

EnCPT 2019 – User's Manual

**A Program for Evaluations
and Soil Layering from CPT Data**

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CHAPTER 1. Introduction

1.1 General Description

EnCPT is a software developed for quickly importing, processing, visualizing Cone Penetration Test (CPT) data. Soil layer interpretations based on three Robertson criteria are implemented. Users can generate soil layers and assign p - y criteria data to each layer to be exported to other Ensoft compatible software such as LPILE.

1.2 Features of the Program

EnCPT provides an easy to use interface for importing CPT data displaying interpretation results. Measured cone resistance, cone friction, and pore water pressure (optional) can be imported into EnCPT to

1. Interactive import dialog for importing raw CPT data.
2. Determine soil type using Robertson 1986, Robertson 2010, and Robertson 2010b criteria and provide soil layering classification plots.
3. Provide estimates for soil properties such as friction angle, unit weight, and undrained shear strength.
4. Generate linear soil layer output and associate p - y criteria data to layers for other software.
5. Export generated soil layers and p - y criteria data to other Ensoft compatible software such as LPILE.
6. The interpretation plot for soil stratigraphy is provided in image format for exporting.

1.3 Organization of EnCPT Manuals

The documentation provided with the computer program EnCPT contains full documentation about the operation of the program on personal computers. The User's Manual covers the areas of installation, preparation of input data, program execution, view of computational results, and example applications. The distribution of the User's Manual is made via standard portable document file (PDF) format.

This manual is installed with the EnCPT program and accessible via any one of the following three methods:

1. Windows start menu
2. Ensoft tile in Windows 8 or Windows 10
3. Help menu (Section 3.1.1.4) within the EnCPT program

1.4 Typographical Conventions

To orient the user to different software features, certain terms are set in typefaces that distinguish them from the body text. The following formatting conventions are used throughout the Manual:

- Commands that are typed directly on the keyboard: “**Enter**” ; “**F1**” ; “**Esc**”
- Commands with keys simultaneously pressed in the keyboard: “**Alt** + **F**” ; “**CTRL** + **O**”
- Menu items and other text displayed on the screen are in sans serif:
From the **F**ile menu choose **O**pen
- File names and names of directories and folder and icon names are in italics:

Open the example file *example1.encpt*

- Internet and electronic mail addresses are underlined:
Send email to support@ensoftinc.com

1.5 Contents of the EnCPT Package

The standard package sent with EnCPT consists of the following items:

- One USB device (sometimes known as hardware key or dongle),
- One backup USB (this may be missing in future releases, since the full program is available for free downloading from the www.ensoftinc.com website).

The user-selected installation directory (default directory is *Program Files (x86)\Ensoft\EnCPT2019*) contains the main Windows-program module (*encpt2019.exe*). The User's Manual is also included in the installation directory. Several examples of input files (all files with extension **.encpt*) are installed in a separate *Ensoft/EnCPT2019-Examples* subdirectory in the root Windows drive (usually *C:*).

1.6 Hardware Requirements

To use EnCPT, the user needs the following minimum hardware configuration:

- Any personal computer with an Intel® Pentium® or newer processor.
- A hard disk with at least 500 MB of free space.
- Microsoft Windows®, XP, VISTA or Windows 7/8/10. A newer release of the Microsoft Windows® operating system may need a more recent update of the EnCPT software.
- Minimum of 512 MB of free RAM memory.
- A mouse or similar pointing device.

1.7 Technical Support

Although computer program EnCPT was designed to be distinguished by its ease of use and by its helpful User's Manual, some users may still have questions. The technical staff at ENSOFT strongly supports all registered users with questions related to the installation or use of EnCPT, according to the stipulations presented below. The software is provided with free maintenance service for the first year. After the first year the user is encouraged to purchase the yearly maintenance services. The yearly maintenance services include free download of the latest version and free technical support as described below.

1.7.1 Preferred Methods of Software Support

Software support is given, in order of preference, by the following methods:

- Electronic mail to: support@ensoftinc.com
- Fax to: (512) 244-6067
- Telephone call to: (512) 244-6464, extension 2

Users are strongly encouraged to utilize electronic means of support via email. In all technical support requests via email, please include the following information:

- full software version/release/update (obtained from the **Help > About** dialog),
- a description of the user's problem or concern,
- attach a copy of the input-data file that is associated with the issue/concern (files with name/extension of the type *filename.ecpt*), and
- name and telephone number of the contact person and of the licensed user (or name and office location of the licensed company site and/or serial number of the USB Key).

Although immediate answers are offered on most technical support requests, please allow up to two business days for a resolution in case of difficulties or schedule conflicts.

Technical help by means of direct calls to our local telephone number, (512) 244-6464, is available, but is limited to the business hours of 9 a.m. to 5 p.m. (US central time zone, UTC –6:00). The current policy of Ensoft is that all telephone calls for software support will be answered free of charge if the user has a valid maintenance contract.

1.7.2 Upgrade Verification and Internet Site

The software provides options for the user to check the most recent maintenance release through an internet connection by selecting **Help > Check for Updates**. This command starts the default internet browser and will display the user's maintenance expiration date, the user's software release number and the most recent release number that is available for downloading.

If the user's version is not the latest version and the maintenance has not been expired, the user can download the latest version from our web server directly (www.ensoftinc.com). Users may also consult our internet site for additional information on software updates, demos, and new applications; technical news; and company information.

1.7.3 Renewal of Program Maintenance

The cost to renew program maintenance will depend on the length of time for which the program maintenance has been expired. There are small price increases with time after expiration. The pricing policy for renewing a program maintenance that has not expired can be found on the Ensoft website at https://www.ensoftinc.com/order_form

1.7.4 Changes of Support Policy

The software support policy and associated expenses are subject to change at ENSOFT's discretion and without specific mailed notices to the users. However, any change of rules will be verbally provided during telephone calls for software support.

CHAPTER 2. Installation

2.1 Installation Procedures

Program EnCPT is distributed with an associated USB key (hardware key or dongle). The hardware key consists of a device that is attached to an empty USB port (or USB hub) of the computer in use (or in the designated software server in the case of local network licenses). This method of software protection has been found to provide compatibility with existing operating systems, better stability than other alternatives, and allows users to obtain software updates or replacements via downloads from the internet.

Users with standard single-user licenses can check the following link to a PDF with Installation Notes:

https://www.ensoftinc.com/doc/Ensoft_Single-User_License_Installation_Booklet.pdf

Users with local network licenses can check the following link to a PDF with Network Installation Notes:

https://www.ensoftinc.com/doc/Ensoft_Network_License_Installation_Booklet.pdf

2.1.1 Installation of Single-User Version

This version of EnCPT has been tested to be compatible with the following versions of the Microsoft Windows® operating systems: Windows 7 and 8, 8.1 and 10 in 32 and 64-bit releases.

The following guidelines are recommended to be followed during the installation process of EnCPT for single-user licenses.

1. Plug the supplied USB Key into one of the available USB ports in your computer. The USB Key is plug-and-play compatible so the operating system will recognize the USB Key automatically and a small but solid green light should appear at the end of the USB Key (a flickering green light or no light indicate problems with the standard windows driver or with the USB Key).
2. If the user installs from a distribution USB Memory Stick and the main installation program does not start automatically upon insertion of the Memory Stick then click on the Windows **Start Menu** button and select **Run**. On the command line, type *d:\setup.exe* or *e:\setup.exe*, where *d:* or *e:* represents the drive that contains the distribution Memory Stick. Click OK to execute the command and start the main installation program for ENSOFT's software. A screen similar to the one in Figure 2-1 should appear.
3. If the user installs from a downloaded file then please run the downloaded file (double click) and go to instruction #5.
4. Click anywhere on the EnCPT 2019 icon and then click on the **Install Standard** button to start the installation of EnCPT.
5. The user should read the license agreement shown in **Error! Reference source not found.**. Users can review the License Agreement online in the following link:

<https://www.ensoftinc.com/doc/Ensoft%20License%20and%20Disclaimer.pdf>

The installer will place the same file (*Ensoft License and Disclaimer.pdf*) in the installation directory. Please click **Yes** if you agree and would like to proceed.

6. Select **Single-User License** in Figure 2.2-3 then click **Next**. For network installations please contact Ensoft support (support@ensoftinc.com).

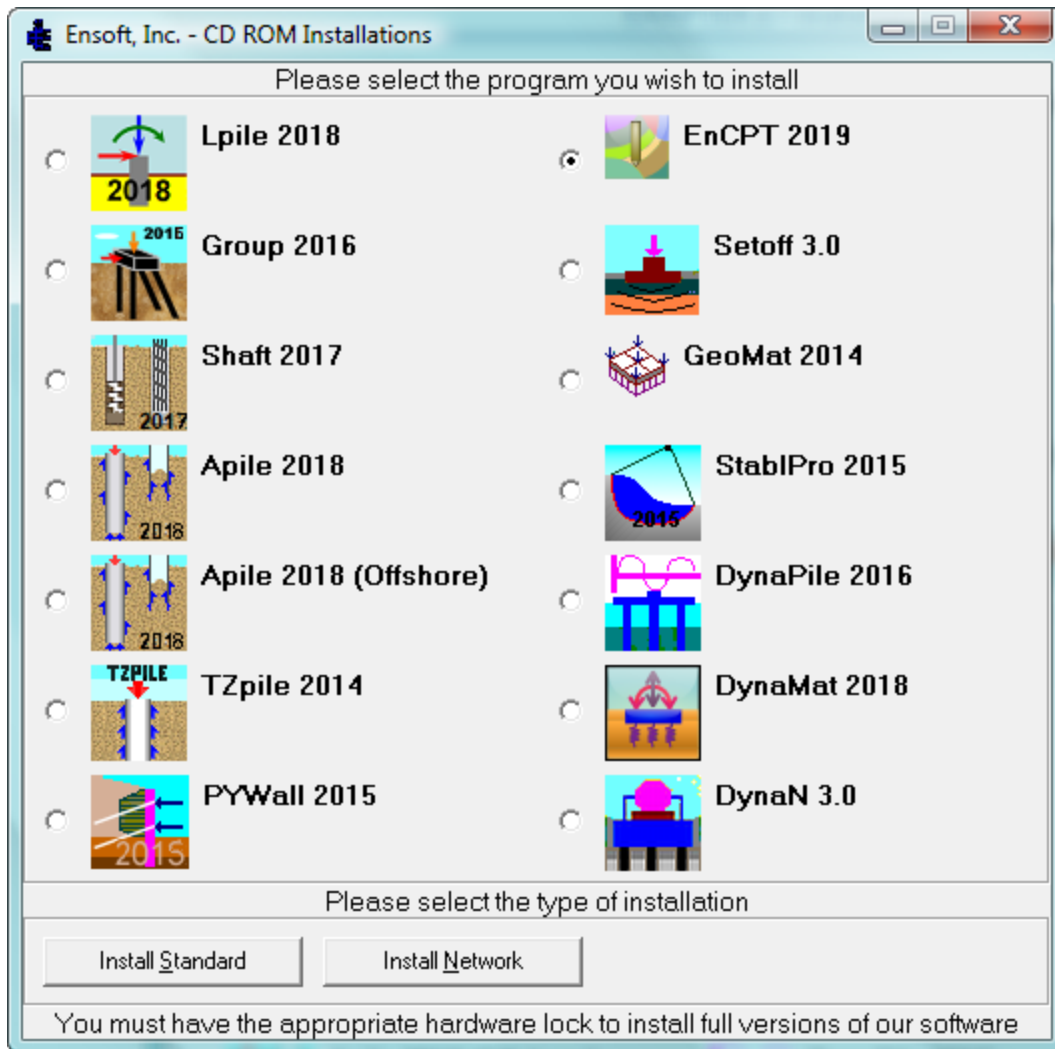


Figure 2-1 Main Installation Screen for ENSOFT Software (may change with time)

7. The user will be provided with an option to select a drive and directory for the installation of example files (see Figure 2.2-4). Default installation directory is the following:
8. The user will also be asked to select a drive and directory for the installation of EnCPT (see Figure 2.2-5). Default installation directory (varies according to the Windows release where it is installed) is one of the following:

(Root Drive)\Ensoft\EnCPT2019-Examples

(Root Drive):\Program Files (x86)\Ensoft\EnCPT2019

(Root Drive):\Program Files\Ensoft\ EnCPT 2019

If the desired directory does not exist, the installation program will automatically create a new directory in the chosen hard drive.

Most distribution files will be copied to the installation directory (either the default or the one selected by the user). However, certain files are copied to system directories in Windows and some Windows services are started during installation (mainly for Network installations). The name of the

- system files, their exact locations, and the type of services that are started may change in time and for different versions of the Microsoft Windows® operating system.
9. During the installation the user will be asked to set the file extension association for opening EnCPT v2019 input data files (see Figure 2.2-6). If the user agrees (leaves the default check mark) then double clicking (or running) any input data file with extensions of the type *filename.ecpt* will start the installed EnCPT v2019 software.
 10. The user will be prompted to confirm the shortcut directory name that will be created in the Windows **Start Menu** (See Figure 2.2-7). The default is *Start Menu/Programs/Ensoft/EnCPT2019*. Windows 10 and 8 will automatically create an Ensoft tile with the same shortcuts.

After the installation is finished, it is usually not necessary to reboot Windows for the program to run. The user may run the program by selecting EnCPT v2019 from the standard links installed in the Microsoft Windows® Start Menu: **Start Menu > All Programs > Ensoft > EnCPT2019**



Figure 2.2-2 Installation Screen with License Agreement (may change with time)

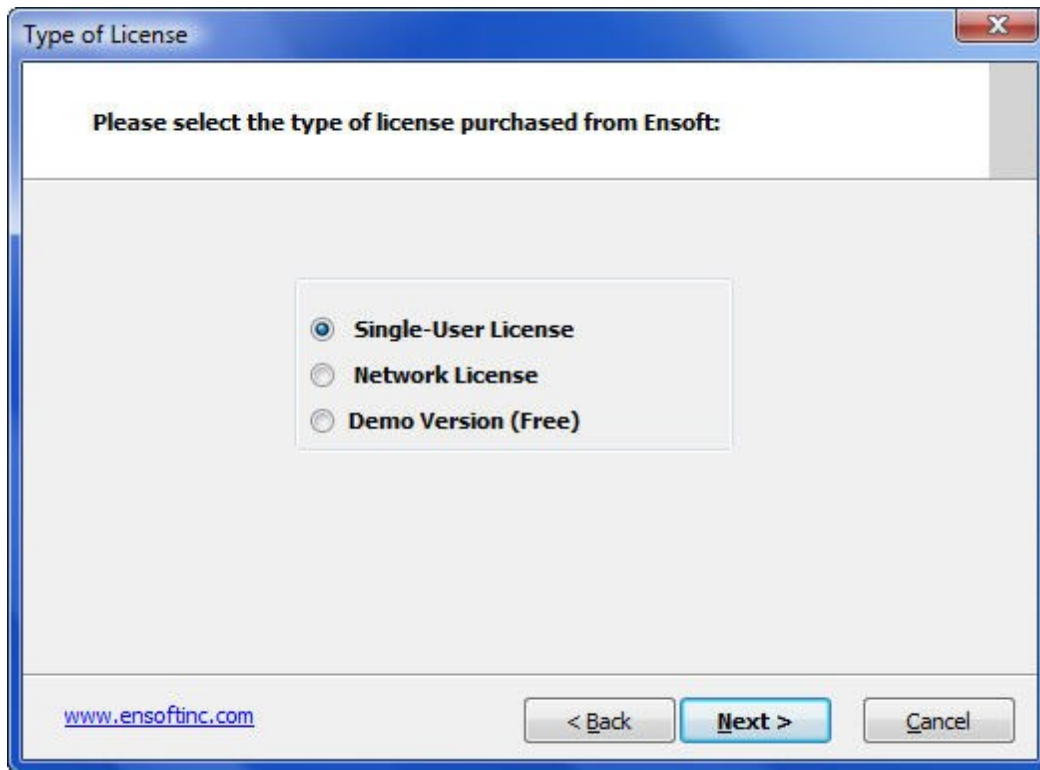


Figure 2.2-3 Selection of Single-User License (may change with time)

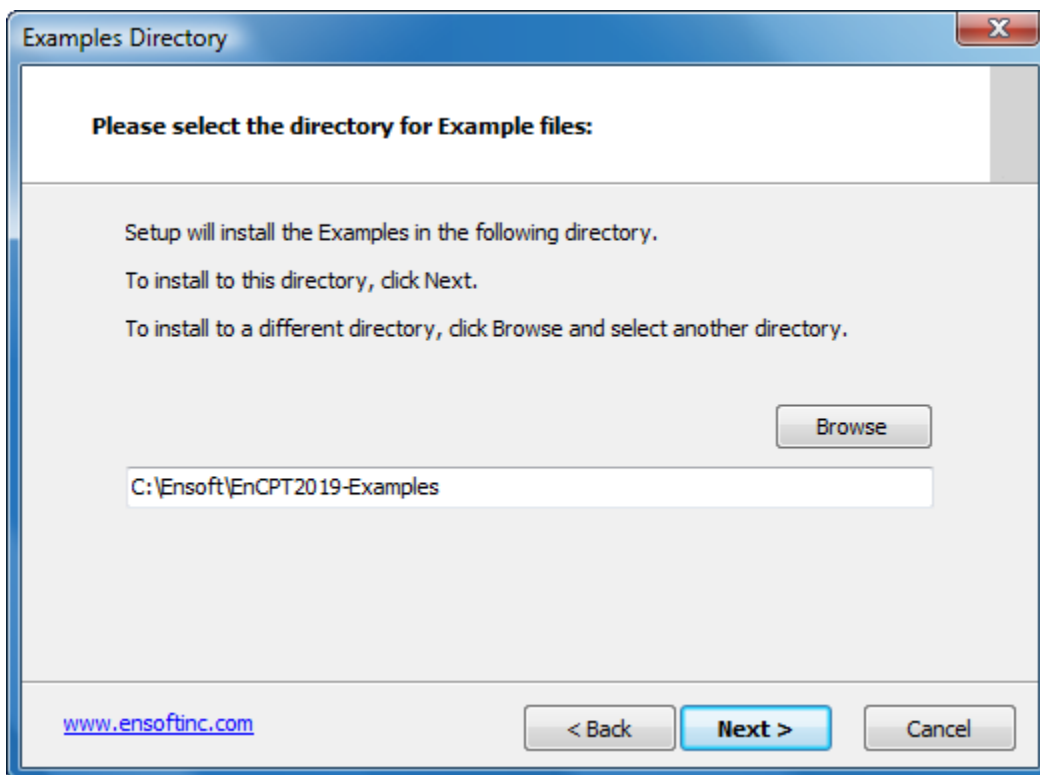


Figure 2.2-4 Default Installation Directory for Example Files (may change with time)

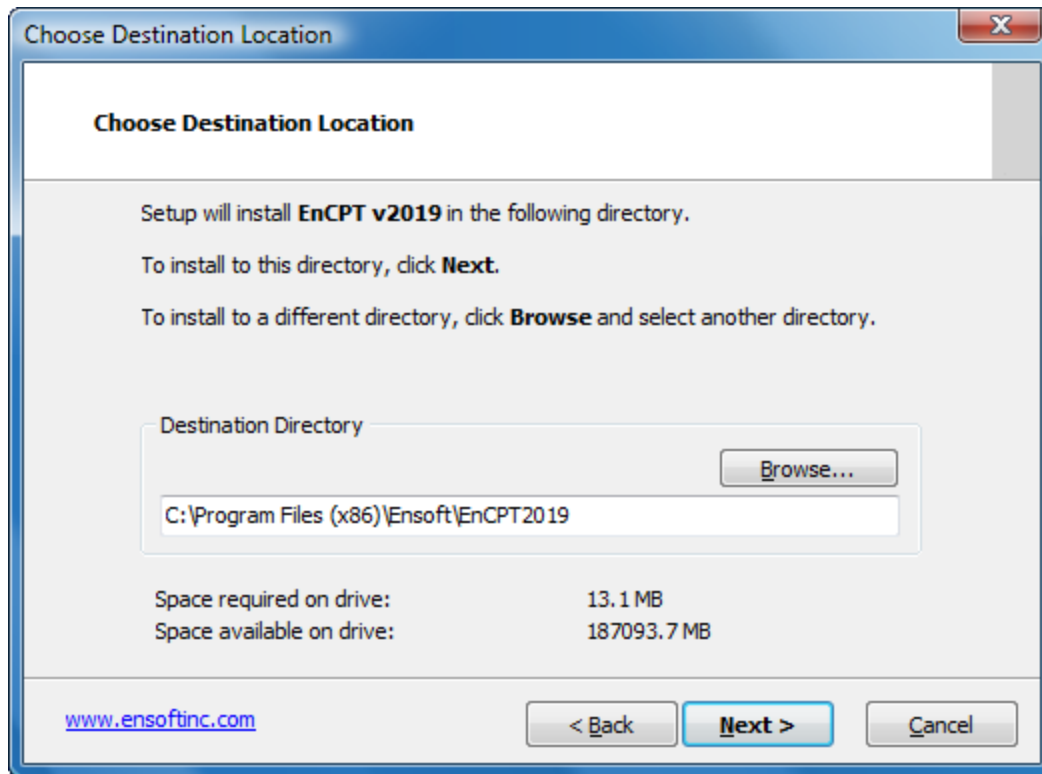


Figure 2.2-5 Default Installation Directory for Program Files (may change with time)

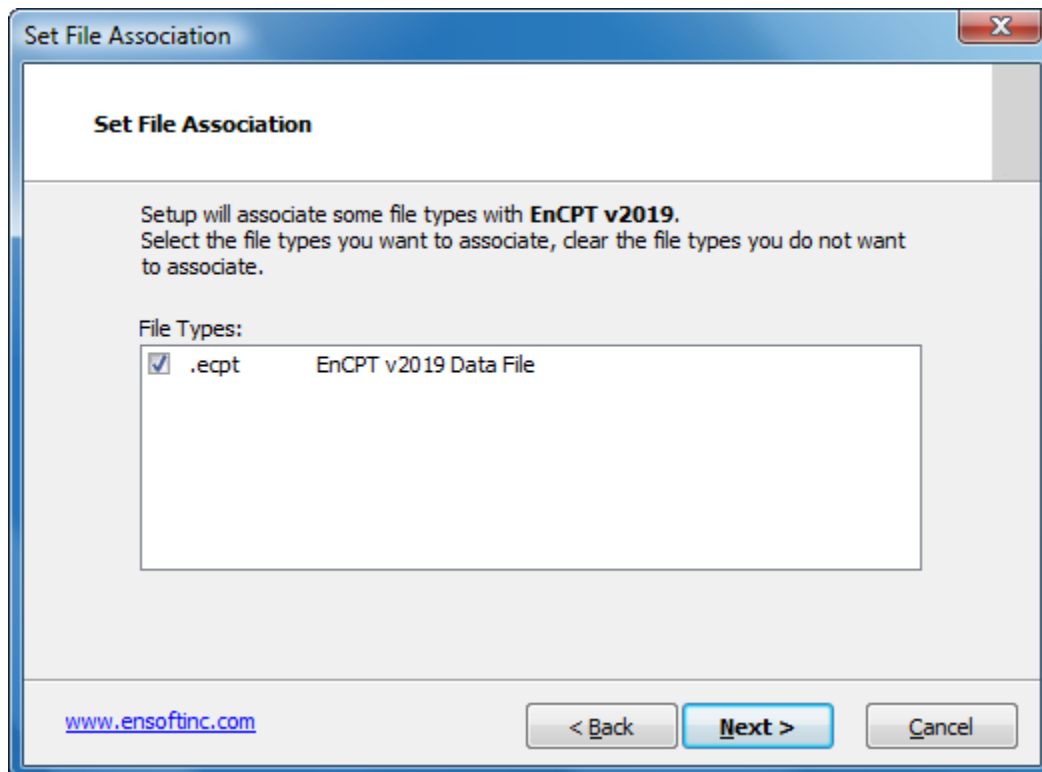


Figure 2.2-6 File Extension Association for PYWALL Data Files (may change with time)

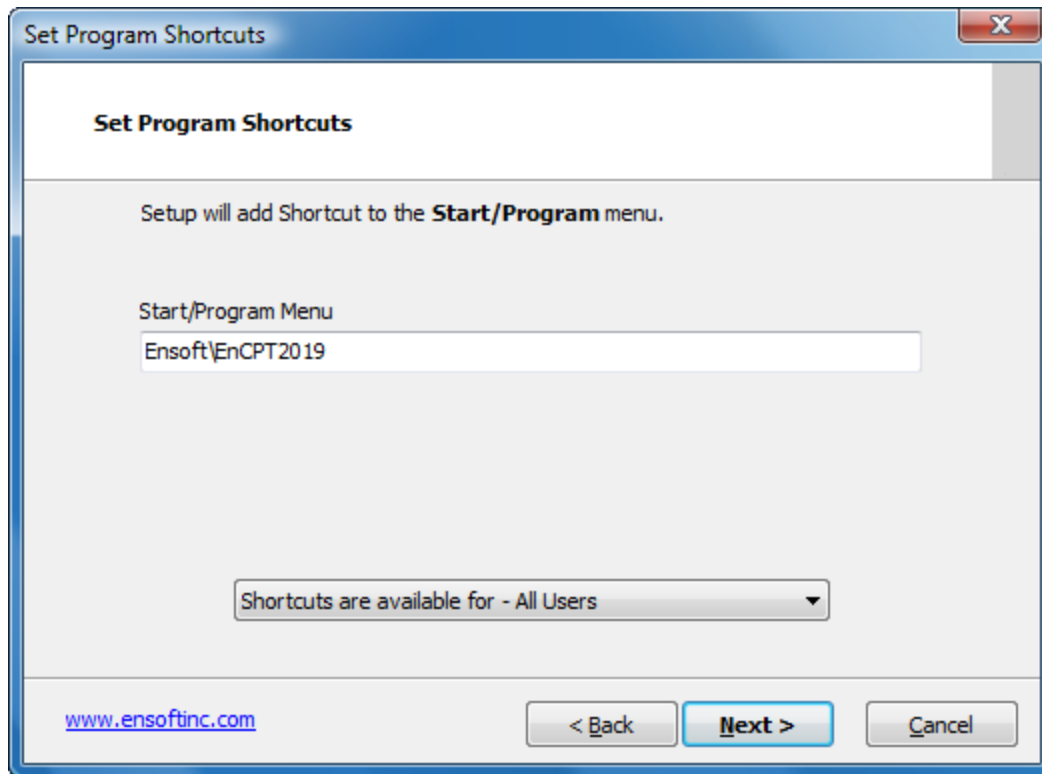


Figure 2.2-7 Default Shortcut Folder in Windows Start Menu (may change with time)

2.1.2 Introduction of Network Version

Special network licenses and USB hardware keys (network keys) are available for users that desire to operate EnCPT on a Windows network. The network version is limited to users within a specified range of IP addresses at each licensed physical site. Discounted rates apply for purchases of multiple network seats for the same site.

Network versions of EnCPT have special subroutines written for installations in “software servers” and for installations of “individual clients”. The “software server” is known as the computer that will be carrying the network key provided by ENSOFT, INC. The software server is not necessarily the same as the existing network server. Any computer in the existing Windows network may be designated software server for EnCPT as long as the network key is attached to an available USB port (or through an USB hub) and the “server” version of the software is installed on its hard drive. Software “clients” may be all other computers of the network that have the program installed as client. Client computers do not need any hardware key attached to their local system. The program installed in “client computers” will be allowed to run as long as the computer designated as “software server” is accessible on the network with the proper operating system and with its network key secured in place.

Users of the network version of EnCPT are allowed to have the software installed in as many computers as desired within their specified IP ranges of their local Windows network. However, only a number of users equal to the total number of purchased licenses will be able to operate the program at the same time.

2.1.2.1 *Installation of Network Version*

Installers of network licenses should refer to a separate booklet with installation instructions for the Network version of this product. The document can be downloaded from the Ensoft web site:

https://www.ensoftinc.com/doc/Ensoft_Network_License_Installation_Booklet.pdf

Alternatively, the document can be requested via email to support@ensoftinc.com

2.1.2.2 *Silent Installations on Client Computers*

For installation of network licenses on local client computers there is an option for command-based installations that are completely silent (performed without other user input). Instructions for silent installations on client computers can be downloaded from the Ensoft web site using the following link:

<https://www.ensoftinc.com/doc/Silent%20Install%20on%20Client%20Computers.pdf>

Alternatively, the document can be requested via email to support@ensoftinc.com

2.1.3 **Backup of Original Software**

The distributed software may be copied for backup purposes. The program may be installed in several computers at the same time. However, unless network licenses are purchased, the program will only operate in the computer that carries the appropriate USB Key.

2.1.4 **Software Updates on the Internet**

Occasionally, ENSOFT will produce software improvements and/or fixes and place the latest software programs on ENSOFT's internet site. Users can check for available updates by selecting **Help > Check for Updates** from the PYWALL menu. Software users may freely download the latest program update from the **PRODUCTS > Downloads** link in the following site: <http://www.ensoftinc.com>

CHAPTER 3. Using EnCPT

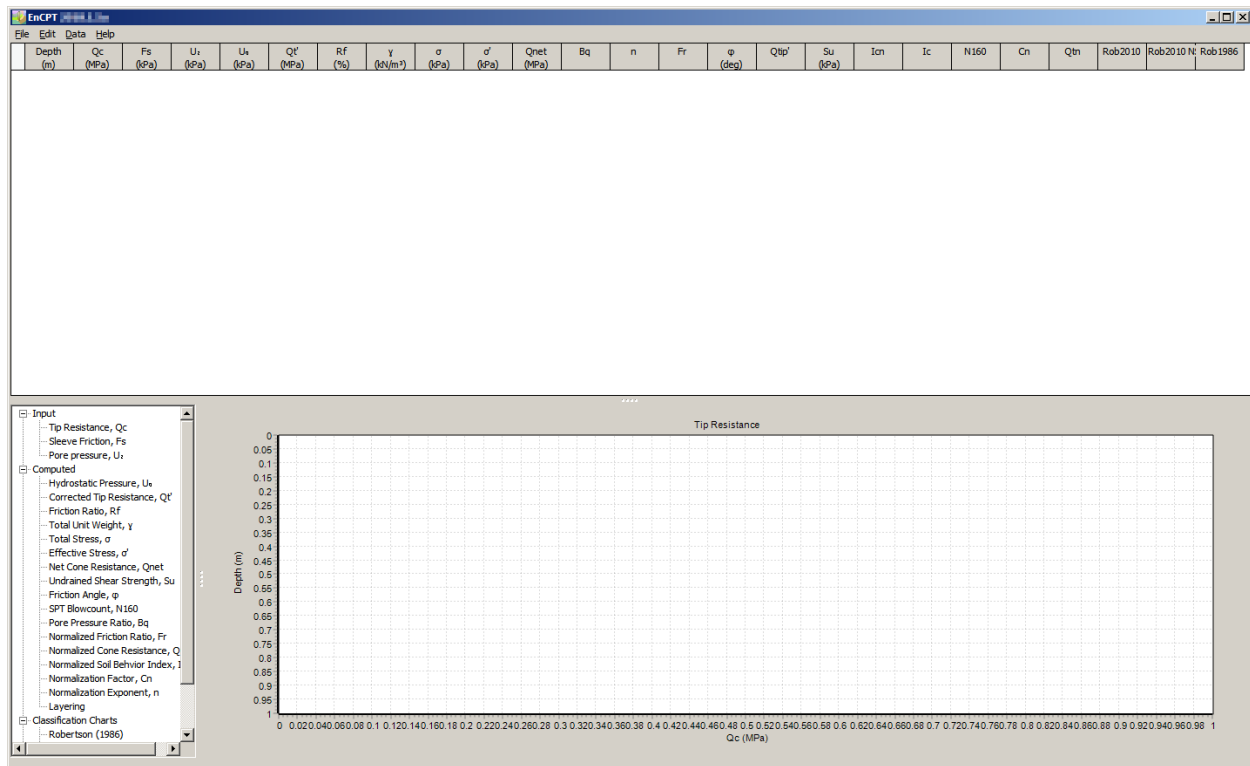


Figure 3-1 EnCPT default view

EnCPT runs under either Licensed or demonstration (Demo) mode. If the hardware USB security key is not found, EnCPT will run under Demo mode. Table 3-1 compares the availability of some of the core functionalities of EnCPT under these two modes.

Table 3-1 EnCPT running mode and available functionalities

	Licensed	Demo
Open	✓	✓
Edit	✓	✓
View existing results	✓	✓
View User's Manual	✓	✓
Save / Save As	✓	✗
Import data	✓	✗
Export SPY file	✓	✗

Throughout this chapter, the full functionality of EnCPT is discussed (i.e. EnCPT running under Licensed mode).

The typical steps followed when using EnCPT is as follows:

1. Open EnCPT
2. Import data (Section 3.2)
3. Save project to a file on local drive
4. View/save results (Section 3.1.3)
5. Generate p - y Criteria and export data (Section 3.5)

3.1 Main Window

The main window of EnCPT (Figure 3-2), displays CPT data in tabular and graphic form. The main window is composed of three major components

1. **Main Menu:** The menu bar houses the common functionalities of EnCPT including importing, saving, and exporting the application. This is further discussed in Section 3.1.1.
2. **Top Table:** Presents CPT data in tabular format, discussed further in Section 3.1.2.
3. **Plots:** Presents CPT data in different format in forms of plots (Section 3.1.3)

Each component is discussed in the following sections



Figure 3-2 EnCPT layout overview

3.1.1 Menu Bars

Functionalities of EnCPT are organized in menus as listed in the below

Menu	Functionality
File	Filing of project, e.g. new file, save, import, etc.
Edit	Edit display units; change CPT computation parameters
Data	Change water table; Generate or modify p - y criteria and layers
Help	Access information about EnCPT

In the following subsections, the available actions within each menu is highlighted.

3.1.1.1 File Menu

The corresponding functionality of the **File** menu is discussed in the below:

Icon	Action	Description
	New	Discard current project data (if any) and start a new project from scratch
	Open	Discard current project data (if any), locate a EnCPT file from local drive, and open it
	Open Recent	Open a recently opened EnCPT file
	Import	Discard current data, and interactively import new RAW CPT data from file
	Export	Export existing table data to CSV format, or generate and export an MS-Word document (requires MS-Word to be installed on client computer)
	Save	Save project under existing file
	Save As	Save project under a different name
	Exit	Exit EnCPT

3.1.1.2 *Edit Menu*

The corresponding functionality of the **Edit** menu each option is discussed in the below:

Icon	Action	Description
	Display Units	Change display units in table and plots
	Interpretation Options	Change interpretation options, including N_{kt} value and the equation used to estimate friction angles

3.1.1.3 *Data Menu*

Icon	Action	Description
	Water Depth	Specify water table depth. All computed values are re-evaluated after changing the water depth.
	p -y Criteria	Generate or specify soil layering data, with option to export to other Ensoft Software such as LPILE and GROUP

3.1.1.4 *Help Menu*

The corresponding functionality of each option in the **Help** menu is discussed in the below:

Icon	Action	Description
	About	Open a dialog with information regarding the copy of EnCPT
-	User's Manual	Prompt open user's manual (this document) outside the application
-	Check for Updates	Open a web browser and check for available updates to the software

3.1.2 CPT Data Table

Main CPT table presents the imported CPT data along with additional computed entries computed based on the imported data. Column entries in this table are summarized in Table 3-2. In this table, only the first 4 columns are editable. Once changes are made to these editable columns, the remaining dependent entries are automatically updated. As indicated in Figure 3-2, the table can be interacted with as follows:

- Pressing the F2 key on the keyboard while a cell in the first four columns has focus, or alternatively, double clicking a cell. Once selected, the table will go into *edit mode* (Figure 3-3). You can exit *edit mode* by pressing
 - a. Enter key on the keyboard to exit edit mode and commit changes
 - b. Esc key to exit without committing changes

NOTE: If a different cell is selected while in *edit mode*, the changes are automatically saved to the table.

	Depth (m)	Qc (MPa)	Fs (kPa)	
1	0.050	12.441	127.361	-2.13
2	0.100	11.139	228.868	-3.24
3	0.150	9.410	285.366	-1.65
4	0.200	6.928273	254.723	-4.06
5	0.250	6.461	230.783	-38.2
6	0.300	4.630	242.274	-49.6
7	0.350	5.130	241.317	-53.7

Figure 3-3 CPT Table in Edit Mode

- Right clicking the table to present a context menu (Figure 3-4). Available options in the context menu are as follows

2.452	6452.544	3.577	19.955	4.993	2
2.942	4619.100	5.245	19.883	5.989	3
3.432			19.918	6.984	3
3.923			19.855	7.978	4
4.413					4
4.903	5276.878	3.448			5
5.394	4242.758	3.521			5
5.884	4267.140	3.321	19.236	11.887	6

Figure 3-4 CPT Table context menu

- a. **Edit:** Edit current cell. This option is available only if a single editable cell in the first four columns has focus.
- b. **Copy:** Copy displayed data within the current selection to clipboard. Copied content will contain for applications that support formatting (e.g. Microsoft Excel), and default to plain text with cells delimited by the TAB character in other applications.
- c. **Color scheme:** Change table row color scheme
 - i. **Robertson (1986):** color based on soil classification type in accordance to Robertson (1986) charts
 - ii. **Robertson (2010):** color based on soil classification type in accordance to Robertson (2010) charts
 - iii. **Robertson (2010) Bq:** color based on soil classification type in accordance to Robertson (2010) charts using Bq values
 - iv. **Alternate rows:** (default) alternate coloring of the rows
 - v. **None:** No row coloring

Table 3-2 CPT Table Field description

Header	Description
Depth	Soil layer depth where the CPT reading was taken. When importing or editing data, the depth is required to be unique, and sorted in increasing order
Qc	Recorded cone penetration pressure, specified in units of force per area
Fs	Recorded cone side friction, specified in units of force per area
U ₂	Recorded pore water pressure, specified in units of force per area
U ₀	Hydrostatic pressure, assuming water level depth of 0
Qt'	Corrected cone tip resistance. This value is estimated using the tip resistance and the recorded pore water pressure, U ₂
Rf	Friction ratio, specified in percentage, computed using the Qt' and Fs
γ	Soil total unit weight, estimated using Qc, Qt', and Fs
σ	Total soil stress, estimated using γ, Depth, and U ₀
σ'	Effective soil stress, estimated using σ, and U ₀
Qnet	Net cone resistance, estimated using Qt', and σ
Qtip'	Normalized cone tip resistance, estimated using σ', σ, and Qt'
Fr	Normalized friction ratio, estimated using Qt', σ, and Fs
lc	Soil behavior index, estimated using Qtip' and Fr
Bq	Pore pressure parameter, estimated using Qc, U ₀ , and U ₂
Qtn	Coefficient computed using Qc, Qt', Fs, σ, and σ'
lcn	Coefficient computed using Qc, Qt', Fs, σ, and σ'
Cn	Coefficient computed using Qc, Qt', Fs, σ, and σ'
n	Coefficient computed using Qc, Qt', Fs, σ, and σ'
N160	SPT N1(60) number, computed using Qt' and lc
Su	Undrained soil strength, computed using lcn, Fr, Qt', and σ
φ	Soil friction angle, computed using Qc, lcn, and σ'
Rob1986	Soil classification in accordance to Robertson (1986) classification charts, utilizing Rf and Qt'.
Rob2010	Soil classification in accordance to Robertson (2010) classification charts, using Qtip' and Fr
Rob2010 nstd	Soil classification in accordance to Robertson (2010) classification charts, using Qtip' and Bq

3.1.3 CPT Table Graphs

Bottom panel of the main window presents a quick way to visualize inputted and computed CPT data. Selecting a category will display the corresponding graph on the right-hand side (see e.g. Figure 3-5).

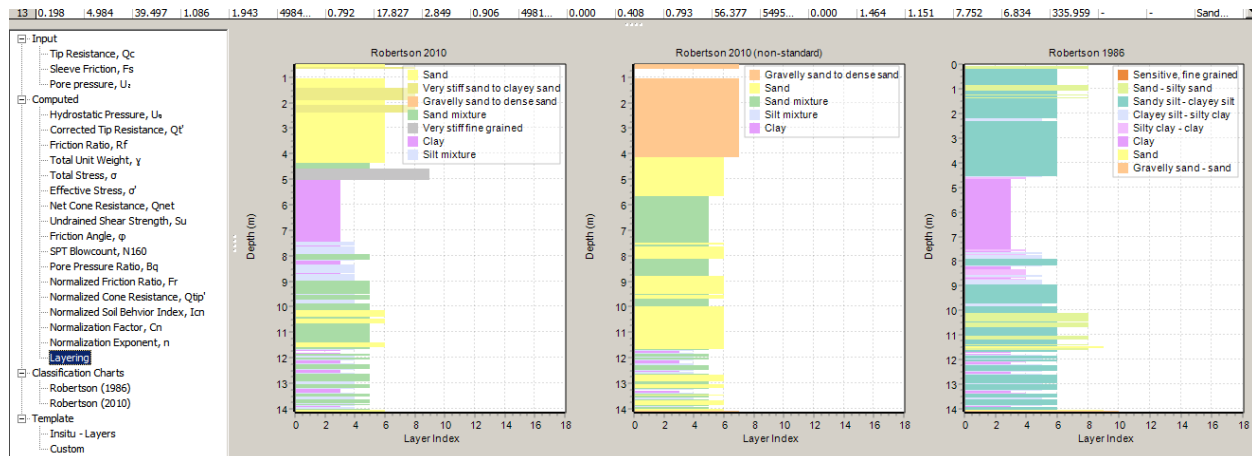


Figure 3-5 Soil layering classification plotted against depth

Available data is presented in a tree view as with following main categories:

- **Input:** Each tree leaf provides a scatter plots of the input data plotted against depth
- **Computed:** Plots of interpreted data based on imported data plotted against depth. The “**Layering**” item presents soil type classification index (see Section 3.1.3.1) for three commonly used classification charts is presented. Each individual record is plotted as a rectangular block colored in accordance to its pre-assigned color (**Error! Reference source not found.**). The eight of the block is the distance from the given Depth record to the subsequent recorded CPT Depth value, and its width is the layer index integer value (Table 3-3).
- **Classification Charts:** Plots under classification charts show the predefined classification zones along with each CPT record (see below).
- **Template:** A convenience template option to visualize different plots side by side. The “**Insitu – Layers**” options provides a pre-configured plots of input data plotted against depth as well as Friction Ratio plots and soil behavior type classification plots. See section below for a more detail description of available options

3.1.3.1 CPT Classification Charts

EnCPT supports three built-in classification charts:

1. Robertson (2010) standard classification charts consisting of 9 predefined zones (see Figure 3-6 left, and Table 3-3), defined in terms of normalized cone resistance (Q_{tip}') and normalized friction ratio (Fr)
2. Robertson (2010) Non-Standard classification charts consisting of 7 predefined zones (see Figure 3-6 right, and Table 3-3), defined in terms of normalized cone resistance (Q_{tip}') and non-dimensional pore pressure parameter (B_q)
3. Robertson (1986) classification chart consisting of 12 predefined zones (see Figure 3-7 and Table 3-3) defined in terms of corrected cone tip resistance (Q_t') and friction ratio (R_f)

Each data point is individually checked to see where it lies within these predefined zones and is then assigned a classification accordingly. If the point lies outside these zones, then the classification type is shown as "-" in the table, and excluded in the "Layering" graph.

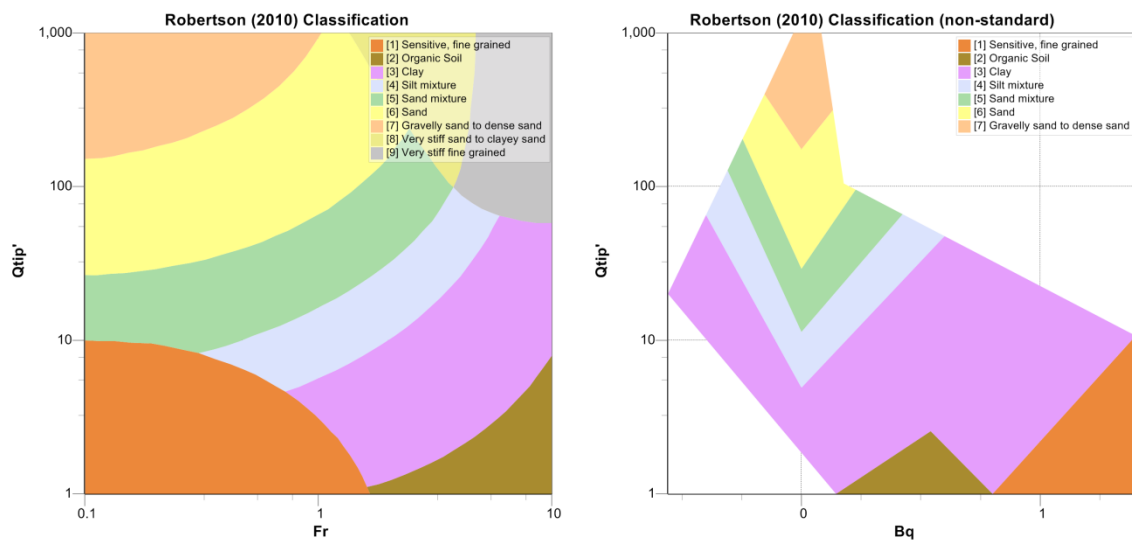


Figure 3-6 Robertson (2010) classification charts: Left: standard classification chart, Right: non-standard classification chart

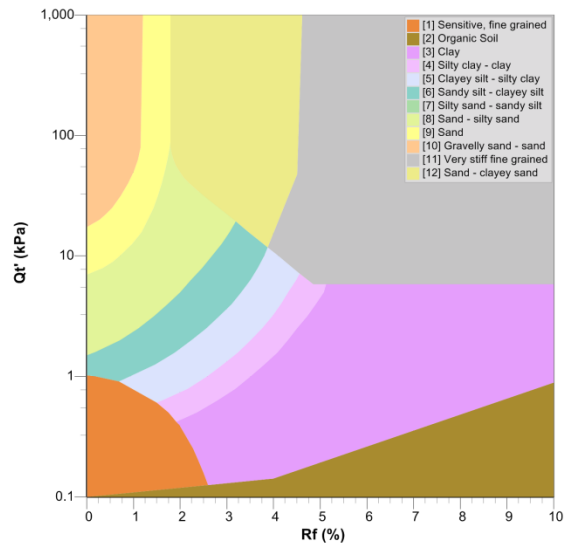


Figure 3-7 Robertson (1986) classification chart

Table 3-3 Classification types and associated layer index number and colors

Layer Index	Robertson (1986)	Robertson (2010)	Robertson (2010) non-standard
1	Sensitive, fine grained	Sensitive, fine grained	Sensitive, fine grained
2	Organic Soil	Organic Soil	Organic Soil
3	Clay	Clay	Clay
4	Silt clay – clay	Silt mixture	Silt mixture
5	Clayey silt – silty clay	Sand mixture	Sand mixture
6	Sandy silt – clayey silt	Sand	Sand
7	Silty sand – sandy silt	Gravelly sand – dense sand	Gravelly sand – dense sand
8	Sand – silty sand	Very stiff sand – clayey sand	
9	Sand	Very stiff fine grained	
10	Gravelly sand – sand		
11	Very stiff fine grained		
12	Sand – clayey sand		

3.1.3.2 CPT Template View

The **Template** subcategory in the tree view provides means to quickly place plots side-by-side (Figure 3-8) and export the resulting graphs as an image file.

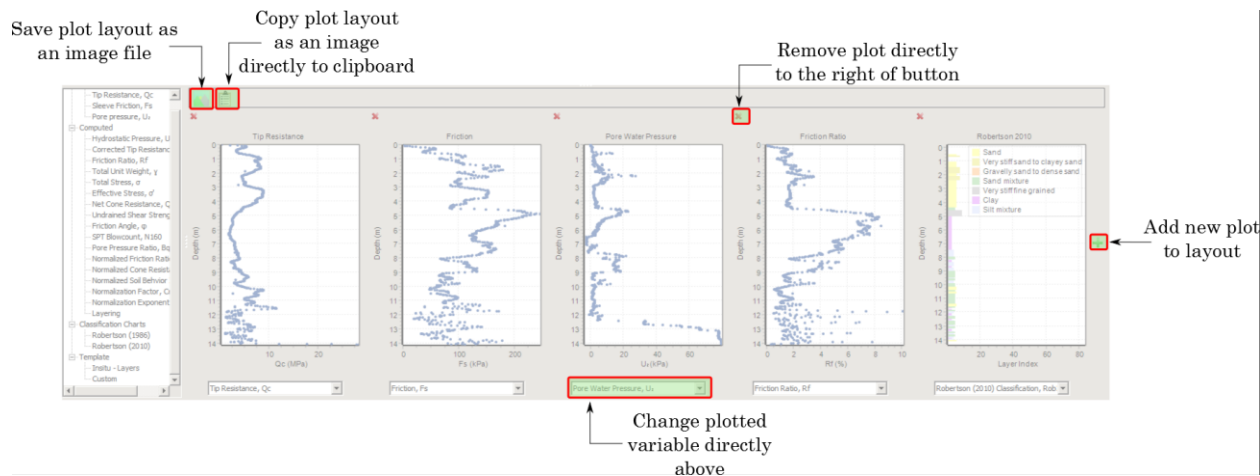


Figure 3-8 Plot layout view

The “Insitu – Layers” tree item is a preconfigured layout comprised of input data, friction ratio, and interpreted layering based on Robertson (2010) criteria. The drop down menu under each graph allows the selected default graph to be changed, and the button allows each plot to be removed. By selecting the button on the right-most side of the panel, additional graphs may be appended to the layout.

The combined plots may be exported as an image using the buttons on available on the top of the graphs:

Icon	Description
	Export selected plots as a PNG image file
	Copy selected plots directly to clipboard. The copied file may then be inserted in applications support image files such as a word processor by pressing Ctrl + M (typical)

3.2 Import Data

New CPT data must be imported from plain ASCII files using the Import Dialog, shown in Figure 3-9. In this document, we will use the term “CPT record” or simply “record” to refer to a tuple of elements uniquely identified by a single “depth” entry.

When first triggered, EnCPT’s Import Dialog tries to automatically select the best default configuration for easy import of data, and displays the chosen data to be imported on the right pane (Figure 3-9). This preview pane is only updated once the Update View button is clicked.

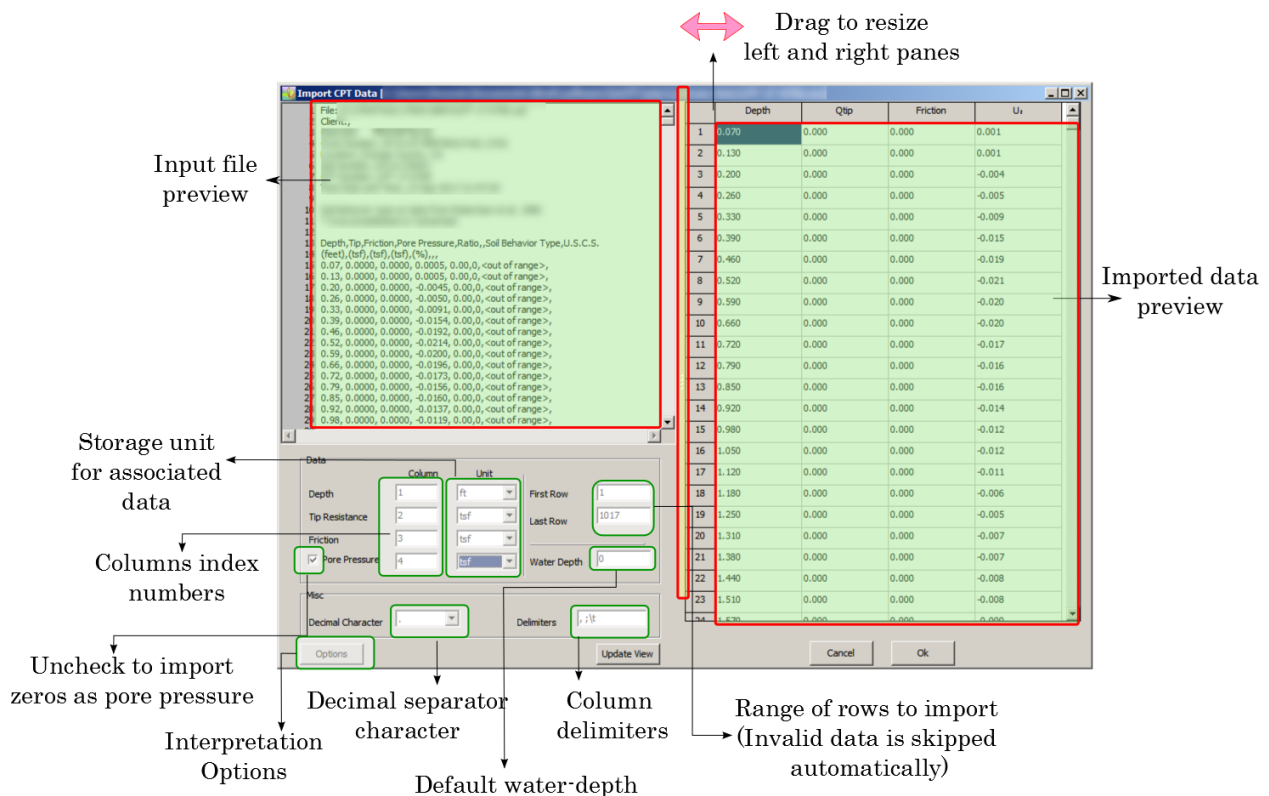


Figure 3-9 CPT data import dialog

EnCPT software requires specification of three or four entries per CPT record (Table 3-4). Each CPT record is required to be

- Written in a single line
- identifiable using a “depth” record
- Sorted in ascending order
- Contain four entries (Table 3-4)

If your import data file does not satisfy the above criteria, it must be first be manually adjusted before attempting to import it to EnCPT.

If duplicate depth values (up to a tolerance) are present, only the first record (read top to bottom) is imported and other records with same depth value are ignored.

These numeric entries are identified by an effective **Column** number in the text file, and must be associated with a unit. Note that the **Column** numbers entries are dependent on the choice of delimiter selection (Table 3-5).

Table 3-4 Required input entries

Item	Description
Depth	Depth where the CPT readings took place. These entries are expected to be unique and sorted in ascending order top to bottom. Once imported, these will be stored as the Depth values (see Table 3-2)
Tip Resistance	Recorded tip resistance at Depth measured as force per area. Once imported, these values are stored as Qc values (see Table 3-2)
Friction	Recorded friction at each Depth . Once imported, these values are stored as Fs (see Table 3-2).
Pore Pressure (optional)	Recorded hydrostatic pressure at each depth. Once imported, these entries are stored as U₂ . If the checkbox is not selected, pore pressure is imported to be zero for all records

Table 3-5 Miscellaneous options on Import Dialog

Item	Description
First Row	First line in CPT raw data file to include in processing, indexed at 1. Data lines that are found to not satisfy input properties are automatically discarded
Last Row	Last line in CPT raw data file to include in processing. Data lines that are found to not satisfy input properties are automatically discarded
Decimal Character	Decimal separator character used in file. For example, a decimal number may be specified as 1.2345 or 1,2345
Delimiters	List of column delimiters, specified in any order. Tab character is specified as '\t'. These delimiters specify how the Column entries are interpreted.
Water Depth	Depth where the water table is located. This specified value can be modified after data is imported into EnCPT
Options	Interpretation options including equation to use to determine friction angle. These values can be modified after importing the data. See Section 3.3.

3.3 Interpretation Options Dialog

The interpretation dialog (Figure 3-10) can be opened either through the toolbars of the main window (Section 3.1.1.2), or by clicking the Options button when importing CPT data (Section 3.2).

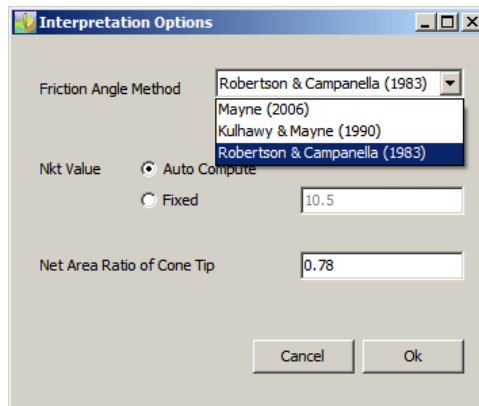


Figure 3-10 CPT Interpretation options

Current version allows specification of sets of options:

1. Friction Angle Method: The equation used for estimating friction angles

- Robertson & Campanella (1983): This is the default option,

$$\tan(\phi) = \frac{1}{2.68} \left[\log_{10} \left(\frac{q_c}{\sigma'} \right) + 0.29 \right]$$

where,

ϕ	Friction angle
q_c	Core resistance, unadjusted for cone projected area
σ'	Effective soil stress

- Kulhawy and Mayne (1990)

$$\phi = 17.6 + 11 \log_{10}(Q_{tn})$$

where,

ϕ	Friction angle, in degrees
Q_{tn}	Normalized cone resistance

- Mayne (2006)

$$\phi = 29.5 B_q^{0.121} (0.256 + 0.336 B_q + \log_{10}(Q_t))$$

where,

ϕ	Friction angle, in degrees
Q_t	Non-dimensional normalized cone resistance taking into account the in-situ vertical stress
B_q	Pore pressure ratio

2. N_{kt} : Value used in determining the undrained shear strength

- If selected as Auto, it will be computed as

$$N_{kt} = 0.5 + 7.0 \log_{10}(F_r)$$

where, F_r is a normalized friction ratio

- If fixed, the input value will be used irrespective of normalized friction value.

3. Net area of cone tip area: Value in range of 0.6 to 0.8 (defaults to 0.78) used in estimating corrected cone resistance.

Note: certain values are outside the domain of the specified equations. In such cases, the function is extended such that its value is zero outside its valid domain.

3.4 Export Data

EnCPT allows for data to be exported in various ways described in following subsections.

3.4.1 Clipboard

The most convenient way of exporting data and figures is through the clipboard. All figures can be copied to clipboard by right-clicking on them and selecting ‘Copy Image’ (see e.g. Figure 3-11). Once selected, the image is copied to clipboard and can be inserted in other applications (e.g. a word processing unit) by pasting it.

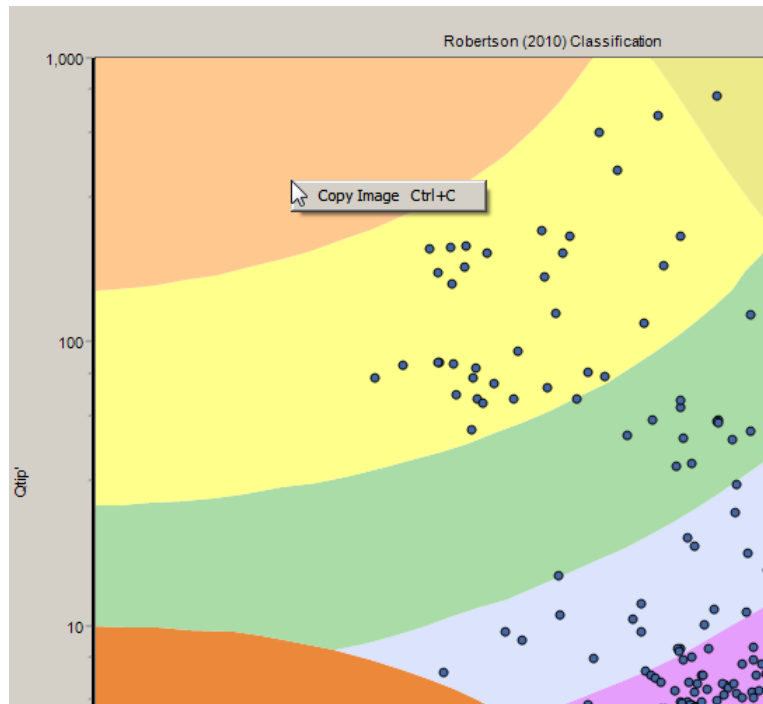
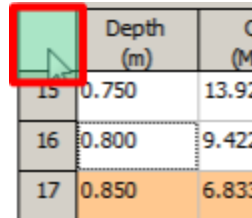


Figure 3-11 Context menu on a classification chart

Data from table views can be copied to clipboard in a similar fashion (see e.g. Section 3.1.2). Copied content will contain for applications that support formatting (e.g. Microsoft Excel), and default to plain text with cells delimited by the TAB character in other applications.

Tip: the entire table can be selected by clicking the top-left button on the table (see Figure 3-12) or selecting **CTRL** + **A** on the keyboard.



	Depth (m)	C (M)
15	0.750	13.92
16	0.800	9.422
17	0.850	6.833

Figure 3-12 Click top-left button to select entire table

3.4.2 CSV

The main CPT table (Section 3.1.2) can be exported to a CSV by selecting

File → Export → Main Table

A UTF-8 formatted CSV file containing the main table will be generated. Make sure correct encoding is selected when importing the generated CSV file to other software such as MS Excel.

3.4.3 Report

EnCPT features a convenience function to generate an MS-Word document on computers with MS-Word installed. If MS-Word is not installed, this functionality will not be available.

Once a new project is initiated (see e.g. Section 3.2), select

File → Export → Report

to generate a report from presented data. Once selected, an report options dialog (Figure 3-13) will be presented on the screen prompting the user to select what data to include in the report file.

Generated report will contain 4 sections:

1. **Summary:** plots of input data along with a soil profile plotted against measurement depths
2. **p-y criteria layer data:** if available (see Section 3.5), includes select soil layering graphs plotted against depth, as well and p-y criteria data table
3. **Classification charts:** includes classification charts (see Section 3.1.3.1) along with interpreted data points superimposed on them
4. **Interpreted data:** scatter graphs of interpreted data plotted against depth. If more than a single graph are selected, the generated graphs will be grouped in to groups of four.

The image shows a software dialog box titled "Options" with a close button (X) in the top right corner. The dialog is organized into four main sections:

- Summary:** Contains four checked checkboxes: "Tip Resistance", "Friction", "Pore Water Pressure", and "Friction Ratio". Below these is a dropdown menu currently set to "Robertson 2010".
- p-y Layer Data:** Contains two checked checkboxes: "Plots" and "Table".
- Classification Charts:** Contains three checkboxes: "Robertson 1986" (checked), "Robertson 2010" (checked), and "Robertson 2010 (None-standard)" (unchecked).
- Interpreted Data:** A list box containing several items, with "Pore Pressure Parameter, B_q " selected. The items are:
 - ☒ Hydrostatic Pressure, U_0
 - ☐ Corrected Tip Resistance, Q_t'
 - ☐ Net Cone Resistance, Q_{net}
 - ☒ Total Stress, σ
 - ☐ Effective Stress, σ'
 - ☐ Pore Pressure Parameter, B_q (selected)
 - ☐ Pressure Exponent, n
 - ☐ C_n
 - ☐ I_{cn}
 - ☐ Soil Behavior Index, I_c
 - ☐ Friction Ratio, R_f
 - ☐ Normalized Friction Ratio, R_{fn}

At the bottom of the dialog are "Cancel" and "Ok" buttons.

Figure 3-13 Report options dialog

3.5 *p-y* Criteria Dialog

Use the *p-y* Criteria Dialog (see Figure 3-14) to generate, interpret, and modify soil layer data, as well as export final soil layer data to other compatible Ensoft products.

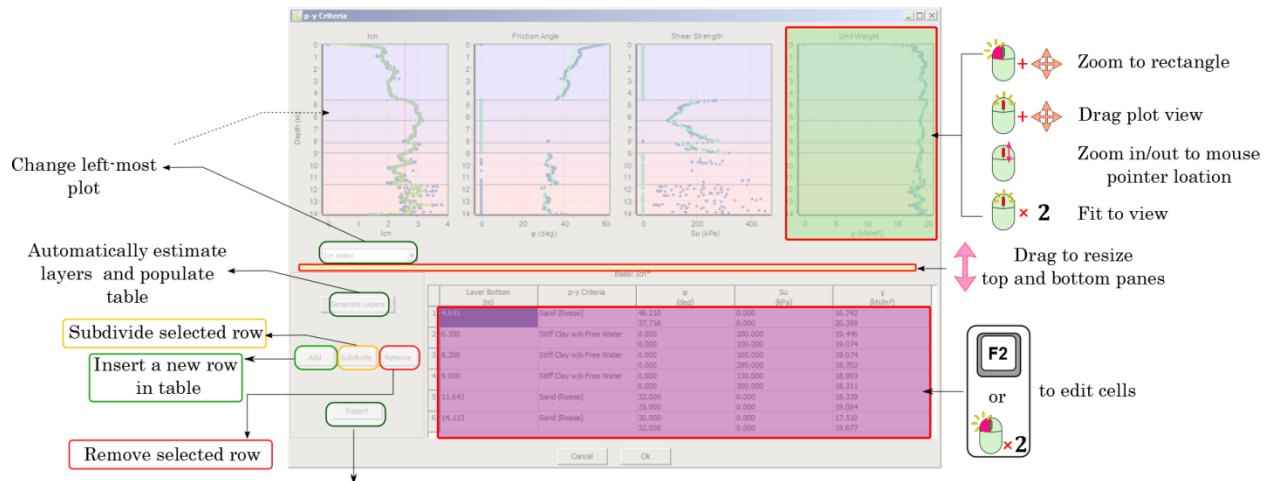


Figure 3-14 *p-y* criteria dialog

This dialog always displays four plots which are (from left to right):

1. scatter plots of *lcn* coefficients (non-dimensional) used for detecting layers, or alternatively other soil classification graphs which can be toggled by the drop down menu below the graph
2. soil friction angle (ϕ),
3. undrained shear strength (S_u),
4. unit weight (γ) plotted against recorded depth.

Scatter *lcn* coefficient graph may also show the moving average of the underlying data (see following section) in a solid green line, as well as expected separation of frictional and cohesive soils (Table 3-6), fixed at value of 2.60, as a dashed red line (Figure 3-15).

Note that these entries are all displayed in the main table of EnCPT (see e.g. Table 3-2).

When opened for the first time, no default layers are specified. Layers can be specified manually, or auto populated using the **Auto Populate** button (see next section).

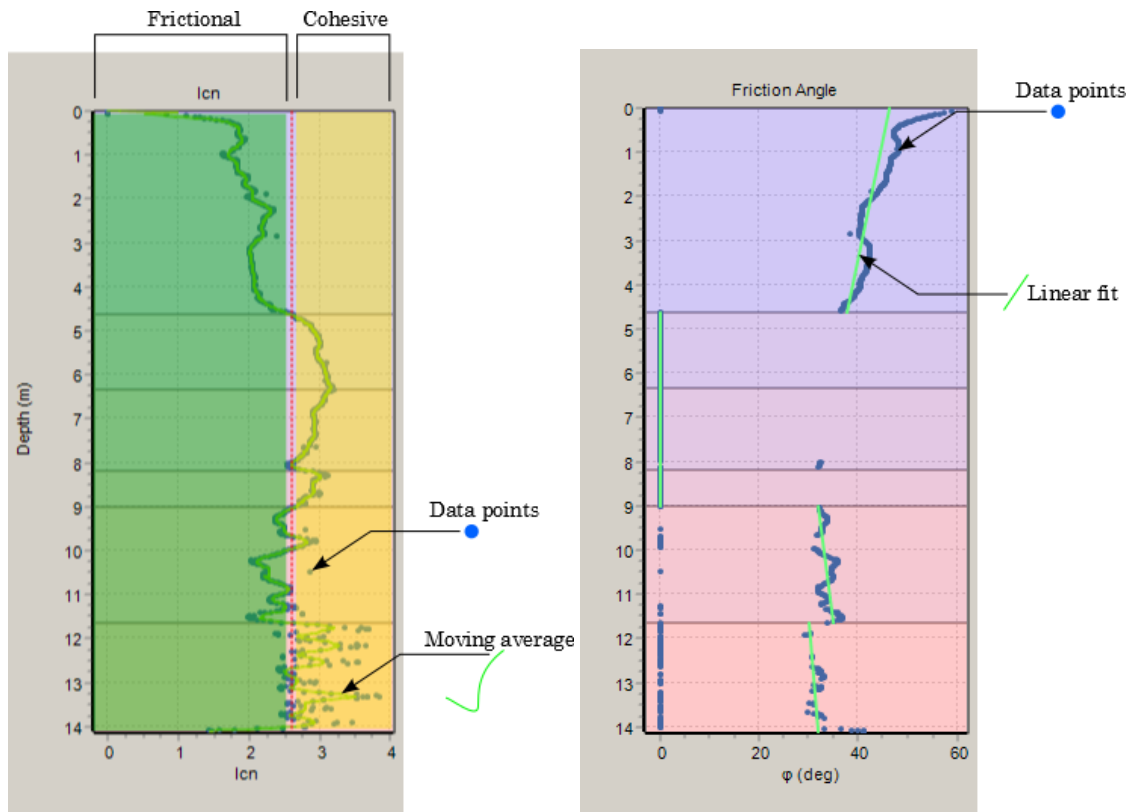


Figure 3-15 Auxiliary data on p - y Criteria dialog graphs

3.5.1 Layer Auto Population

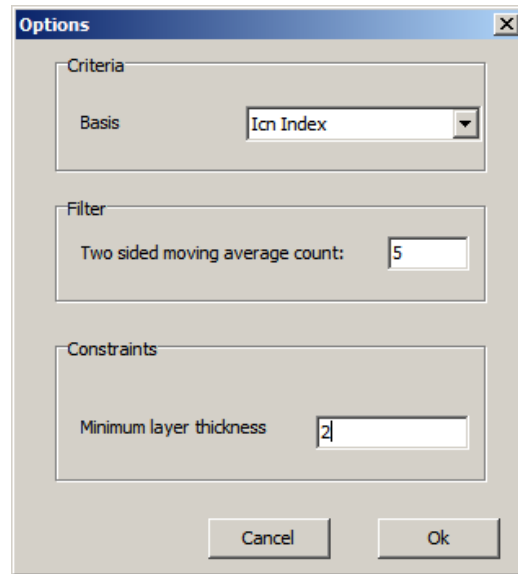
Pressing the Auto Populate button will prompt open an options dialog (Figure 3-16). Two options may be specified:

Basis: Variable used for detecting layer changes

Filter: A non-negative integer which specifies the number of points to use for passing a two sided moving average over the I_{cn} values. This will in effect act as a simple low pass filter and remove high frequency oscillations in the data, but will introduce a phase shift in the data. Using a value of 0 will result in no filtering. The moving average of the data points will be shown by a solid green line on the I_{cn} graph in the p - y Criteria dialog.

Minimum layer depth: Minimum acceptable depth of each layer. If the I_{cn} values indicate layers with thickness below the specified value, they extent is extended and distributed to other detected

layers. If the thickness of the estimated consecutive layers is less than the specified amount, the values are pushed in a queue and their means are popped once they exceed the specified tolerance. The last layers may thus violate the minimum specified value.



The image shows a software dialog box titled "Options". It contains three main sections: "Criteria", "Filter", and "Constraints". In the "Criteria" section, there is a label "Basis" followed by a dropdown menu currently showing "Icn Index". In the "Filter" section, there is a label "Two sided moving average count:" followed by a text input field containing the number "5". In the "Constraints" section, there is a label "Minimum layer thickness" followed by a text input field containing the number "2". At the bottom of the dialog box are two buttons: "Cancel" and "Ok".

Figure 3-16 Layer data auto population options

Using these data, EnCPT will detect layers based on the specified variable (Table 3-6 through Table 3-8), and populate the soil layer table.

For each layer, EnCPT will perform a linear least squares fit to the data and specify a “top” and “bottom” value for friction angle, undrained shear strength, and unit weight. The resulting variation of these properties in each layer is displayed in the plots using a green straight line (see e.g. Figure 3-14).

Table 3-6 Associated *p-y* criteria and *I_{cn}* classification.

<i>I_{cn}</i> Range	<i>I_{cn}</i> Classification	<i>p-y</i> criteria
$(-\infty, 1.31)$	Gravelly sand	Sand Reese
$[1.31, 2.05)$	Sands	Sand Reese
$[2.05, 2.60)$	Silty sand	Silt
$[2.60, 2.95)$	Silty clay	Silt
$[2.95, 3.60)$	Clays	Clays
$[3.60, \infty)$	Organic soils – clays	Clays

Table 3-7 Robertson 1986 and default associated *p-y* criterion

Layer Index	Robertson (1986)	<i>p-y</i> criteria
1	Sensitive, fine grained	Clays
2	Organic Soil	
3	Clay	
4	Silt clay – clay	Silt
5	Clayey silt – silty clay	
6	Sandy silt – clayey silt	
7	Silty sand – sandy silt	
8	Sand – silty sand	Sand
9	Sand	
10	Gravelly sand – sand	
11	Very stiff fine grained	
12	Sand – clayey sand	

Table 3-8 Robertson 2010 criteria and default associated *p-y* criteria

Layer Index	Robertson (2010)	<i>p-y</i> criteria
1	Sensitive, fine grained	Clays
2	Organic Soil	
3	Clay	
4	Silt mixture	Silt
5	Sand mixture	Sand
6	Sand	
7	Gravelly sand – dense sand	
8	Very stiff sand – clayey sand	
9	Very stiff fine grained	Silt

Table 3-9 Robertson 2010b criteria and default associated *p-y* criteria

Layer Index	Robertson (2010) NS	<i>p-y</i> criteria
1	Sensitive, fine grained	Clays
2	Organic Soil	
3	Clay	
4	Silt mixture	Silt
5	Sand mixture	Sand
6	Sand	
7	Gravelly sand – dense sand	

NOTE: Values generated using the **Auto Populate** button are suggested values only, and can be overwritten by the user by directly editing the table.

3.5.2 Manual Layer Edits

If desired, users can manually edit the generated layers (or manually define them) using the **Add**, **Subdivide**, and/or **Remove** buttons. Scatter plots displayed above the tables will be updated automatically according to the specified changes.

Once satisfied, these values may be exported using the **Export** button to following formats:

SPY: Soil layer data importable to compatible Ensoft products

CSV: Comma separated values encoded as UTF-8.

3.6 Import *p-y* Criteria (.spy file) from compatible Ensoft product

The soil layer data saved in a spy file can be imported within compatible Ensoft product (e.g. LPILE)

For instance from LPILE program, the Import Soil Layer Data from the spy file is called from the data menu as displayed in the following figure

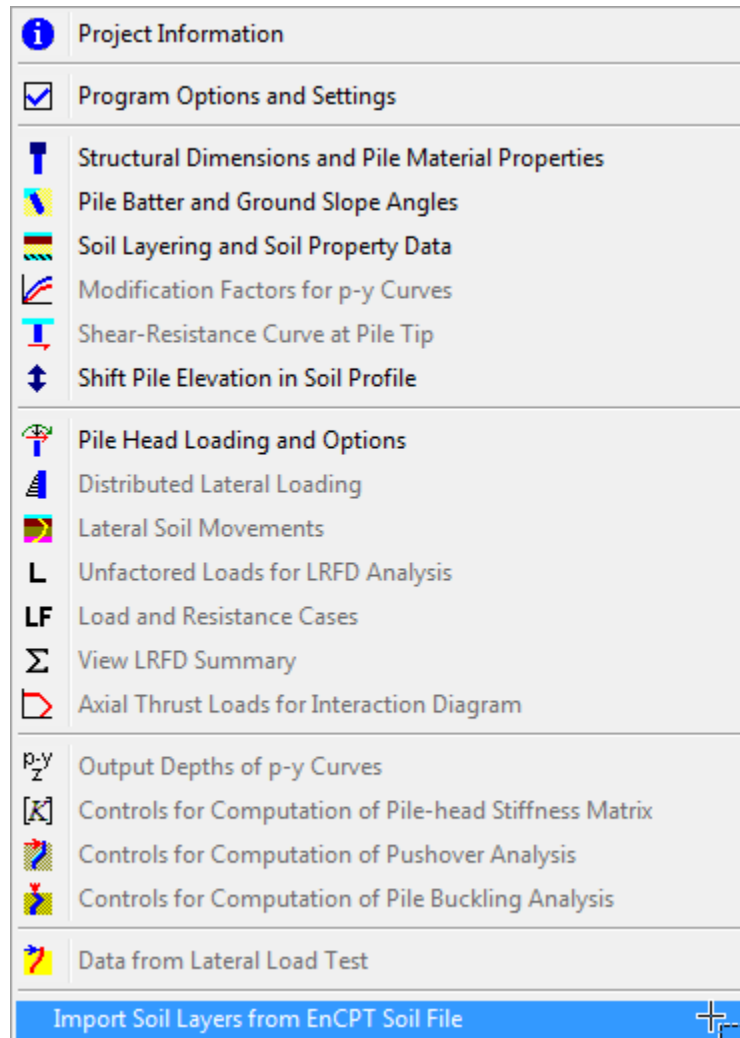


Figure 3-17 Options Menu from LPILE program

After selecting the:

Data > Import Soil Layers

from EnCPT Soil File in the **Data Menu**, the program will open the **Import Window**, as presented in next figure.

Import Soil Layers from an EnCPT Soil File

EnCPT Soil File:

File Format Version :

SOIL LAYER DATA PREVIEW

Number of Layers : 0

Layer Number	Soil Type	Location	Depth	Effective Unit Weight	Undrained Cohesion	Friction Angle

Depth of Ground Surface (m)

Note: Current Soil Layer Definition Will be Overwritten

Figure 3-18 Import Window

In the import window click on **Browse and Open File** to search for the EnCPT soil file (*.spy) containing the soil layer desired to be imported into the Ensoft Program (i.e. LPILE). In the Open Dialog Window look for the file double click on the file name or select the file and then click **Open** in the dialog. After selecting the file, the program will populate the table and display the information saved in the EnCPT file as presented in next figure.

Import Soil Layers from an EnCPT Soil File

EnCPT Soil File:

File Format Version : 2019-02-14

SOIL LAYER DATA PREVIEW

Number of Layers : 4

Layer	Soil	Location	Depth	Effective Unit	Undrained	Friction
Number	Type			Weight	Cohesion	Angle
			m	kN/m3	kPa	deg
1	Sand (Reese)	Top	0	10.549	0	59.958
		Bottom	3.396	6.553	0	24.238
2	Stiff Clay with Free Water	Top	3.396	3.448	3.23	0
		Bottom	32.839	6.258	68.313	0
3	Sand (Reese)	Top	32.839	9.197	0	35
		Bottom	34.428	9.697	0	40

Depth of Ground Surface (m)

Note: Current Soil Layer Definition Will be Overwritten

Figure 3-19 Import Window after selecting the EnCPT file

To complete the process of importing click on the button **Copy Soil Layer Data to Current Model** that is enabled after the program reads the information from the EnCPT file. Please note that the Ensoft Program (i.e. LPILE) will overwrite the current soil layer data that is defined in the model.

Click in the **Close** button the close the Import Window.

CHAPTER 4. Examples

Examples are provided in this section to highlight the functionality of EnCPT. Presented screen captures may change in time.

4.1 Example 1

As an example, consider CPT data stored in a file as shown in Figure 4-1.

12:11:07 08:32 GREGG				
CPT-01	J. DOE		Bay Area	CLIENT
0.050,	28.997,	0.040,	1.948	
0.100,	22.727,	0.020,	1.603	
0.150,	14.971,	0.020,	1.466	
0.200,	11.890,	0.031,	1.052	
0.250,	10.539,	0.087,	0.759	
0.300,	12.242,	0.527,	1.293	
0.350,	21.295,	0.962,	1.535	
0.400,	27.457,	1.786,	1.776	
0.450,	43.644,	1.769,	2.276	
0.500,	59.480,	2.374,	1.828	
0.550,	76.019,	2.800,	1.672	
0.600,	115.257,	3.037,	1.466	
[truncated]				
29.700,	122.716,	4.133,	6.914	
29.750,	183.169,	6.817,	6.897	
29.800,	224.975,	8.255,	6.811	
29.850,	260.241,	8.408,	6.776	
29.900,	252.566,	7.142,	6.707	
29.950,	178.345,	5.971,	6.621	
30.000,	176.034,	4.467,	6.466	
30.050,	132.661,	3.371,	6.190	
30.100,	66.722,	2.191,	5.897	
30.150,	40.428,	1.451,	5.397	
30.200,	30.537,	0.933,	5.138	
30.250,	33.104,	1.110,	5.293	
30.300,	38.590,	1.097,	4.828	
30.350,	35.293,	1.419,	4.880	
30.400,	35.888,	1.473,	4.880	
30.450,	35.212,	1.334,	4.880	
30.500,	34.996,	1.367,	4.897	
=====				
Units: metres,tsf,tsf,psi				
0.960, 0.960, 0.700				

Figure 4-1 Example 1 file contents

To import the data into EnCPT we proceed as follows:

1. Open data import dialog

File – Import

or alternatively, using keyboard shortcuts **Ctrl** + **I**. Once selected, a file selection dialog should appear on the screen (Figure 4-2).

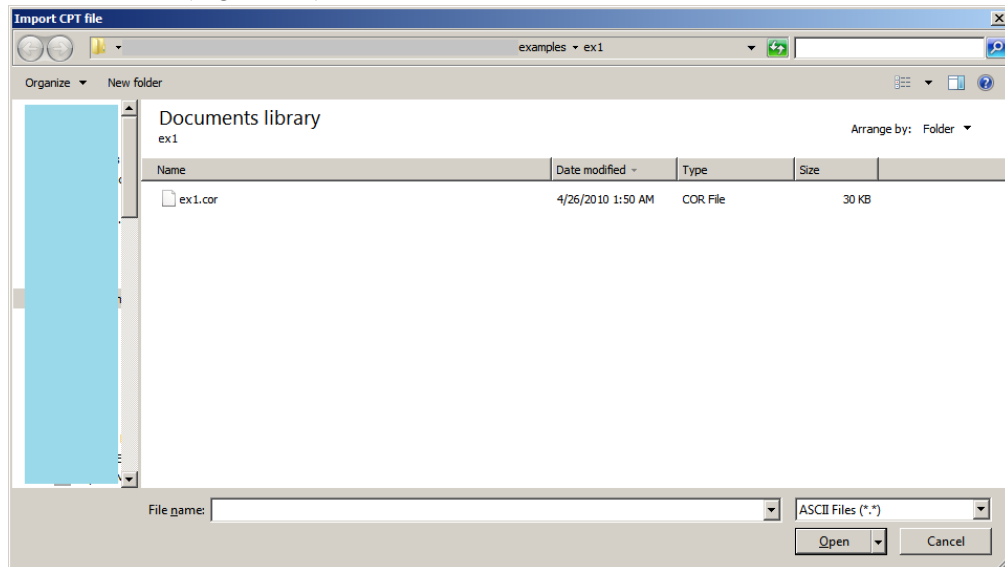


Figure 4-2 File import selection dialog. The appearance of the File Open dialog may be different depending on the OS version

2. In the prompted file selection dialog, navigate to the file location on local drive, and click Open. The Import CPT dialog is then opened (Figure 4-3).

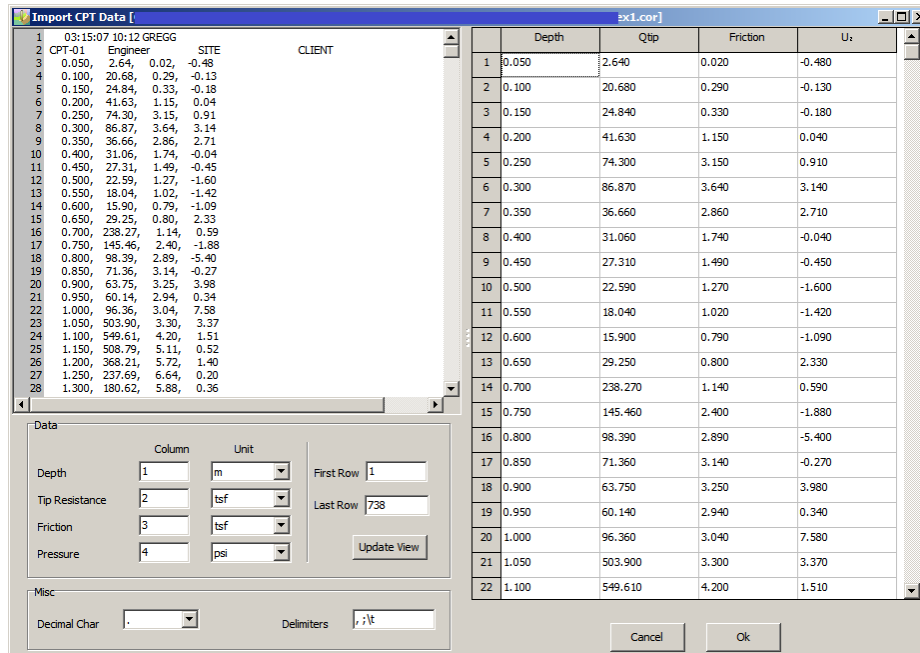


Figure 4-3 Data import dialog in Example 1

This dialog includes a file content preview, and chosen setting for importing the data. Below summarizes the settings:

- **Delimiters:** Character sets comma (“,”), space (“ ”), semicolon (“;”), and tab character (“\t”) are chosen to separate file contents at each line. The first data line in the example contains the following lines

0.050, 28.997, 0.040, 1.948

In the above, four numeric entries are separated by commas, and multiple spaces. Given the selected delimiters, EnCPT will read break the file contents into the following tabular format, ignoring commas and multiple spaces:

Column	1	2	3	4
Data	0.05	28.997	0.040	0.040

- **Decimal char:** The character “.” is used as the decimal separator character.
- **First Row:** Starting row that is used for attempting to import the data. Lines that do not contain data in expected format are automatically skipped. As a result, even though the input file in this example contains 2 header lines, starting line number of 1 is used, with understanding that EnCPT will simply ignore the first two lines since they do not contain valid data
- **Last Row:** The last row number of the file content to be read, as interpreted and displayed in the input preview panel. Once again, invalid lines are automatically ignored. As a result, even though this file contains a total of 4 footer lines, all lines are specified to be included read, with the understanding that EnCPT will automatically ignore the last 4 lines.

- **Depth Column:** Column number, as defined by choice of delimiters corresponding to recorded Depth values. Given the chosen delimiters and file contents, the first column is specified to contain the Depth values.
 - **Depth Units:** Unit associated with the depth values, selected to be “meters” in this example.
 - **Tip Resistance:** Column number, as defined by choice of delimiters corresponding to recorded Qc values. Given the chosen delimiters and file contents, the first column is specified to contain the Qc values.
 - **Tip Resistance Units:** Unit associated with the tip resistance, selected to be “tsf” in this example
 - **Friction Column:** Column number, as defined by choice of delimiters corresponding to recorded Fs values. Given the chosen delimiters and file contents, the first column is specified to contain the Fs values.
 - **Friction Units:** Unit associated with the friction, selected to be “tsf” in this example
 - **Pressure Column:** Column number, as defined by choice of delimiters corresponding to recorded U_2 values. Given the chosen delimiters and file contents, the first column is specified to contain the U_2 values
 - **Pressure Units:** Unit associated with the pressure, selected to be “psi” in this example
3. Click the Open button to import the data as selected. Once selected, data will be imported into EnCPT as shown in Figure 4-4.

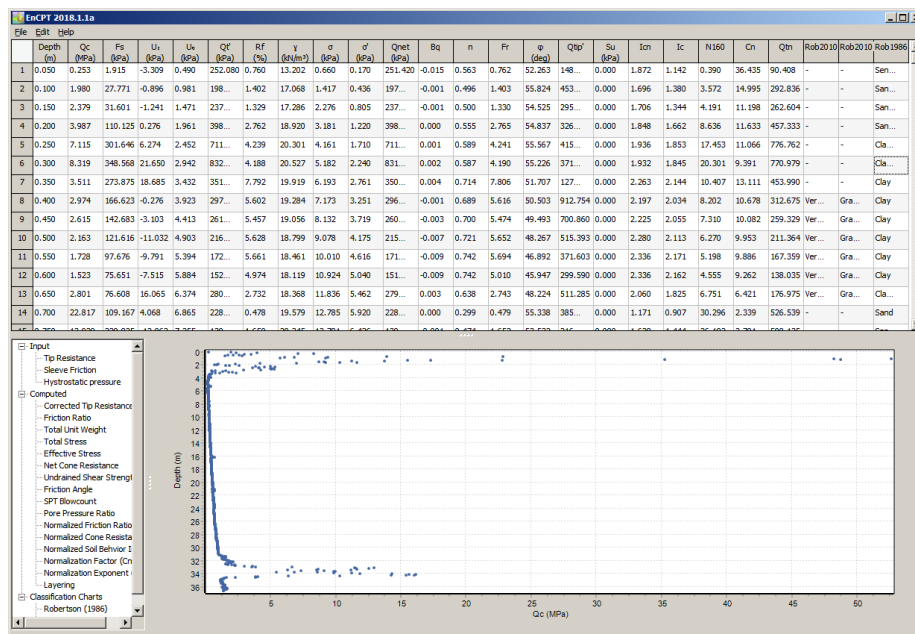


Figure 4-4 Imported data in Example 1

4. Generate layer data to be imported to other Ensoft software by navigating to

Data – p - y Criteria

prompting open the Layers dialog (Figure 4-5).

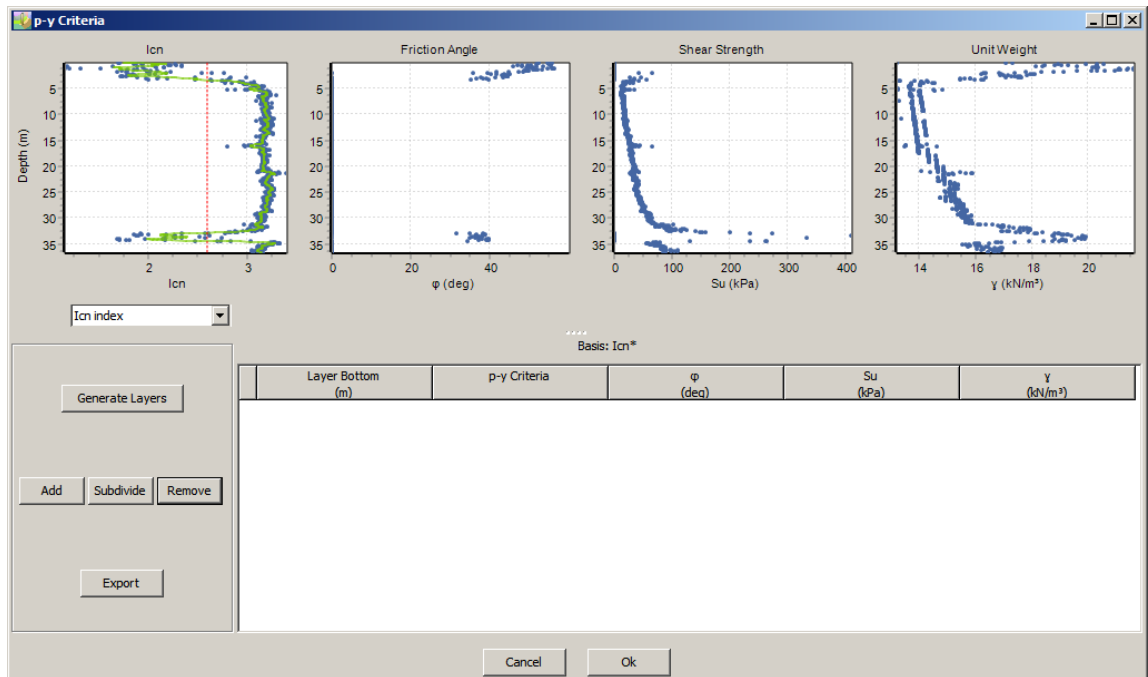


Figure 4-5 Example 1 Layer dialog

- Click the “Auto Populate” prompting open to specify available options to use to automatically select layers (Figure 4-6)

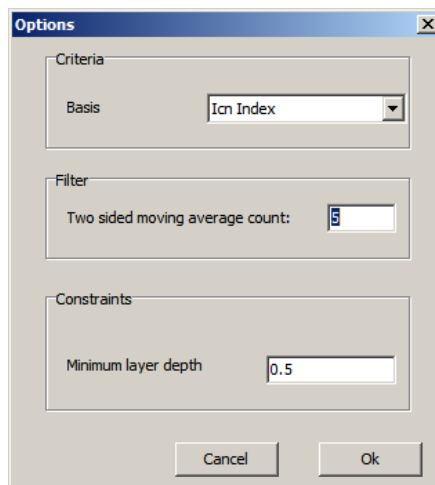


Figure 4-6 Example 1 auto layer population options

- Average count:** Use default value of 5 to filter high frequency noise in Icn values.
- Minimum layer depth:** Use a minimum acceptable depth of 0.5 meters.

6. Click OK to generate layers

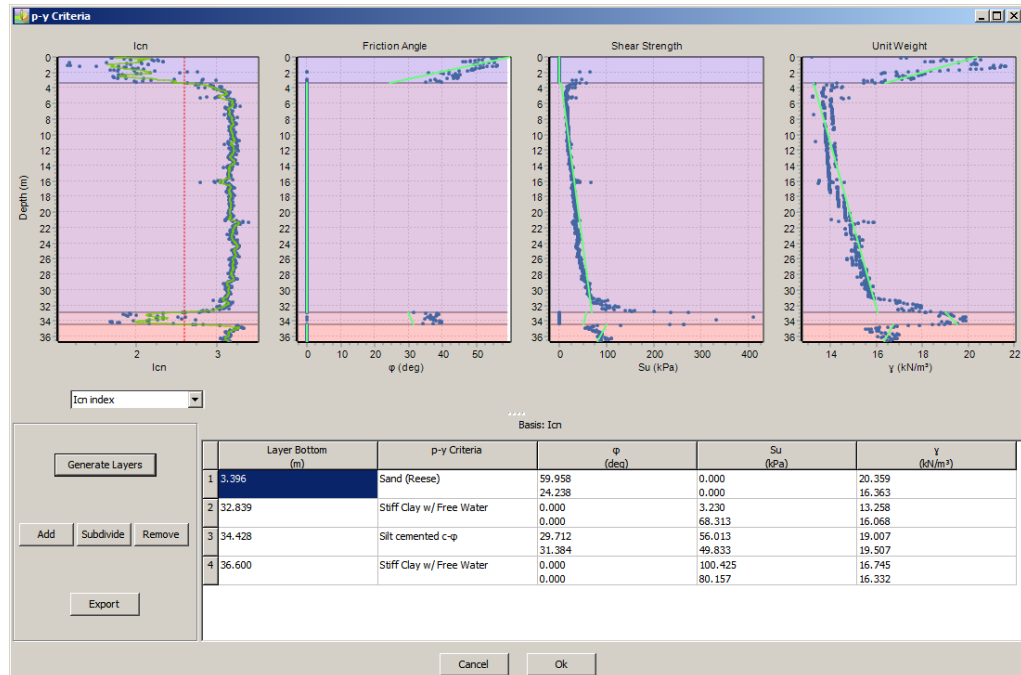


Figure 4-7 Auto selected layers in Example 1

A total of 4 layers are selected as shown in Figure 4-7. The green lines in the right-most graphs show linear least square fit to data. We may wish to adjust the selected S_u values in the last layer to visually better fit the data. Double click S_u in last row to edit the values, and insert “50” and “100” in the cell instead.

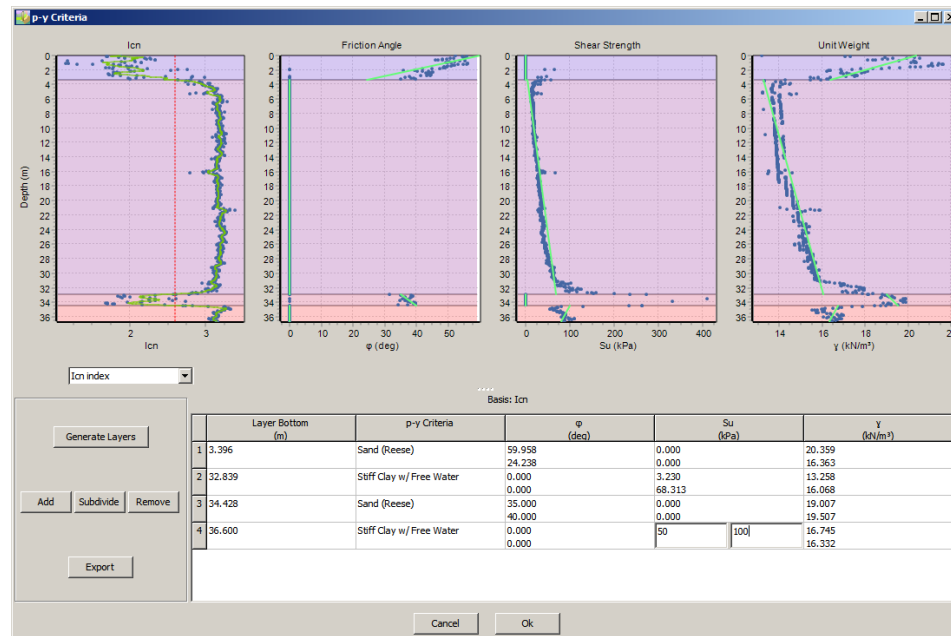


Figure 4-8 Example 1 modified layer data

- Export data by selecting the **Export** button and choose a location and file name to write the layer data to file.

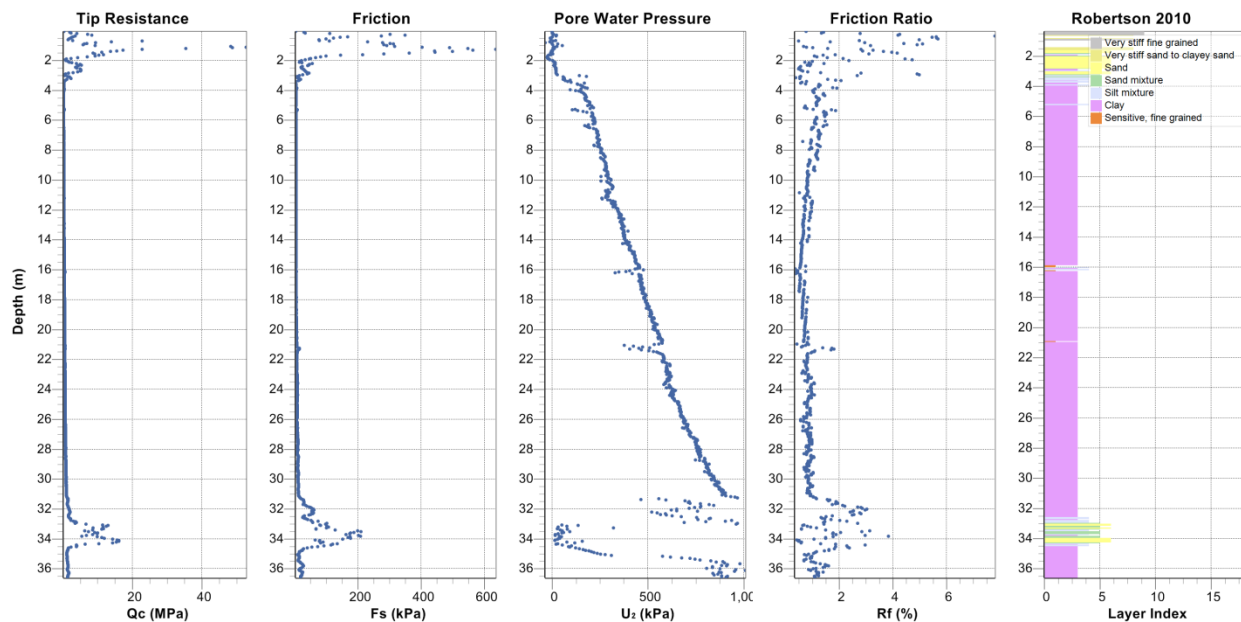


Figure 4-9 Example 1 soil stratigraphy

The interpretation plot for soil stratigraphy is provided in a bitmap file as shown in Figure 4-9. The user can insert the interpretation plot into the standard geotechnical investigation report conveniently.

4.2 Example 2

Consider CPT data stored in a file as shown in Figure 4-10.

05:01:07 08:36 GREGG				
CPT-C1	Eng	Concord	Client	
0.050,	0.000,	0.000,	0.000	
0.100,	0.000,	0.000,	0.000	
0.150,	0.000,	0.000,	0.000	
0.200,	0.000,	0.000,	0.000	
0.250,	0.000,	0.000,	0.000	
0.300,	0.000,	0.000,	0.000	
0.350,	0.000,	0.000,	0.000	
0.400,	0.000,	0.000,	0.000	
0.450,	0.000,	0.000,	0.000	
0.500,	0.000,	0.000,	0.000	
0.550,	0.000,	0.000,	0.000	
0.600,	0.000,	0.000,	0.000	
0.650,	0.000,	0.000,	0.000	
0.700,	0.000,	0.000,	0.000	
0.750,	0.000,	0.000,	0.000	
0.800,	0.000,	0.000,	0.000	
[truncated]				
29.900,	331.570,	1.820,	-6.670	
29.950,	350.690,	2.170,	-6.940	
30.000,	322.520,	1.900,	-5.640	
30.050,	309.070,	1.840,	-5.680	
30.100,	310.540,	2.440,	-5.660	
30.150,	329.660,	2.530,	-5.660	
30.200,	330.230,	2.690,	-5.370	
30.250,	350.110,	3.010,	-5.310	
30.300,	367.510,	3.190,	-5.620	
30.350,	406.070,	2.520,	-5.620	
30.400,	429.640,	1.940,	-5.680	
30.450,	426.650,	1.940,	-5.880	
30.500,	386.820,	1.940,	-5.960	
=====				
Units: metres,tsf,tsf,psi				
0.96, 0.96, 0.70				

Figure 4-10 Example 2 file contents

Follow the steps in Example 1 to import data into EnCPT. Figure 4-11 show the layers as identified using Robertson classification charts.

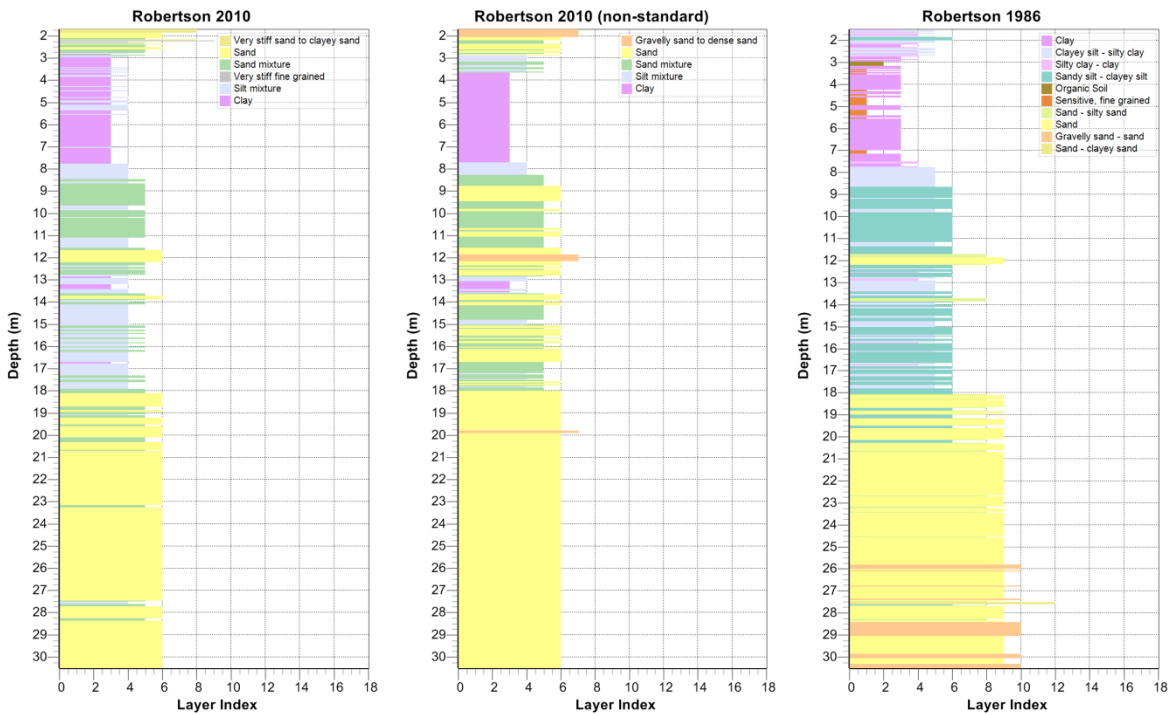


Figure 4-11 Soil layers as identified using Robertson (2010) classifications charts dependent on Friction Ratio (Left) and Bq (Center) data, and Robertson 1986 criteria (Right)

Same as in Example 1, to generate layer data to be imported to other Ensoft software by navigating to

Data – p - y Criteria

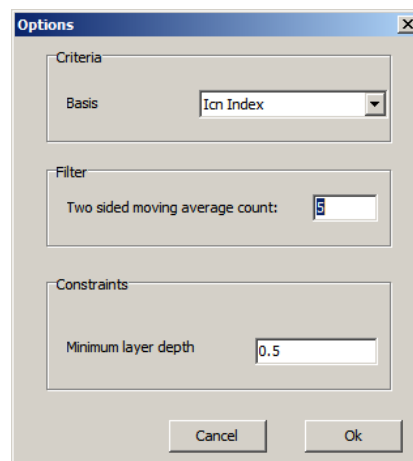


Figure 4-12 Example 1 auto layer population options

- **Average count:** Use default value of 5 to filter high frequency noise in I_{cn} values.
- **Minimum layer depth:** Use a minimum acceptable depth of 1.0 meters.

Populate the tables using the **Auto Populate** button. The selected layers will look similar to the ones shown in Figure 4-13.

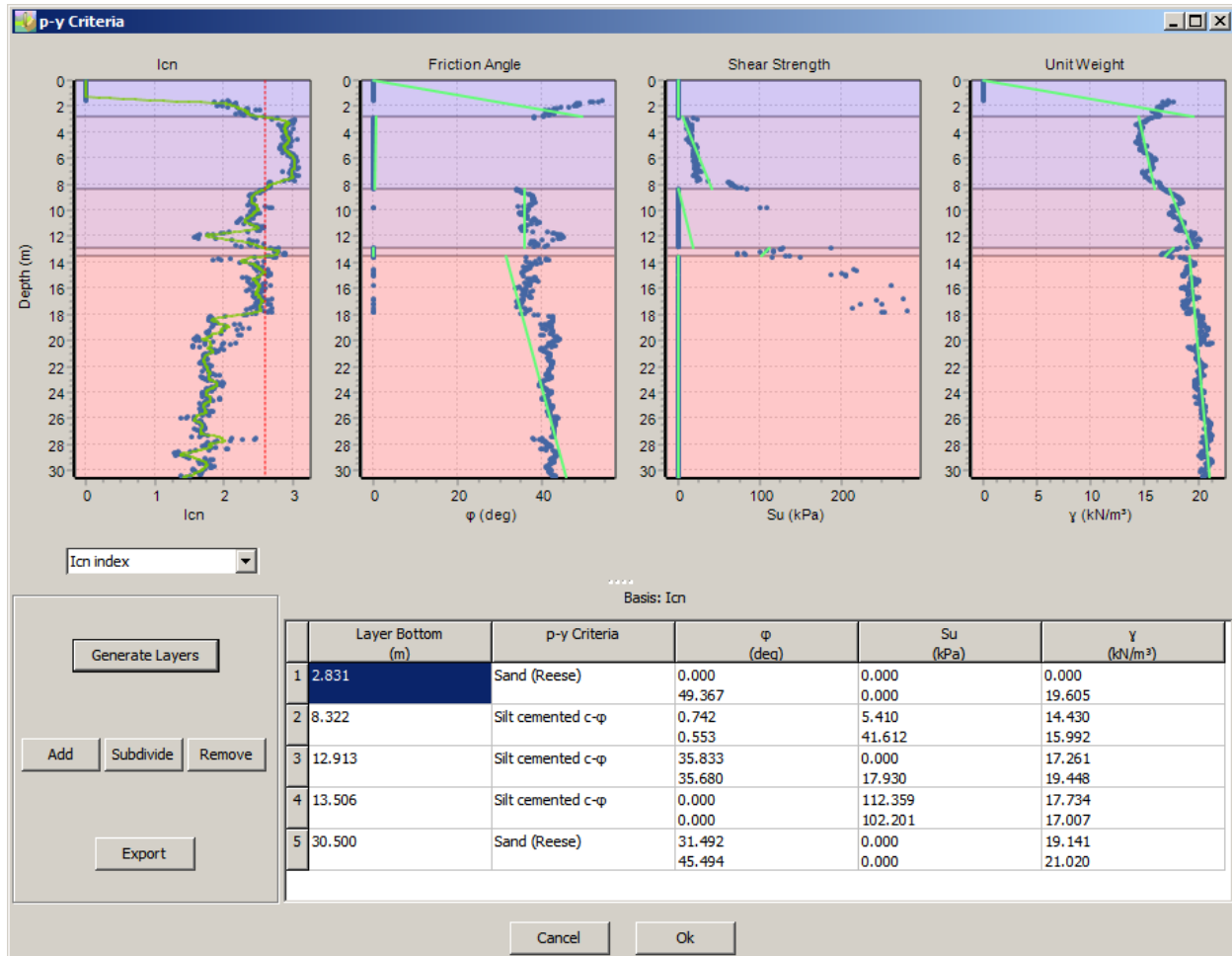


Figure 4-13 Auto selected layers in Example 2

Visually looking at the estimated friction angles and unit weights, it may be a good idea to merge the last three layers. This can be achieved by removing Layers 3 and 4:

1. Left-click on number 3 displayed on the table to select Layer 3 (Figure 4-14)

Basis: Icon					
	Layer Bottom (m)	p-y Criteria	ϕ (deg)	Su (kPa)	γ (kN/m ³)
1	2.831	Sand (Reese)	0.000	0.000	0.000
			49.367	0.000	19.605
2	8.322	Silt cemented c- ϕ	0.742	5.410	14.430
			0.553	41.612	15.992
3	12.913	Silt cemented c- ϕ	35.833	0.000	17.261
			35.680	17.930	19.448
4	13.506	Silt cemented c- ϕ	0.000	112.359	17.734
			0.000	102.201	17.007
5	30.500	Sand (Reese)	31.492	0.000	19.141
			45.494	0.000	21.020

Figure 4-14 Layer 3 selection

- Click the **Remove** button to remove the table row

Note: previously computed values remain unaltered after removal of rows.

- Since Layer 3 was removed, previously identified Layer 4 is now relabeled as Layer 3. Remove the new Layer 3 by repeating the previous steps.

Resulting layers and the interpolated values look as shown in Figure 4-15 after following above steps.

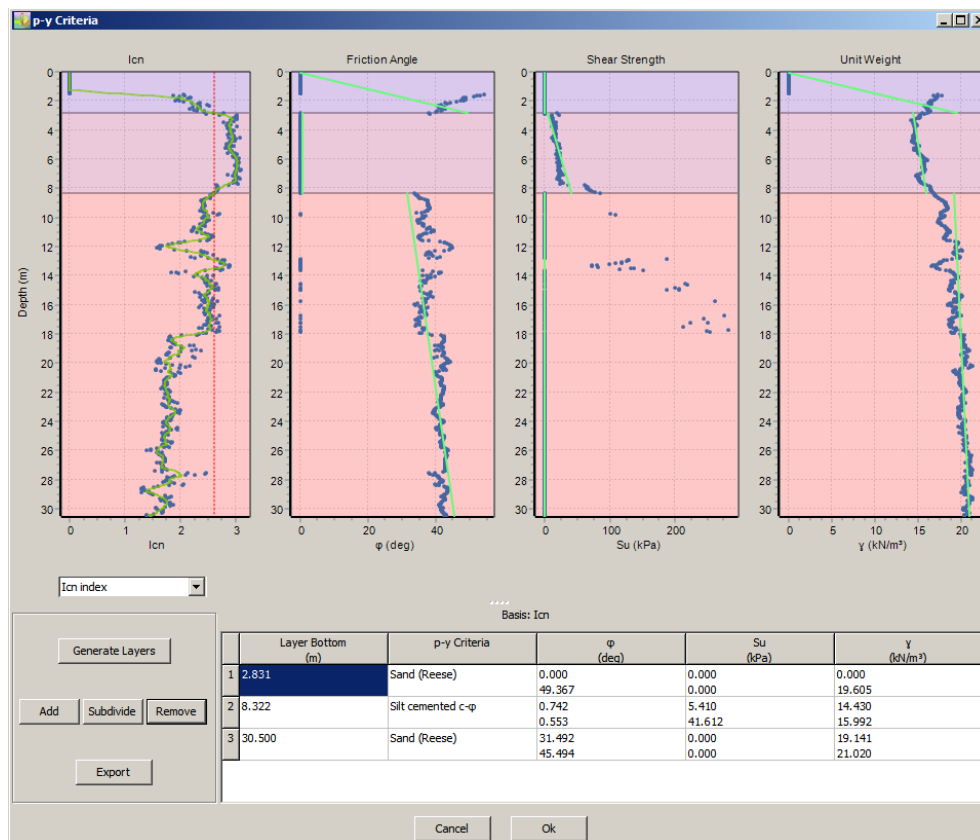


Figure 4-15 New layering after removal of two layers

Looking at the new layering (Figure 4-15), it may make sense to introduce a new layer at around 1.5 meters.

1. Click on the Add button
2. Insert the following data into the newly created row, and set the “Layer Bottom” data to 1.5.
Note that doing this, the table will automatically rearrange the layer such that the table is sorted by layer depths in ascending order
3. Next, modify the second layer by double clicking each cell as follows:
 ϕ : 52, 38
 γ : 18, 15

The resulting layers are shown Figure 4-16. The data can be exported to file using the Export button as in the previous example.

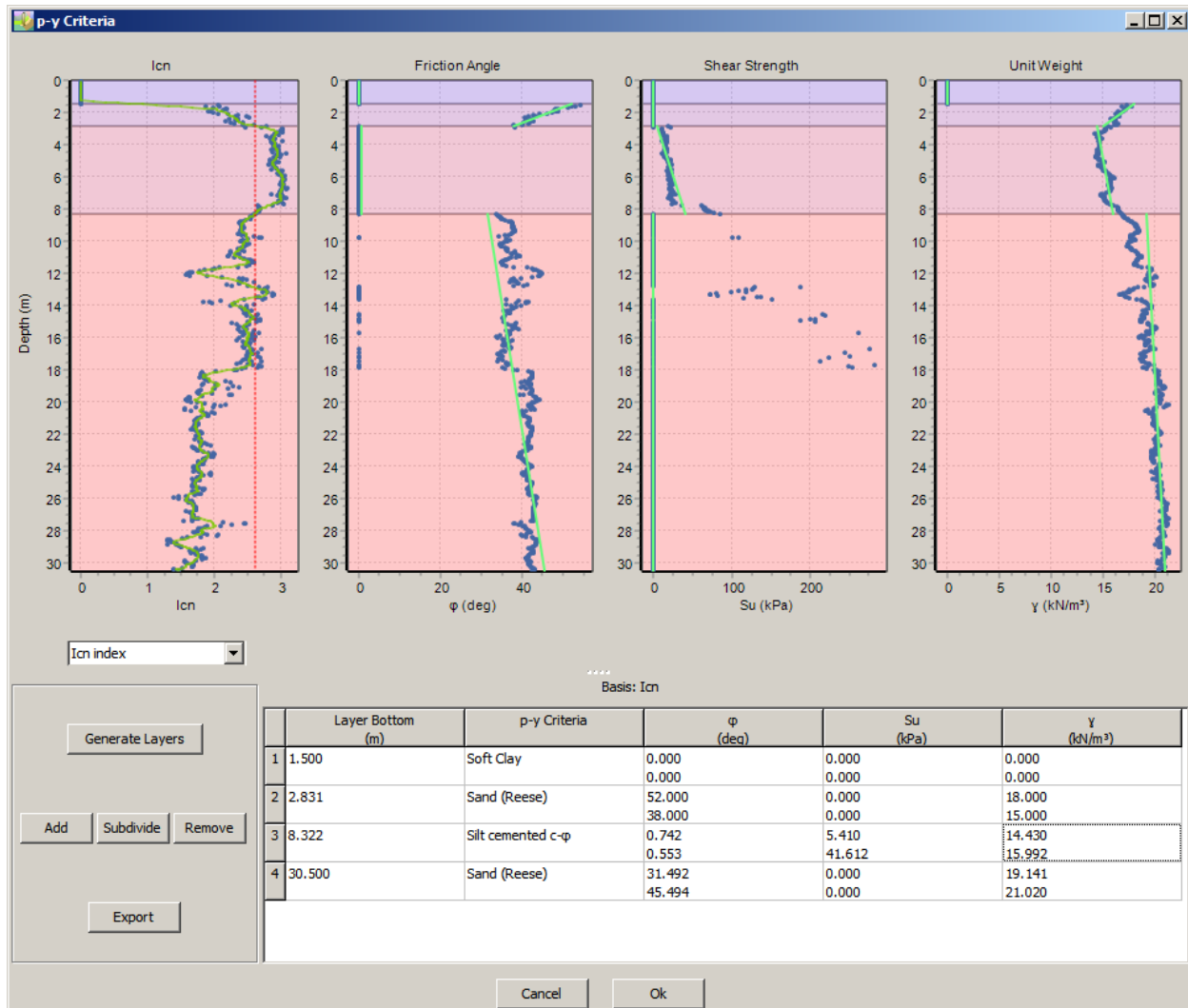


Figure 4-16 Example 2 final layer data

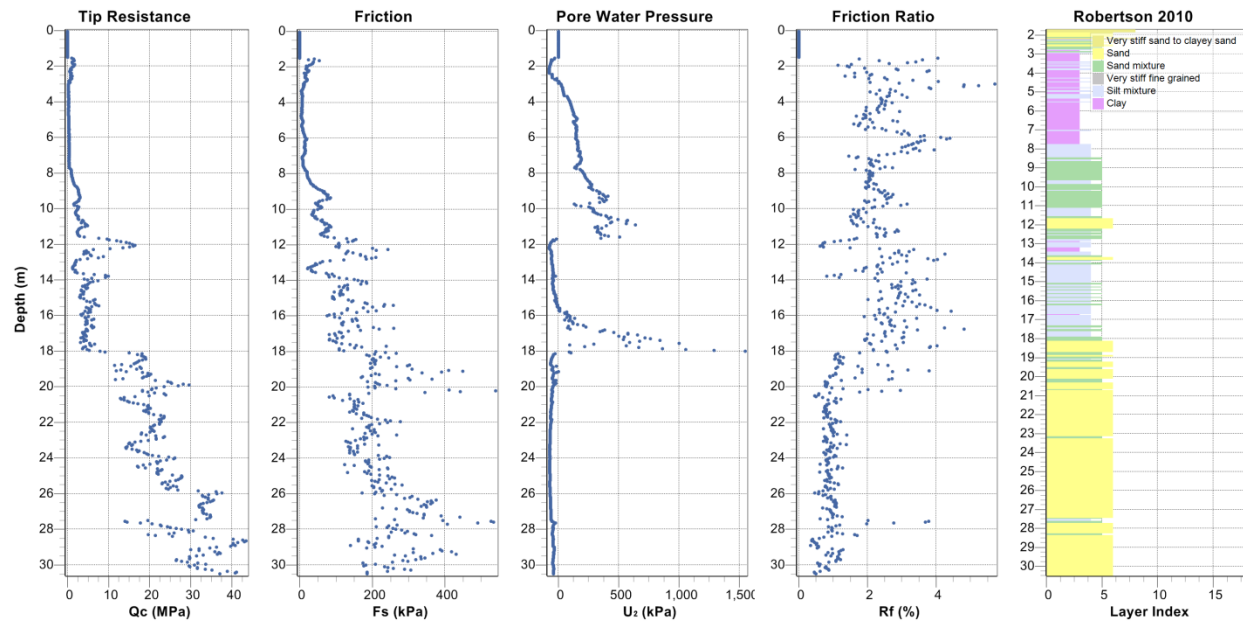


Figure 4-17 Example 2 soil stratigraphy

The interpretation plot for soil stratigraphy is provided in a bitmap file as shown in Figure 4-17. The user can insert the interpretation plot into the standard geotechnical investigation report conveniently.

4.3 Example 3

Consider CPT data stored in a file as shown in Figure 4-18.

```

UNICAN-LAND      05
CPT
02-Nov-2010
Honrsby Bend Lower
Cecil-Curtis-Rober
CPT1_Changyoung
T-Rex
10:34:49  11:26:50
0.0
1701-1849
14103

      [ truncated ]

---      ---      0      0
---      ---      0      0
---      ---      0      0

RecordNr,Tijd(sec),Depth (ft),Cone (tsf),Cone+Fric. (tsf),Pore 2 (MPa),--- (---),Slope x
(Deg),Slope y (Deg), (), (), (), (), (),
1,0,0,5.48005587085883,7.8664091482667,-2.60468211200004E-02,0,3.60859340000335E-
03,0.947872724499999,0,0,0,0,0,0,
2,0,0,5.48005587085883,7.8664091482667,-2.60468211200004E-02,0,3.60859340000335E-
03,0.947872724499999,0,0,0,0,0,0,
3,2,0,5.8292745615076,8.18650817774772,-2.60430003200004E-
02,0,0.186044124200003,0.915908297499999,0,0,0,0,0,0,
4,3,0,-62.8442246089716,-34.4335163551146,-2.60330662400004E-
02,0,0.458911377000003,0.716148699999999,0,0,0,0,0,0,

      [ truncated ]

546,545,11.7650918635171,94.2520579119539,117.61008940957,-2.82560076800004E-
02,0,0.931889117800003,1.712134801,0,0,0,0,0,0,
547,546,11.8274278215223,94.4021303172065,117.6316986185,-2.82200921600004E-
02,0,0.937369383000003,1.713811813,0,0,0,0,0,0,
548,547,11.8897637795276,94.8598816971356,118.053986991146,-2.80779584000004E-
02,0,0.933204087600003,1.710848128,0,0,0,0,0,0,
549,548,11.9586614173228,95.5980261598772,118.794152885814,-2.81811200000004E-
02,0,0.935327139400003,1.7002294615,0,0,0,0,0,0,

      [ truncated ]

1750,3068,46.2729658792651,1.68446613692693,3.88970883942706,-2.89024870400004E-02,0,-
0.578181061799997,-1.562693753,0,0,0,0,0,0,
1751,3098,46.2729658792651,1.73170738254239,3.99573533184191,-2.68079244800004E-02,0,-
0.286213688999997,1.7699555725,0,0,0,0,0,0,
1752,3119,46.2729658792651,1.63885389978097,3.95312277965232,-2.67743014400004E-
02,0,0.762610631200003,1.21534891,0,0,0,0,0,0,
1753,3120,46.2729658792651,1.62887622290529,3.94262110802266,-2.67796505600004E-
02,0,0.500931641000003,-0.500696990000001,0,0,0,0,0,0,
1754,3121,46.2729658792651,1.64027928219178,3.92707055580181,-2.67934054400004E-
02,0,0.430892970200003,0.626703240999999,0,0,0,0,0,0,

```

Figure 4-18 Example 3 raw file contents

The data contains initial header lines followed by raw data which contains duplicate readings at each measurement depth. Some preprocessing may be necessary before attempting to import the data into EnCPT. Processed data with some duplicate rows and extra columns removed is shown Figure 4-19. The original column units (Figure 4-18) is retained in this new processed data file.

```
Depth (ft),Cone (tsf),Fric (tsf),Pore 2 (MPa)
0,1.129802765,0.000130205,3.61127E-06
0.00328084,1.114327185,-0.000390404,8.96039E-06
0.00328084,1.123897609,0.001163811,1.04887E-05
0.00328084,1.198017495,-1.78013E-05,1.27812E-05
0.00328084,1.236910072,-0.00142008,2.08295E-06
0.00328084,1.098647978,0.001467136,1.27812E-05
0.00328084,1.208402424,0.001051219,2.19511E-05
0.01312336,1.265824972,-0.000210997,1.43095E-05
0.075459318,1.538480265,-3.04176E-05,2.08295E-06
0.137795276,20.00023688,-0.005984536,1.43095E-05
0.200131234,36.46096021,-0.00266434,8.19623E-06
0.265748031,45.53962803,0.028554936,-6.74556E-05
0.32808399,50.35436619,0.075015411,-0.000253911
0.393700787,53.24504172,0.124992548,-0.000514489
0.456036745,54.98136112,0.17248414,-0.000525952
0.521653543,55.08928293,0.240941132,-0.000775832
```

[truncated]

```
45.31496063,75.19817073,1.666406419,-0.079250479
45.37401575,64.76090984,1.498840094,-0.079478199
45.43635171,45.28183744,1.296578378,-0.079802202
45.5019685,38.04537457,1.227706845,-0.079716617
45.56430446,28.52443094,1.603341053,-0.079638672
45.62664042,22.01267321,1.731535742,-0.079588238
45.68897638,28.53888839,1.401639474,-0.079579832
45.75459318,42.42129857,1.32463334,-0.079601228
45.81692913,46.62719481,1.114536015,-0.079698277
45.88254593,41.66767853,0.836360432,-0.079720437
45.94488189,43.44309413,1.024585706,-0.07965854
46.00393701,76.1957348,1.393667946,-0.079631031
46.06299213,125.650192,1.351010054,-0.079585181
46.12532808,185.3010206,1.098294338,-0.079623389
46.1843832,237.709481,0.987476245,-0.079644021
46.21062992,292.5620651,0.899918783,-0.079604285
46.2171916,296.3517497,1.150914173,-0.079670003
46.27296588,296.4894009,1.155691534,-0.07964937
```

Figure 4-19 Example 3 data with duplicate entries removed

Additionally, for this dataset it is known in advance that the water depth is at around 12.5 meters (or 41.011 ft). Follow the steps in Example 1 to import data into EnCPT, this time setting the water depth value to 41.011 foot, and making sure that the correct header units are selected as follows:

- Depth: ft
- Tip resistance: tsf
- Friction: tsf
- Pressure: MPa

Graphs in Figure 4-20 show the layers as identified using Robertson classification charts.

Follow the steps in Example 1 to import data into EnCPT. Figure 4-20 show the layers as identified using Robertson classification charts.

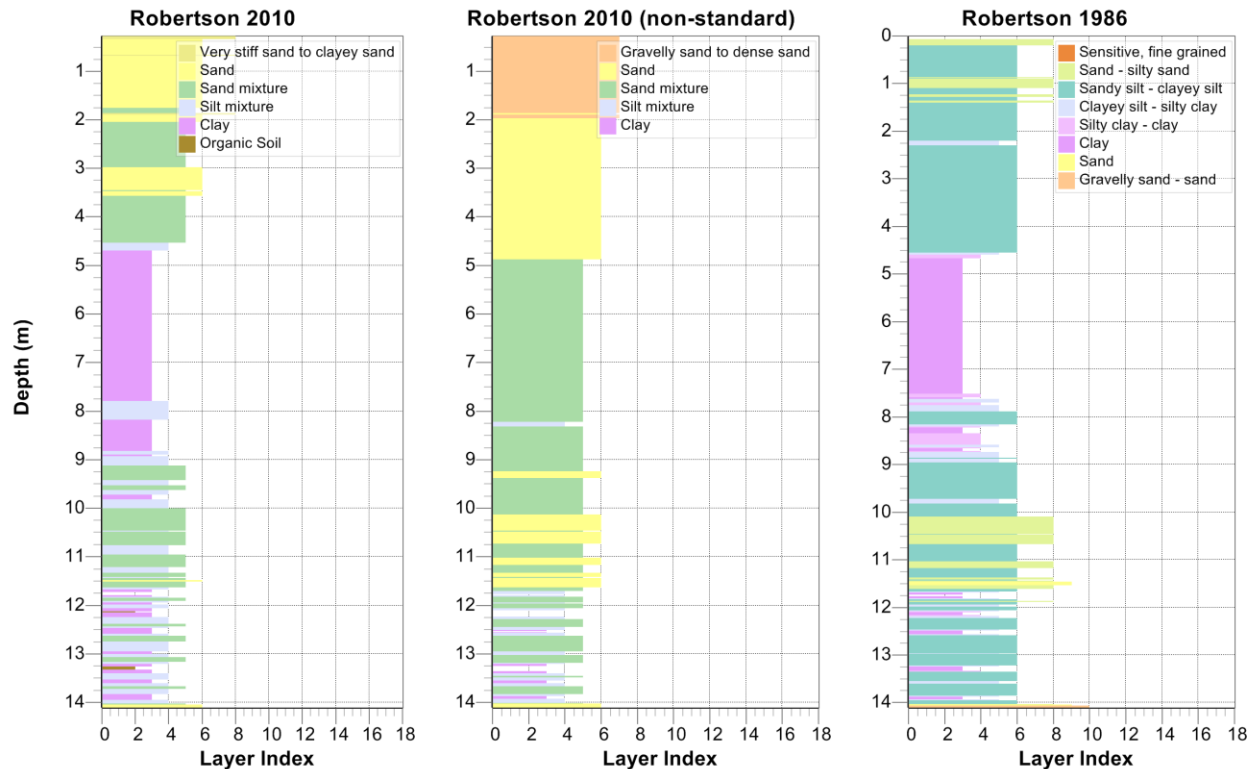


Figure 4-20 Soil layers as identified using Robertson (2010) classifications charts dependent on Friction Ratio (Left) and Bq (Right) data, and Robertson 1986 charts

Same as in Example 1, to generate layer data to be imported to other Ensoft software by navigating to

Data – p - y Criteria

- **Average count:** Use value of 3 to filter high frequency noise in l_{cn} values.
- **Minimum layer depth:** Use a minimum acceptable depth of 0.5 meters.

Populate the tables using the **Auto Populate** button. The selected layers will look similar to the ones shown in Figure 4-21.

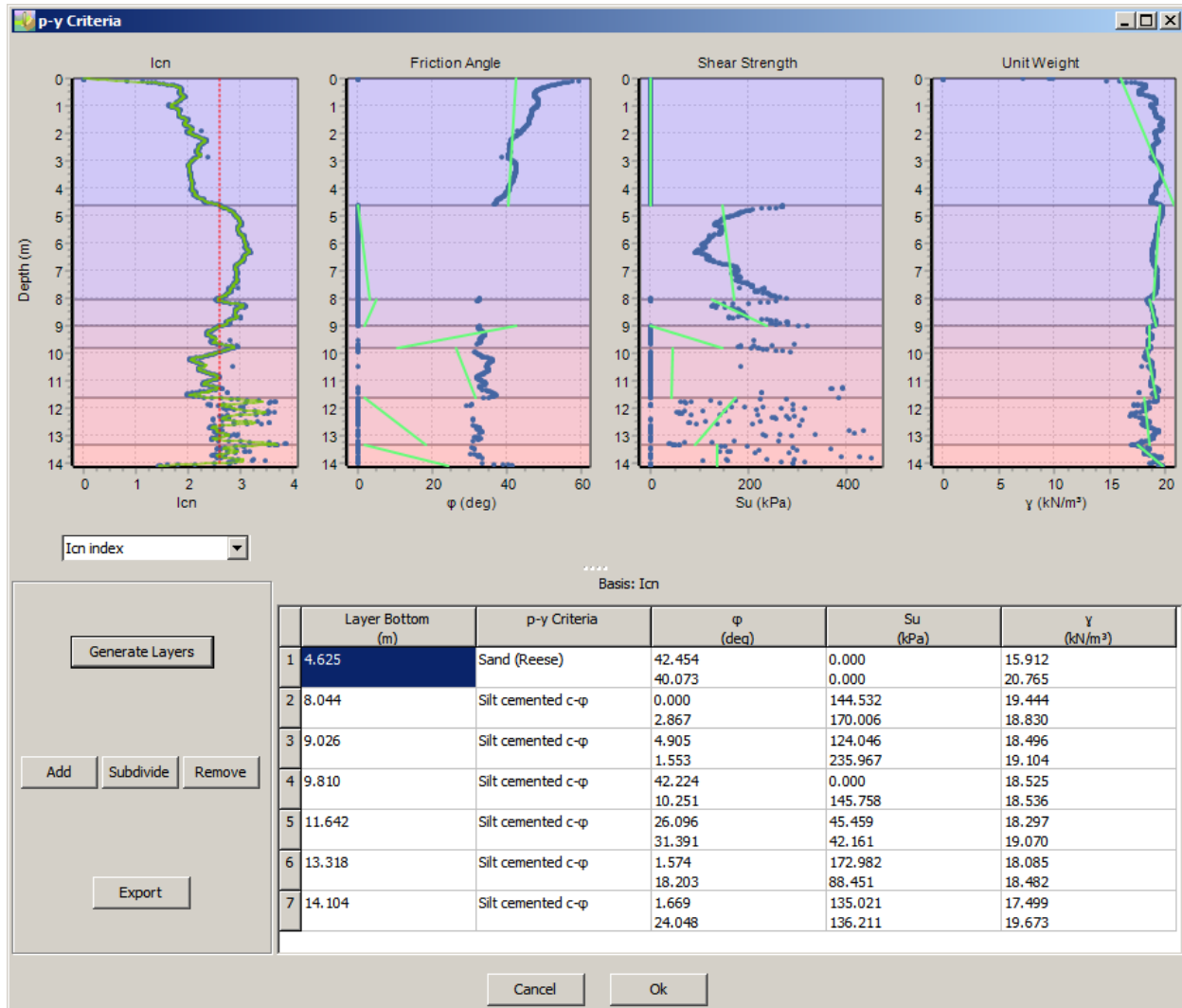


Figure 4-21 Auto selected layers in Example 3

Visually looking at the estimated friction angles and unit weights, it may be a good idea to subdivide the second layer into 2 layers. Click on the second layer, and click the Subdivide button. Next, we can modify the table so that its contents better match the underlying data, match those shown in Figure 4-22.

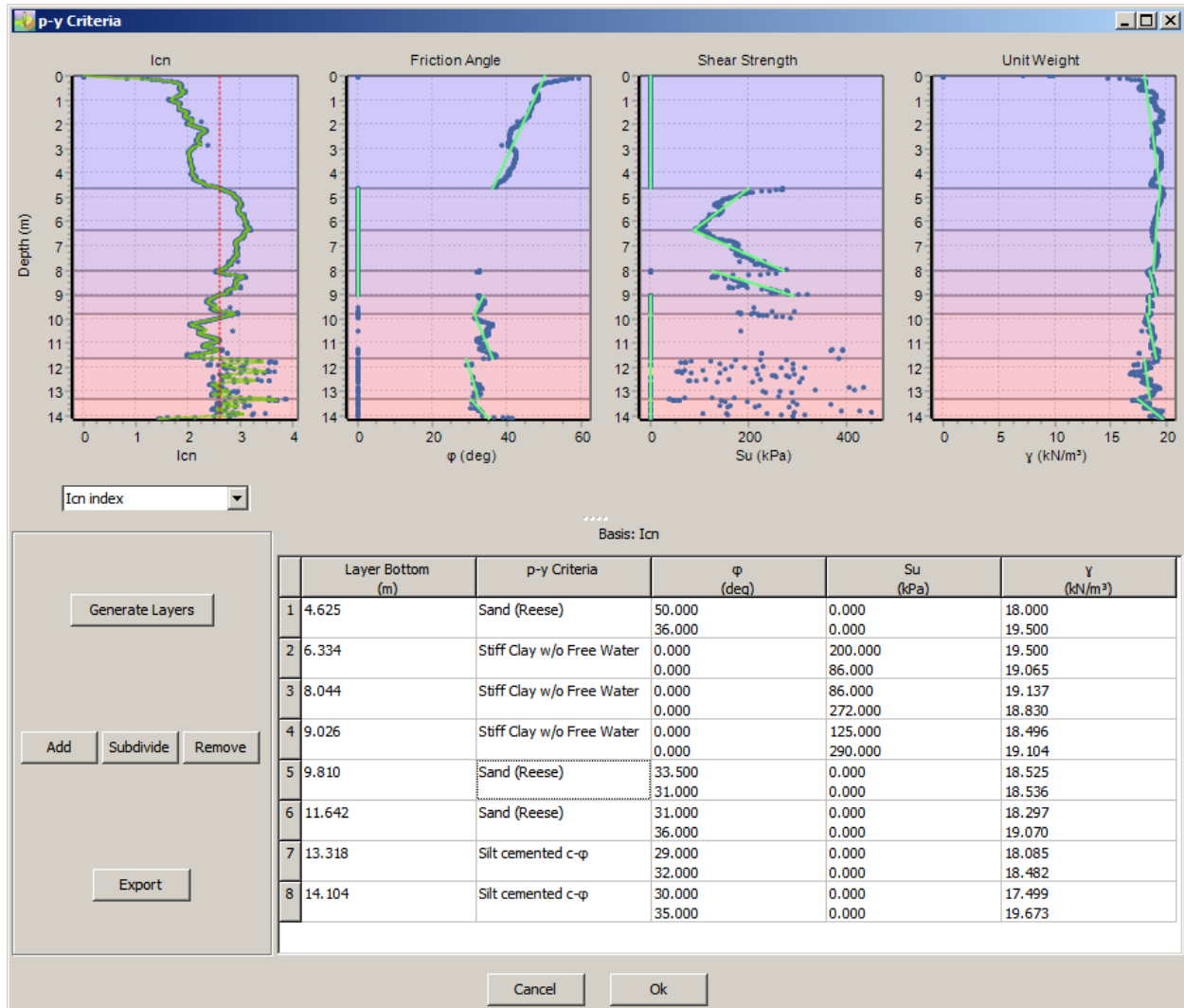


Figure 4-22 Layer selection in Example 3

As before, the layer data can be exported to file using the **Export** button as in the previous example.

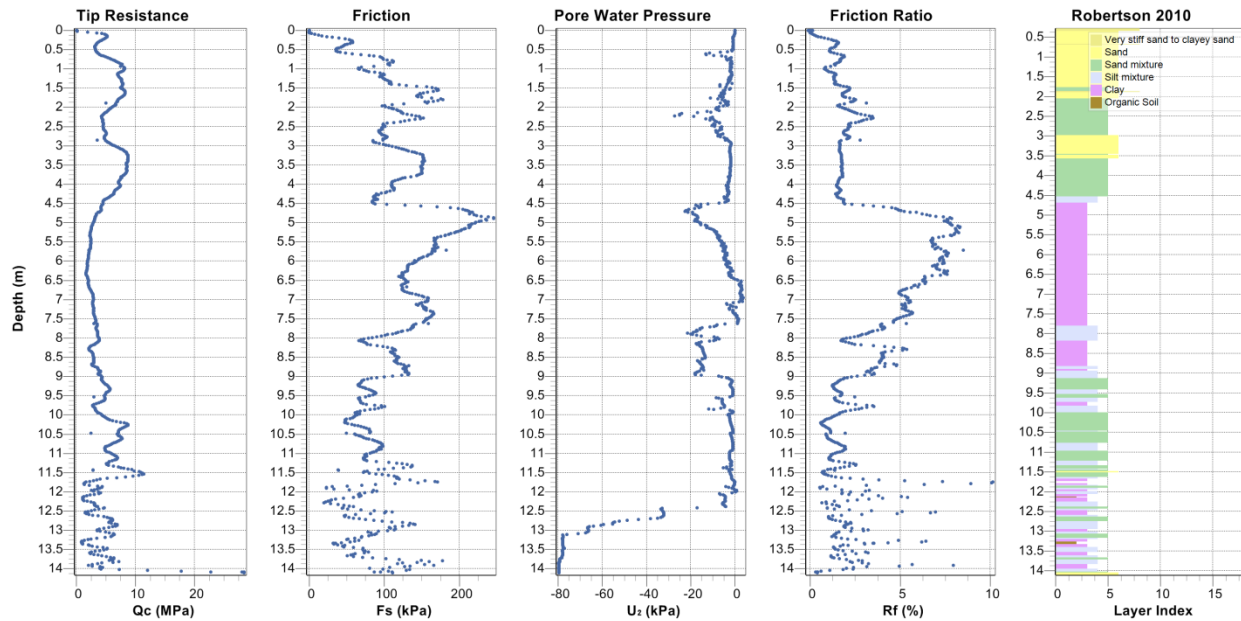


Figure 4-23 Example 3 soil stratigraphy

The interpretation plot for soil stratigraphy is provided in a bitmap file as shown in Figure 4-23. The user can insert the interpretation plot into the standard geotechnical investigation report conveniently.

4.4 Example 4

Example 4 considers importing of the same data originally collected in Example 3, but with corrections made to the pore water pressure measurements prior to importing it to EnCPT.

Depth (m)	Cone Resistance (MPa)	Sleeve Friction (kPa)	Pore Pressure 2 (kPa)
Friction ratio (%)			
0	.108461065456351	.012499676741534	-3.61127225805349E-03
1.15245749144557E-04			
.001000656167979	.106975409732168	-3.74787586837272E-02	-8.96039225805473E-03 -
3.50349288472574E-04			
.001000656167979	.107894170508966	.111725824595564	-1.04887122580541E-02
1.03551307794039E-03			
.001000656167979	.115009679503736	-1.70892064682917E-03	-1.27811922580531E-02 -
1.48589288675799E-05			
.001000656167979	.118743366915827	-.136327715527511	-2.08295225805413E-03 -
.001148086996928			
.001000656167979	.105470205906352	.140845020714237	-1.27811922580531E-02
1.33540102158608E-03			
.001000656167979	.116006632687069	.100917059055065	-2.19511122580528E-02
8.69924906167149E-04			
[truncated]			
14.013188976378	4.1705370368966	98.3602278129452	79.6585404077416
2.35845472520099E-02			
14.0312007874016	7.31479054041802	133.792122854941	79.6310306477415
1.82906293920066E-02			
14.0492125984252	12.062418436162	129.696965169084	79.5851810477415
1.07521527175897E-02			
14.0682250656168	17.7888979731263	105.436256479474	79.6233890477416
5.92708197206801E-03			
14.0862368766404	22.8201101792745	94.7977194724128	79.6440213677415
4.15413066491279E-03			
14.0942421259842	28.0859582493355	86.3922031206411	79.6042850477415
3.07599272040808E-03			
14.0962434383202	28.4497679688456	110.487760593559	79.6700028077415
3.88360849601835E-03			
14.1132545931759	28.4629824855502	110.946387218141	79.6493704877415
3.89791854295189E-03			

Figure 4-24 Example 4 data with pore water pressure correction

The water depth is at the depth of 12.5 meters as before.

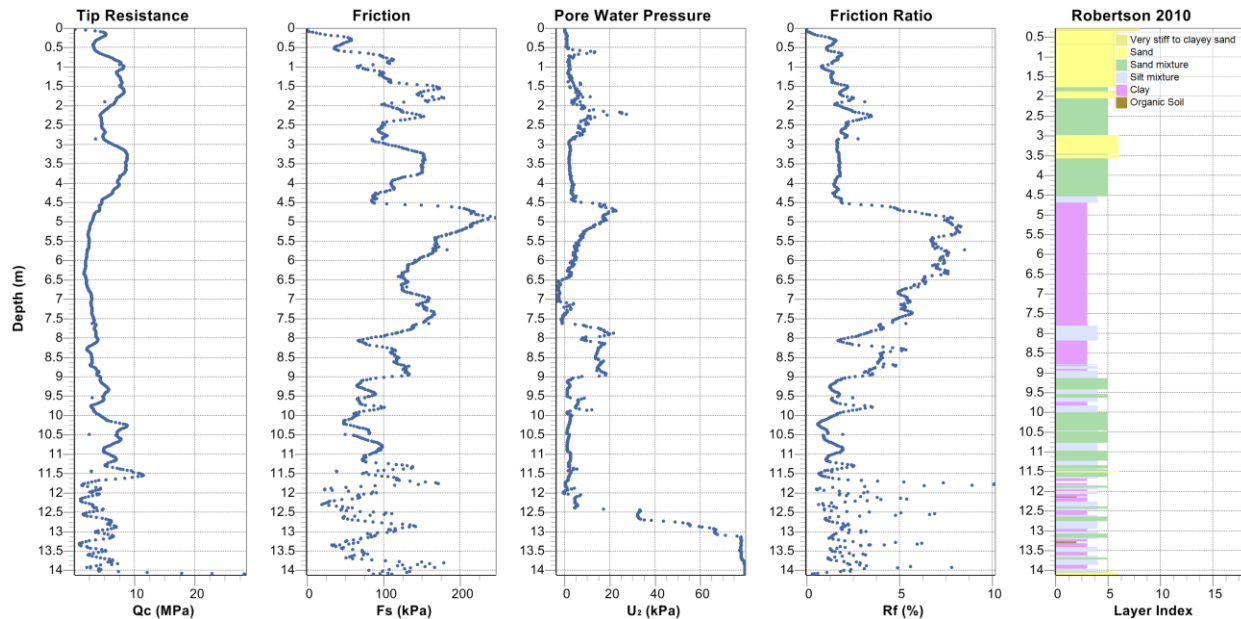


Figure 4-25 Example 4 soil stratigraphy

4.5 Example 5

Example 4 is revisited, this time considering using Mayne (2006) proposed equation for estimating the soil friction angles. Specifically, we proceed as follows:

1. Open Example 4
2. Change the equation used for estimating the friction angle by selecting

Edit → Interpretation Options

and changing the friction angle equation to Mayne (2006). By clicking OK, the interpreted results are updated.

We then proceed as before and request the software to recreate a baseline for the layers, and then modify the selection as need. The final selection is shown in Figure 4-26. Note that because of the change in the equation used, the estimated friction angles may be significantly different (see for example the second layer where previously they were zero).

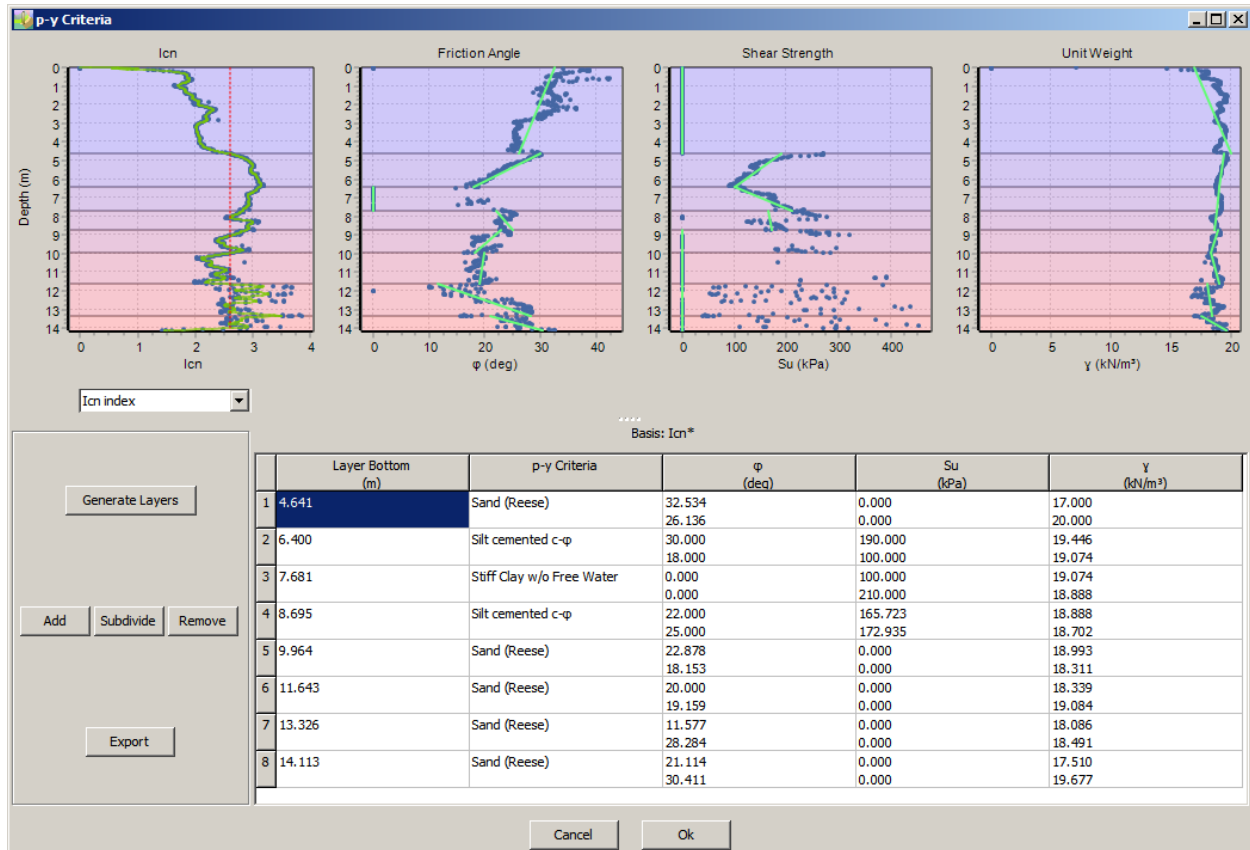


Figure 4-26 Layer selection in Example 5

CHAPTER 5. References

Ensoft, Inc., Computer Program LPILE – A Program to Analyze Deep Foundations Under lateral Loading, Austin, Texas, January 17, 2018.

Ensoft, Inc., Computer Program GROUP – A Program for the Analysis of a Group of Piles Subjected to Vertical and lateral Loading, Austin, Texas, May, 2016.

Ensoft, Inc., Computer Program PYWALL – A Program for the Analysis of Flexible Retaining Structures, Austin, Texas, December, 2017.

Robertson, P.K., Campanella, R.G., Gillespie, D., and Greig, J., 1986. Use of Piezometer Cone data. In-Situ'86 Use of Ins-itu testing in Geotechnical Engineering, GSP 6 , ASCE, Reston, VA, Specialty Publication, SM 92, pp 1263-1280

Robertson, P.K., 1986. In-Situ testing and its application to foundation engineering. 1985 Canadian Geotechnical Colloquium, Canadian Geotechnical Journal 23(4) 573-594.

Robertson, P.K. 2009. Interpretation of cone penetration tests – a unified approach. Canadian Geotechnical Journal 2009, 46: 1337-1355.

Robertson, P.K., 2010. Soil behavior type from the CPT: an update. 2nd

Robertson, P.K., K.L. Cabal. Cone Penetration Testing for Geotechnical Engineering. Gregg Drilling & Testing, Inc. 2015.

International Symposium on Cone Penetration Testing, CPT'10, Huntington Beach, CA, USA.

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