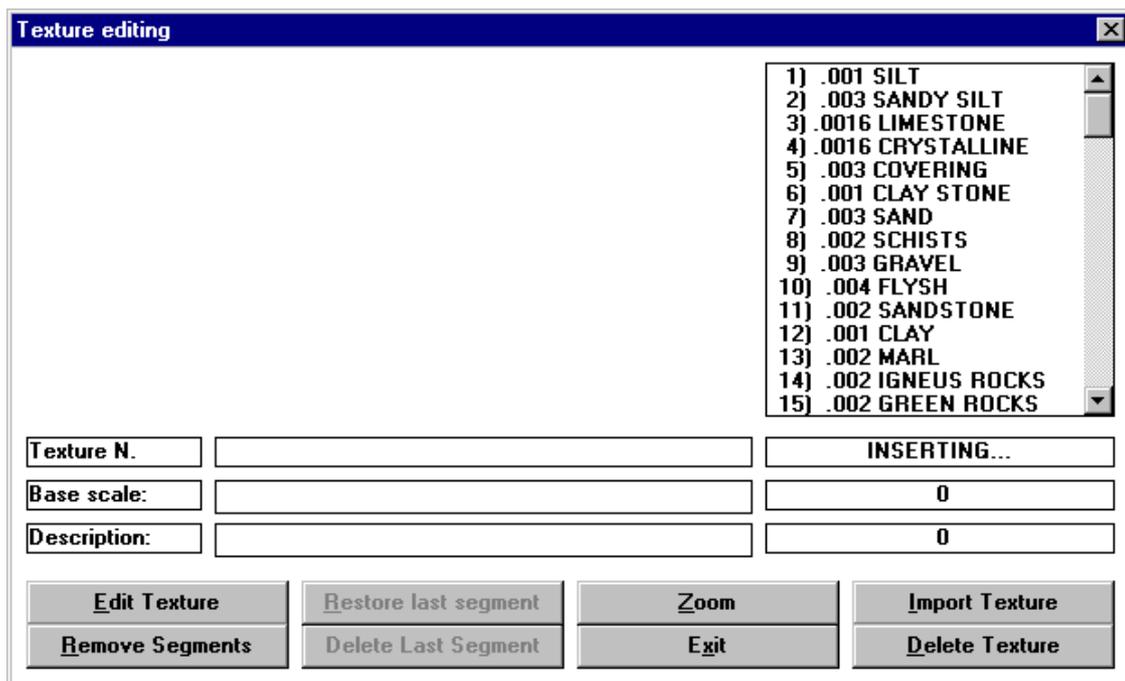
Chapter 7 - Generation and modification of geological textures

The Editret program

Selecting this command starts the utility used to generate and modify geological patterns in the stratigraphy column. More than thirty geological types of patterns are supplied with the program, these are inspired by the A.G.I. legend and the Standard American legend, all these can be modified with this command. It is also possible to create new patterns up to a maximum of 99 base patterns are obtained, each can be reproduced in 9 different scales and be superimposed on any of the others obtaining a vast range of possibilities.

The patterns are saved in four files, in the program directory, called SET1.NTR, SET2.NTR, SET3.NTR, SET4.NTR. If it is necessary to reinstall the program, remember to save these four files before beginning the installation to avoid the losing previously executed pattern modifications and additions. After the new installation, copy the files one saved in the directory indicated above.

On the right of the "Texture editing" window is a list of the existing patterns, listed in order of creation and distinguished by a number. We shall now consider how to create, modify or eliminate a pattern.



Creation of a new pattern.

- ☞ select the first available position from the list (where the line number followed by a zero) and double click it.
- ☞ press the TAB key to put the cursor on the first pattern listed, then, by using the UP and DOWN arrows, select the first available position and press the key combination of ALT+E to activate the <Edit Texture> key.

In the appropriate fields of the window, one can define the pattern's scale of representation in respect to the dimensions as predefined by the program for the base cell (100x50 cm) and the lithotype description. During the stratigraphy creation phase an enlargement factor (varying from 1 to 9) can be added beside the scale base of the pattern defined here; this factor will be multiplied by the base scale when it is printed: this permits the same pattern to assume different characteristics enabling, for example, the reproduction of large grain gravel by drawing the pattern in large scale and fine gravel by reducing the scale factor.

The drawing of a new pattern is done with the mouse. The base cell, which is traced in light grey when a pattern is selected, is subdivided into four squares. By moving the mouse inside the base cell the coordinates of the point in which the mouse is found are reported in the two fields located underneath the list for this purpose. Double click to start drawing a new segment then move the mouse. To interrupt the segment and start a new one connected to it, double click. To end a segment, click once. The program is only able to draw straight lines. To facilitate the drawing phase, the following buttons are available as well:

- <Add segment / Remove segment>: by clicking on this button one passes from the drawing function to segment cancellation. When the form used to create or modify pattern is opened the drawing function is active. A reminder to this is placed beneath the list of patterns: if the Add segment function is active one can draw in the cell; if the Remove segment function is active the segments composing the patterns can be deleted simply by clicking on them.
- <Delete last segment>: deletes the last drawn segment.
- <Restore last segment>: redraws the last segment cancelled.
- <Zoom>: by clicking on this button it is possible to verify the result that will be obtained in the printing phase: all of the modifications effected in the same cell are presented in numerous cells positioned side by side, permitting a more realistic view of what will be obtainable using the pattern inside the stratigraphic column. By clicking on this button again, normal visualisation is returned.

How to modify a pattern

 choose the pattern to be modified from the list then double click it to select it.

 press the TAB key to put the cursor on the first pattern of the list then, by using the UP and DOWN arrows, select the pattern to be modified and press the key combination ALT+E to activate the <Edit Pattern> key.

The drawing scale and description of the pattern are shown in specific fields present in the window, this enables them to be modified. By using the commands described previously the pattern drawing can be modified.

How to copy an existing pattern

With the <Import Pattern> button it is possible to duplicate an existing pattern:

 from the list, choose the place into which one wants to import the pattern to be copied by double clicking on it. The this can be empty or already occupied by a pattern.

 press the TAB key to put the cursor on the first pattern of the list then, using the UP and DOWN arrows, select the pattern, that can be empty or already occupied, where one wants to have the pattern to be copied and press the key combination ALT+E to select it.

Now one should indicate the pattern to import:

 click on the <Import Pattern> button to call up the “Selection of pattern to copy” window and enter the number of the pattern to be imported in the Pattern number field then click on the <Ok> button. If the selected pattern is to be imported into a place that is not empty the program asks for confirmation before executing the operation.

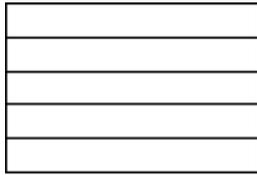
 press ALT+I to call up the “Selection pattern to copy” window and enter the number of the pattern to be duplicated in the Pattern number field then confirm by pressing the key combination ALT+O. If the selected pattern is to be imported into a place that is not empty the program asks for confirmation before executing operations.

How to delete an existing pattern

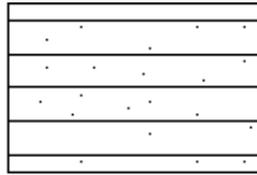
 select the pattern to be deleted from the list by double clicking on it and then click on the <Delete Pattern> button. If the deletion is confirmed the pattern is deleted from the list.

 press the TAB key to put the cursor on the first pattern listed then, using the UP and DOWN arrows, select the pattern to delete and press the key combination ALT+D to activate the <Delete Pattern> button. If the deletion is confirmed the pattern is deleted from the list.

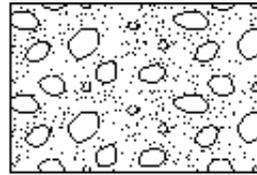
Patterns used in drawing stratigraphies



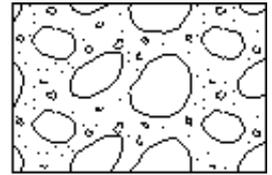
29 CEMENTED SAND



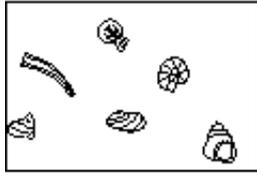
30 SLIGHTLY SANDY CLAY



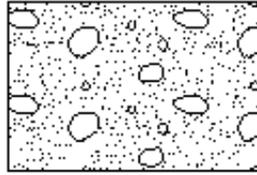
31 CLEAN GRAVEL AND SAND



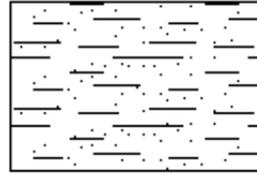
32 GRAVEL AND HEADERS



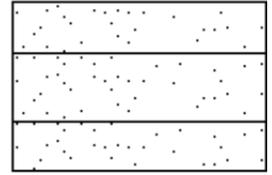
25 FOSSILS



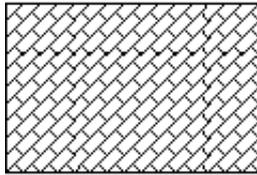
26 SAND AND GRAVEL



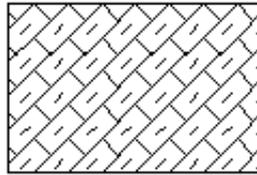
27 SLIGHTLY CLAYED SAND



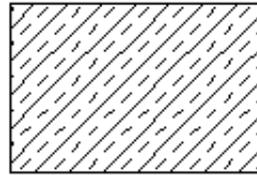
28 CLAYED SAND



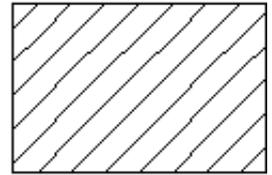
21 LIMESTONE AND DOLOMIA



22 LIMESTONE WITH MARL



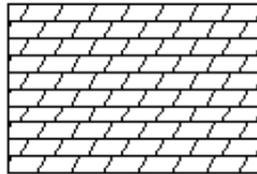
23 MARL



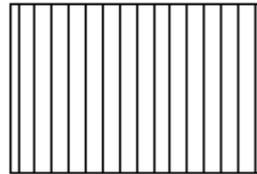
24 SANDSTONE



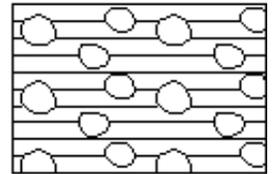
17 DEBRIS



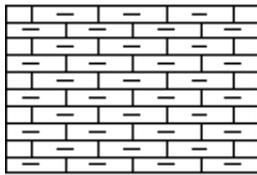
18 DOLOMIE



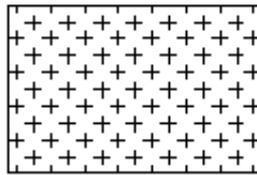
19 VERTICAL



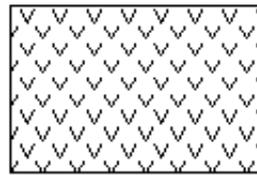
20 CHAOTIC



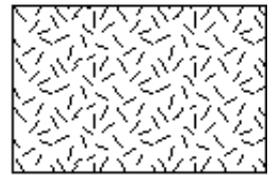
13 MARL



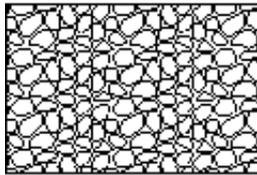
14 IGNEOUS ROCKS



15 GREEN ROCKS



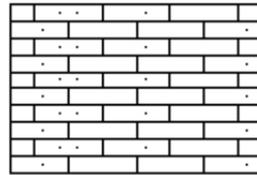
16 METAMORPHOSITES



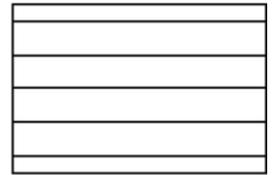
9 GRAVEL



10 FLYSH



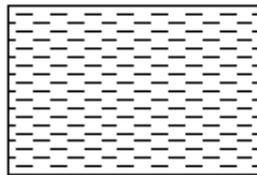
11 SANDSTONE



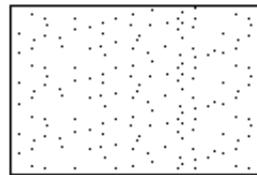
12 CLAY



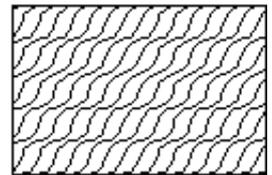
5 COVERING



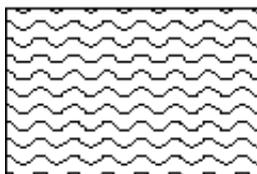
6 CLAYSTONE



7 SAND



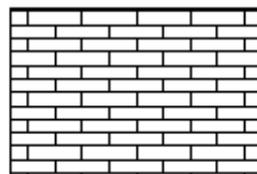
8 SCHISTS



1 SILT



2 SANDY SILT



3 LIMESTONE



4 CRYSTALLINE