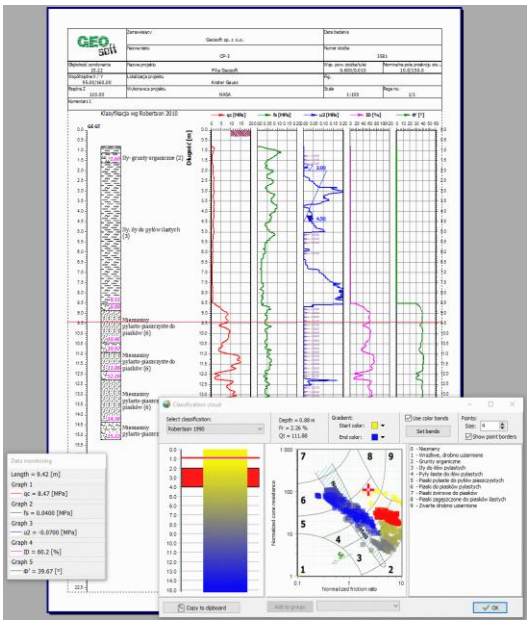
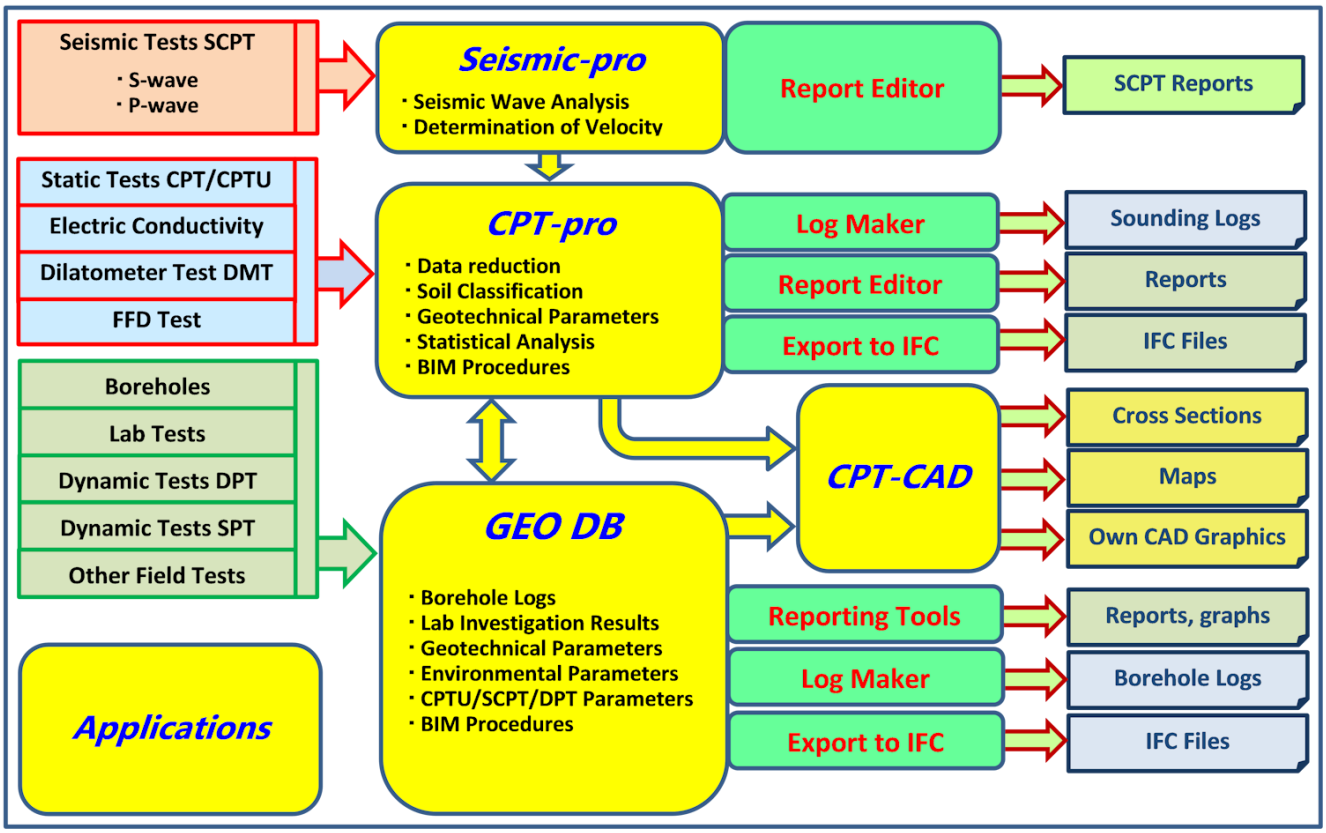
CPT-pro

Interpretation of CPT soundings



Cooperation with:

- CPT-CAD
- GEO DB
- VANE-pro
- Seismic-pro



CPT-pro, along with related programs, is used for:

- Analysis and **interpretation** of **CPT/CPTU** static soundings
- Analysis and **interpretation** of **DMT** soundings
- Creation of **geotechnical and geological documentation**

Analysis and interpretation of CPT/CPTU soundings includes:

- **Analysis and correction** of measurement data
- Analysis, correction, and **supplementation** of header data
- Soil **classification**
- Estimation of **geotechnical parameter** values
- Estimation of **characteristic values** of parameters
- Generation of **sounding logs** with interpretation results
- Generation of **tabular summaries**
- Data export to **IFC** (Industry Foundation Classes) format, which is the basis of **BIM** (Building Information Modeling) technology

Key features of CPT-pro:

- **User-friendly licensing** and update terms
- **Data security** – local database
- **Automation** of a range of analytical and calculation procedures
- **Parallel work** with file packages
- **Multiple soil classification** methods
- **Multiple methods** for estimating geotechnical parameters
- Calculation of **characteristic values of parameters**
- Analysis and interpretation of **offshore sounding**
- Compatibility with **AGS**, **GEF**, and **CSV** exchange formats
- **BIM** compatibility – export to **IFC** format
- High-quality **graphics**
- Maps and cross-sections generated in **DWG / DXF** formats
- **Multi-language** sounding logs and reports

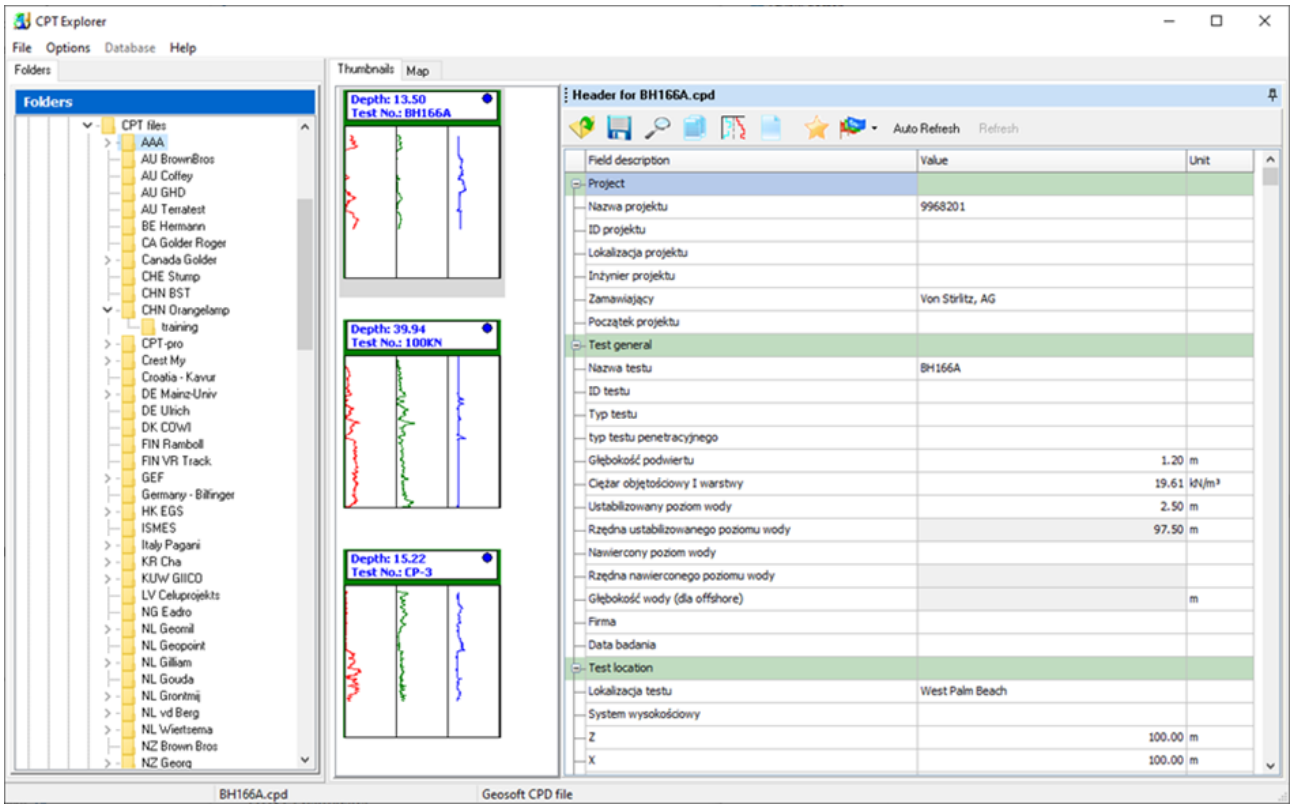
The interpretation methods implemented in the program are derived from the monograph

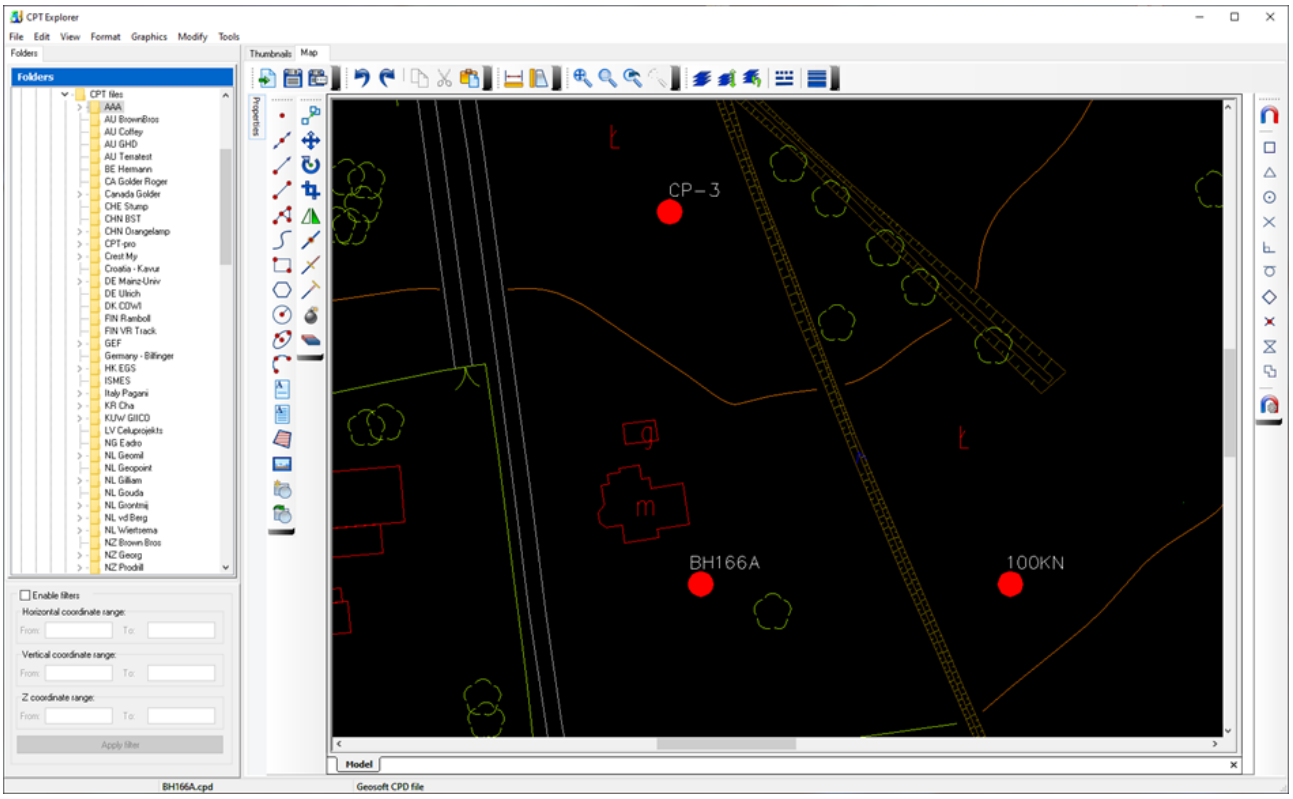
Lunne, T., Robertson P.K. and Powell J.J.M.

Cone Penetration Testing in Geotechnical Practice

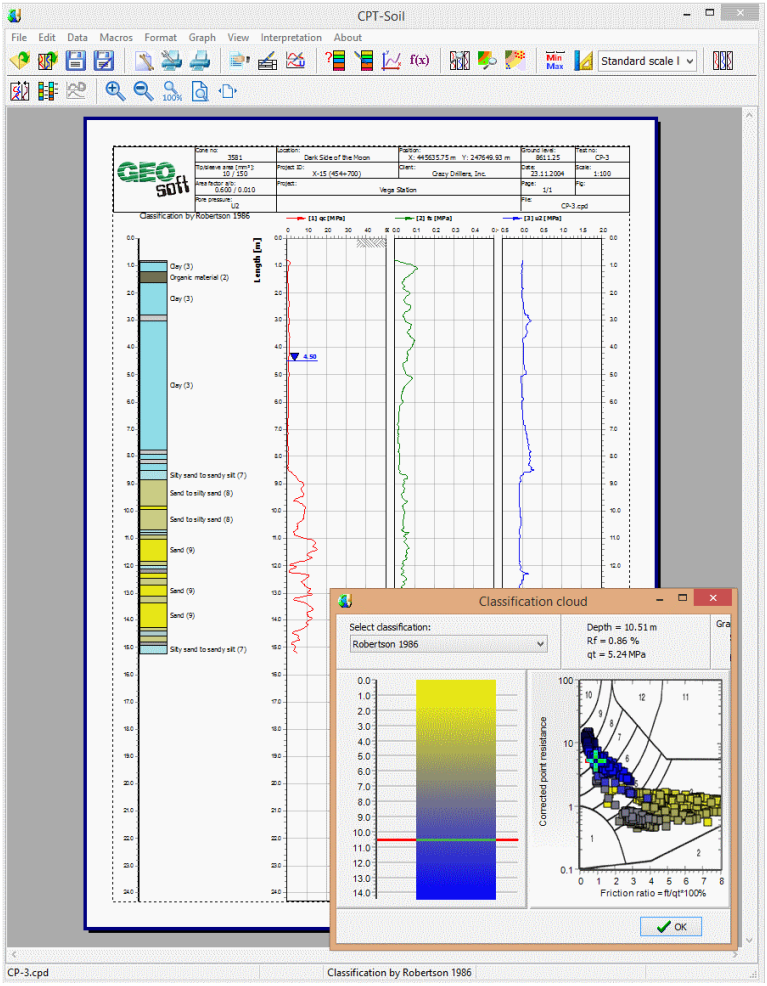
as well as from a number of publications by widely recognized authors.

CPT Explorer window. Selecting tests for analysis.





Interpretation module:



Interpretation module features:

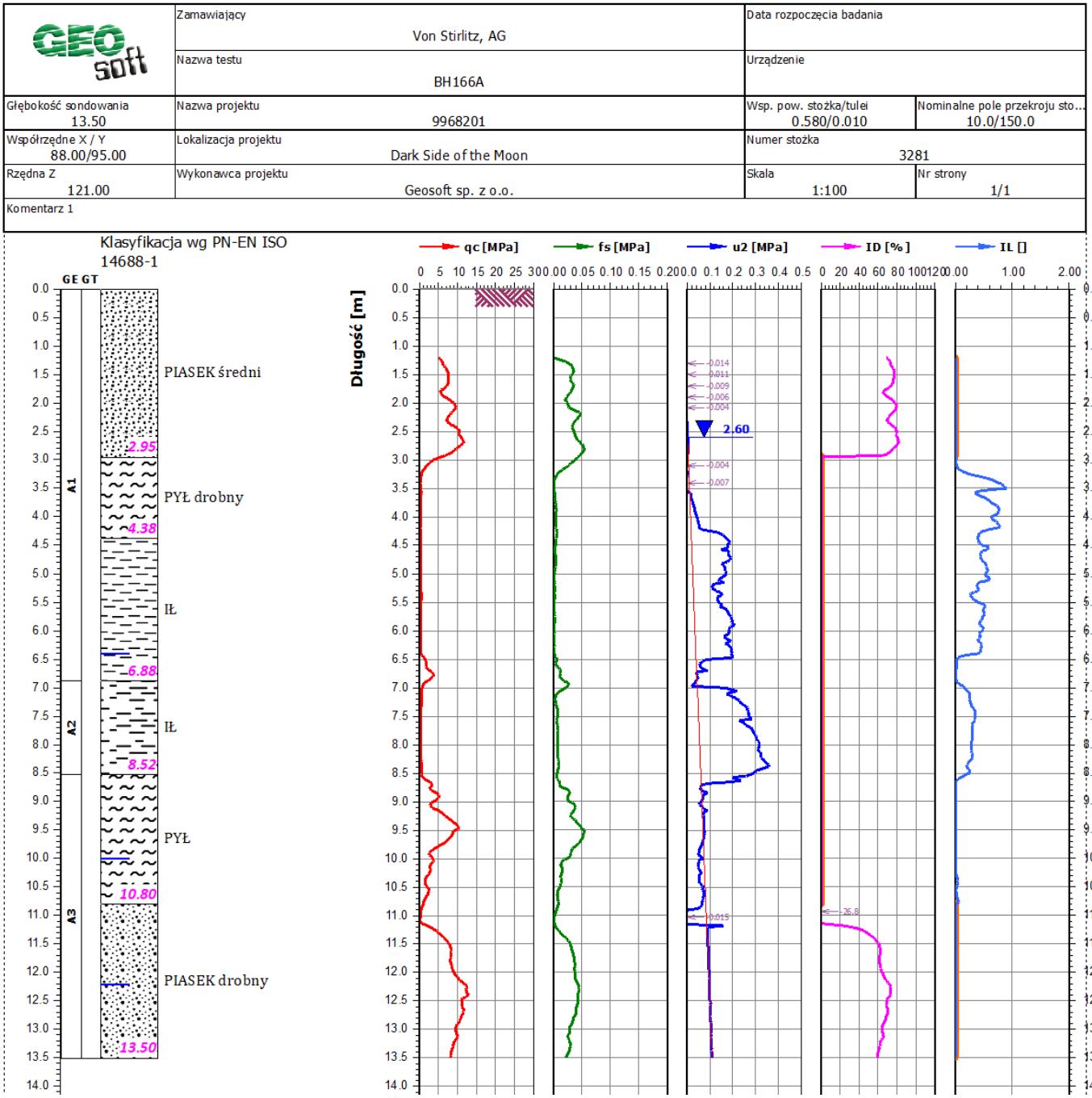
- Import of CPT files in various formats, including AGS, GEF, and CSV
- Export of files to AGS, GEF, and CSV exchange formats
- File format conversion
- Analysis and correction of sounding results
- Classification of soils and estimation of parameter values
- Grouping of separated layers into engineering-geological layers
- Estimation of characteristic values of parameters in engineering-geological layers based on advanced statistical methods
- Creation of sounding logs with parameter graphs and classification results
- Text and tabular reports
- Statistics of individual soundings and summary statistics
- Presentation of open piezometers
- Analysis and presentation of dissipation tests
- Analysis, interpretation, and presentation of DMT tests
- Tracking of parameter values and presentation of relevant points in classification diagrams
- BIM technology - export to IFC format

The following classification methods are implemented in the program:

- ***Robertson 1986 (q_c - R_f i Q_t - B_q)***
- ***Robertson 1990 (Q_t - F_r i Q_t - B_q)***
- ***Robertson 2009 (Q_{tn} - F_r)***
- ***Robertson 2010 (q_c/p_a - R_f)***
- ***Robertson 2016 (Q_{tn} - F_r)***
- ***Polska norma PN-B-04452***
- ***Eurocode, DE (q_c - R_f)***
- ***Meigh 1987 (q_c - R_f)***
- ***Senneset & Janbu 1985 (q_t – B_q)***

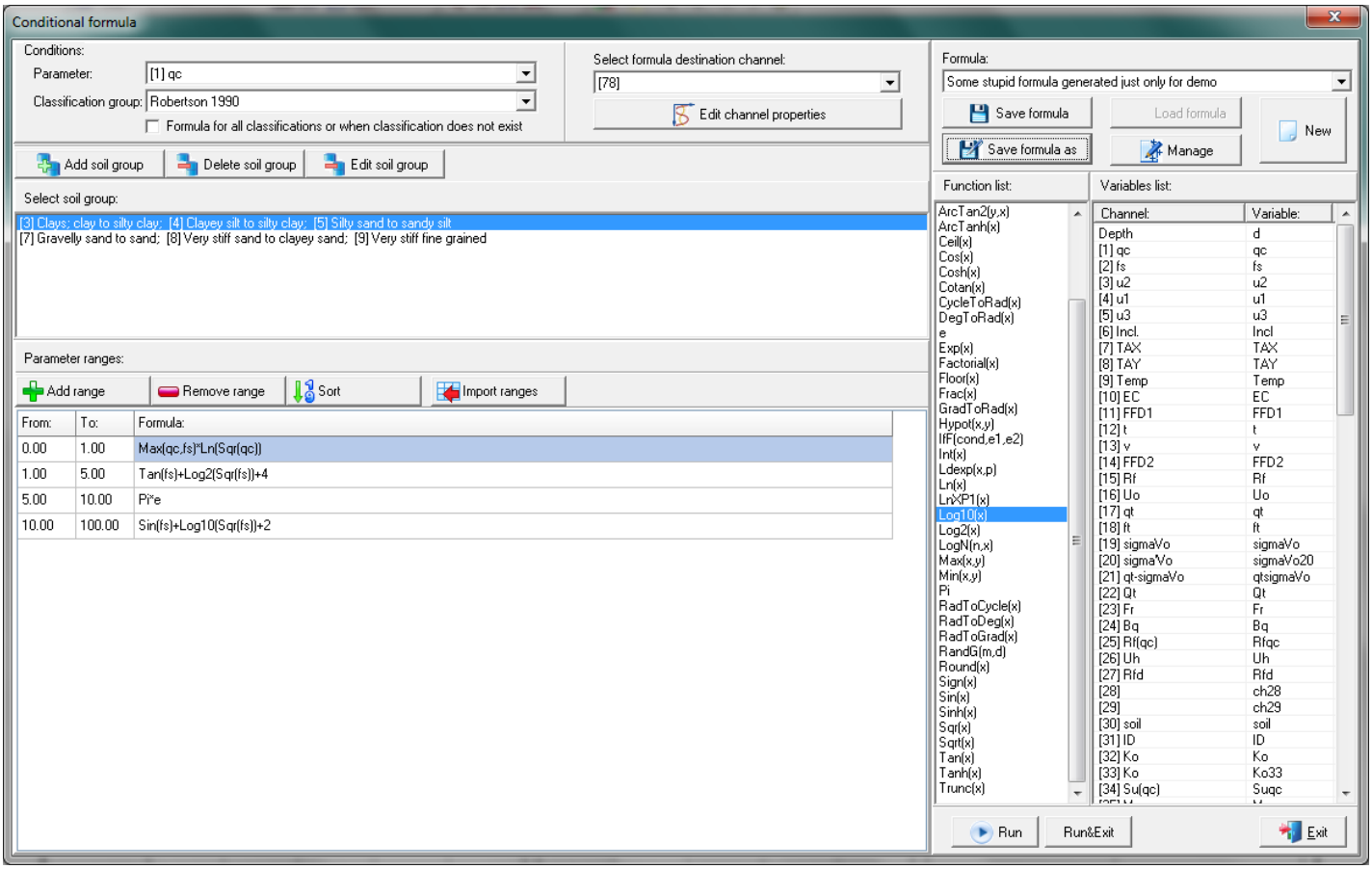
Interpretation of geotechnical parameters based on borehole classification.

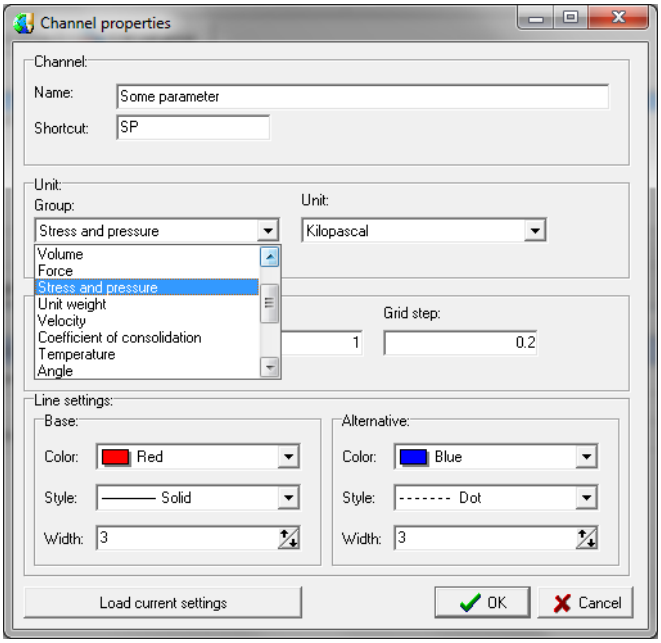
The **CPT-pro** program can interpret geotechnical parameter values based on soil classification and lithological stratification defined by drilling and other analyses (laboratory tests, etc.) and recorded in the **GEO DB** database. During interpretation, interpretation methods based on soil particle size are automatically taken into account (e.g., the density index ($\mathbf{I_D}$) is interpreted only for sandy soils, the plasticity index ($\mathbf{I_L}$) is interpreted only for cohesive soils, etc.).



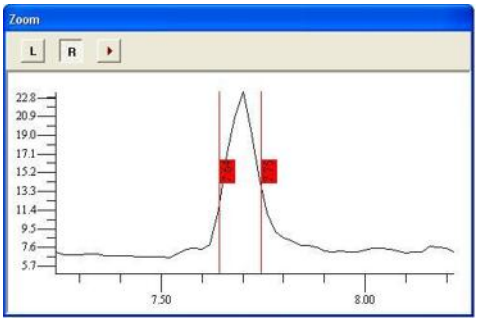
Formula Editor

The optional **Formula Editor** allows you to enter your own conditional interpretation formulas based on soil type, depth, and the range of variation of the selected leading parameter. Most mathematical functions used in engineering calculations are available.



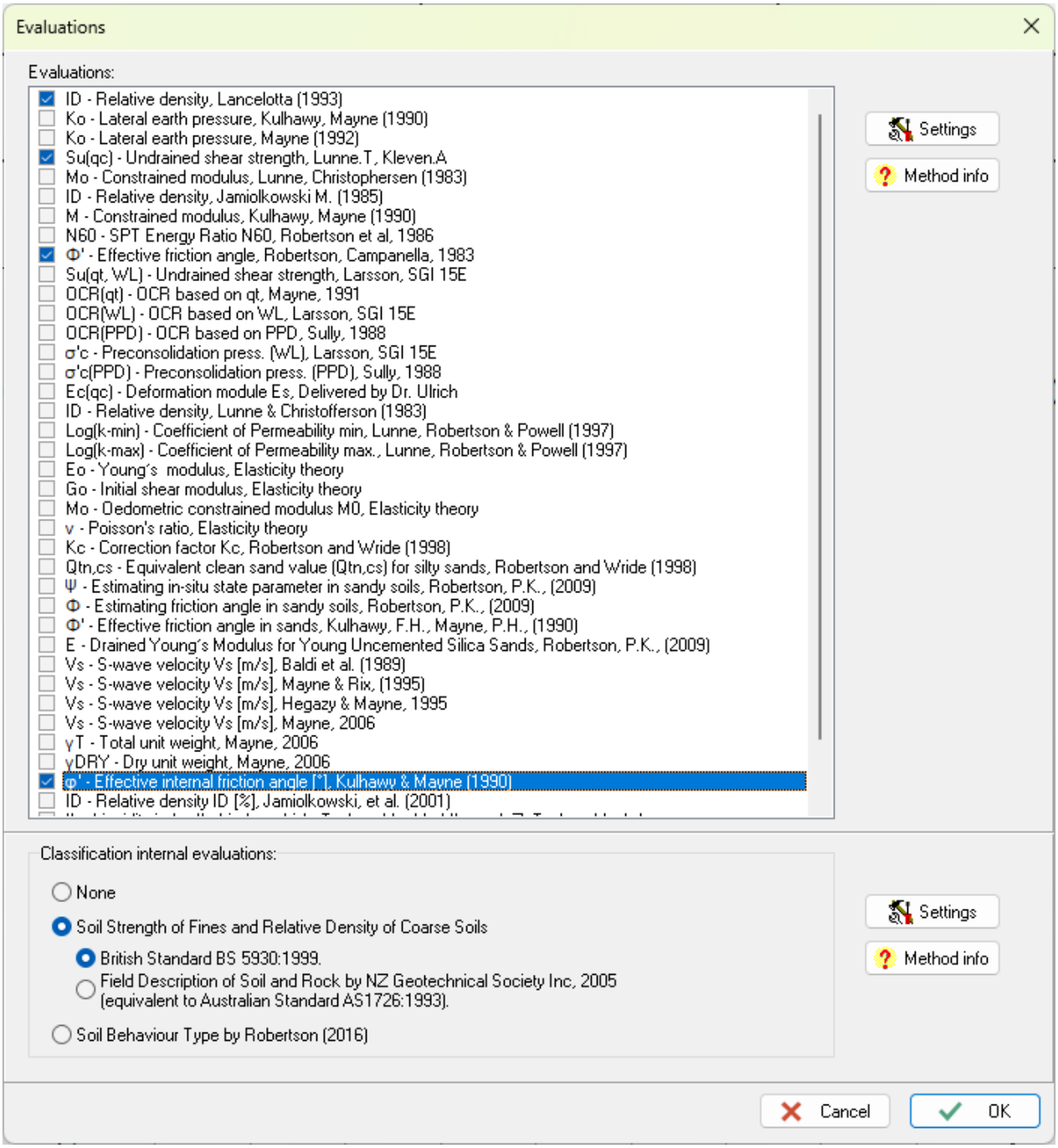


Each formula can be saved under a unique name and used in exactly the same way as the geotechnical parameter evaluation methods implemented in the program. The interpretation result of a **User Formula** can be saved to a selected channel with a unique name, abbreviation, unit, and attributes such as color, line thickness, line style, vertical grid, and horizontal scale (minimum and maximum). The unit group and parameter unit can be freely selected.



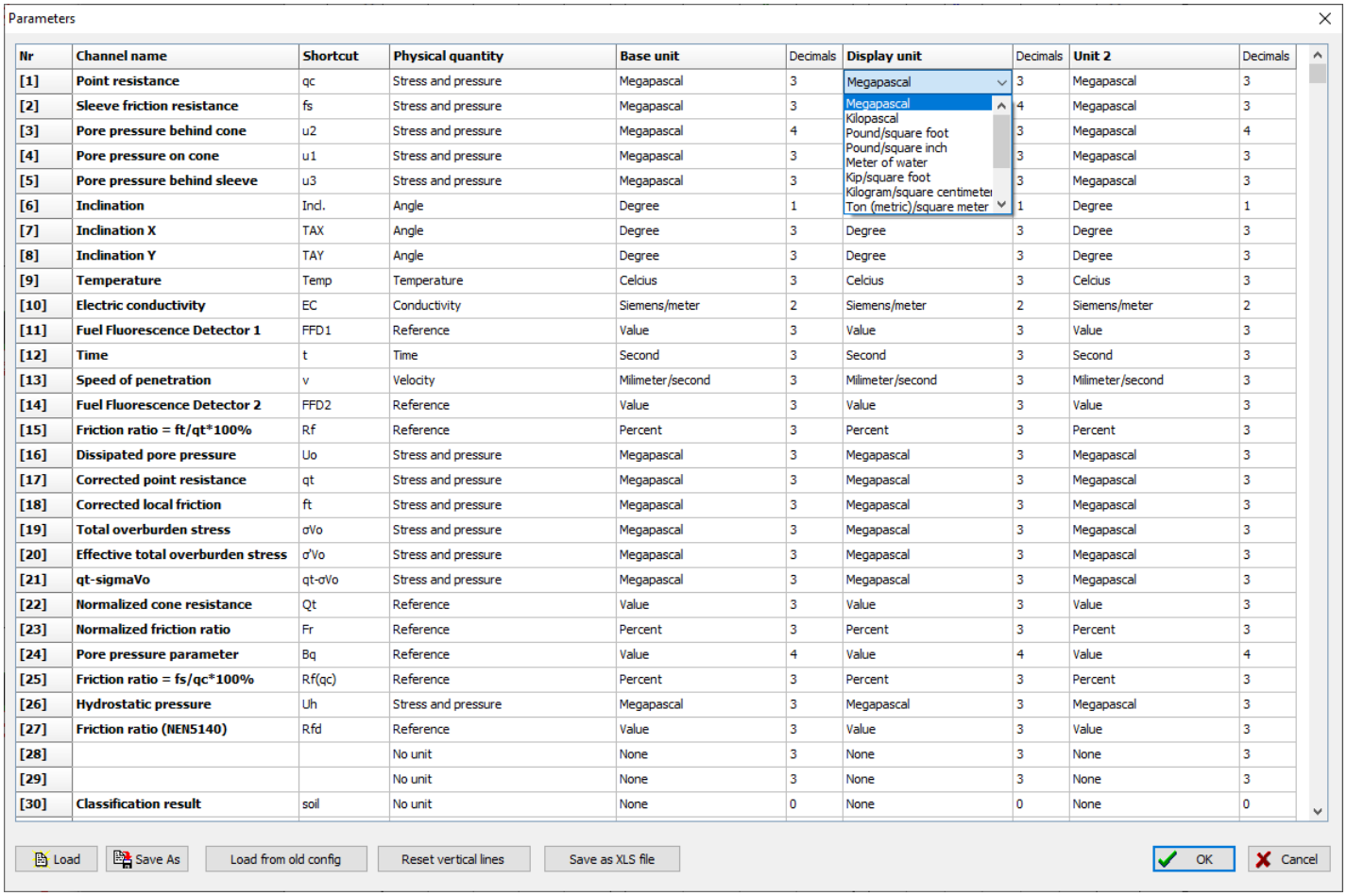
Data filtering allows for the removal of unreliable measurements. Removal of "zero peaks" resulting from, among other things, the addition of rods is performed automatically.

Interpretations included in ***CPT-pro.***



Unit systems

CPT-pro allows you to enter parameter values and display them in any units. The built-in **unit manager** allows you to select any unit on the sounding log and in the exported file.



Nr	Channel name	Shortcut	Physical quantity	Base unit	Decimals	Display unit	Decimals	Unit 2	Decimals
[1]	Point resistance	qc	Stress and pressure	Megapascal	3	Megapascal	3	Megapascal	3
[2]	Sleeve friction resistance	fs	Stress and pressure	Megapascal	3	Megapascal	4	Megapascal	3
[3]	Pore pressure behind cone	u2	Stress and pressure	Megapascal	4	Kilopascal	3	Megapascal	4
[4]	Pore pressure on cone	u1	Stress and pressure	Megapascal	3	Pound/square foot	3	Megapascal	3
[5]	Pore pressure behind sleeve	u3	Stress and pressure	Megapascal	3	Pound/square inch	3	Megapascal	3
[6]	Inclination	Incl.	Angle	Degree	1	Meter of water	1	Degree	1
[7]	Inclination X	TAX	Angle	Degree	3	Kip/square foot	3	Degree	3
[8]	Inclination Y	TAY	Angle	Degree	3	Kilogram/square centimeter	3	Degree	3
[9]	Temperature	Temp	Temperature	Celcius	3	Ton (metric)/square meter	3	Celcius	3
[10]	Electric conductivity	EC	Conductivity	Siemens/meter	2	Siemens/meter	2	Siemens/meter	2
[11]	Fuel Fluorescence Detector 1	FFD1	Reference	Value	3	Value	3	Value	3
[12]	Time	t	Time	Second	3	Second	3	Second	3
[13]	Speed of penetration	v	Velocity	Milimeter/second	3	Milimeter/second	3	Milimeter/second	3
[14]	Fuel Fluorescence Detector 2	FFD2	Reference	Value	3	Value	3	Value	3
[15]	Friction ratio = ft/qt*100%	Rf	Reference	Percent	3	Percent	3	Percent	3
[16]	Dissipated pore pressure	Uo	Stress and pressure	Megapascal	3	Megapascal	3	Megapascal	3
[17]	Corrected point resistance	qt	Stress and pressure	Megapascal	3	Megapascal	3	Megapascal	3
[18]	Corrected local friction	ft	Stress and pressure	Megapascal	3	Megapascal	3	Megapascal	3
[19]	Total overburden stress	σVo	Stress and pressure	Megapascal	3	Megapascal	3	Megapascal	3
[20]	Effective total overburden stress	σ'Vo	Stress and pressure	Megapascal	3	Megapascal	3	Megapascal	3
[21]	qt-sigmaVo	qt-σVo	Stress and pressure	Megapascal	3	Megapascal	3	Megapascal	3
[22]	Normalized cone resistance	Qt	Reference	Value	3	Value	3	Value	3
[23]	Normalized friction ratio	Fr	Reference	Percent	3	Percent	3	Percent	3
[24]	Pore pressure parameter	Bq	Reference	Value	4	Value	4	Value	4
[25]	Friction ratio = fs/qc*100%	Rf(qc)	Reference	Percent	3	Percent	3	Percent	3
[26]	Hydrostatic pressure	Uh	Stress and pressure	Megapascal	3	Megapascal	3	Megapascal	3
[27]	Friction ratio (NEN5140)	Rfd	Reference	Value	3	Value	3	Value	3
[28]			No unit	None	3	None	3	None	3
[29]			No unit	None	3	None	3	None	3
[30]	Classification result	soil	No unit	None	0	None	0	None	0

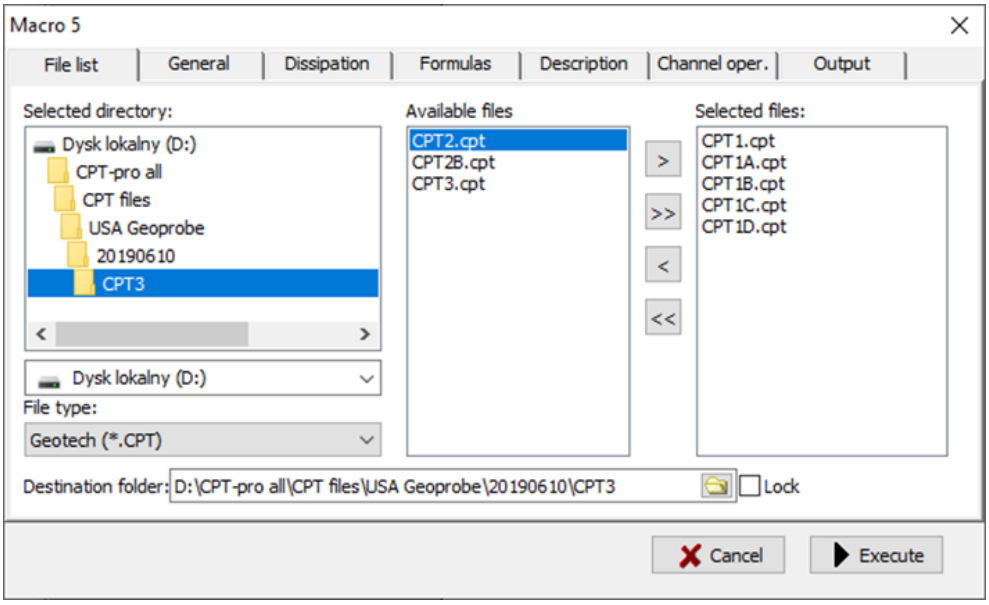
Working with a File Package

The **CPT-pro** program is equipped with a number of procedures that allow you to perform multiple, interconnected operations simultaneously on a selected file package. This significantly reduces the time it takes to analyze soundings and generate documentation.

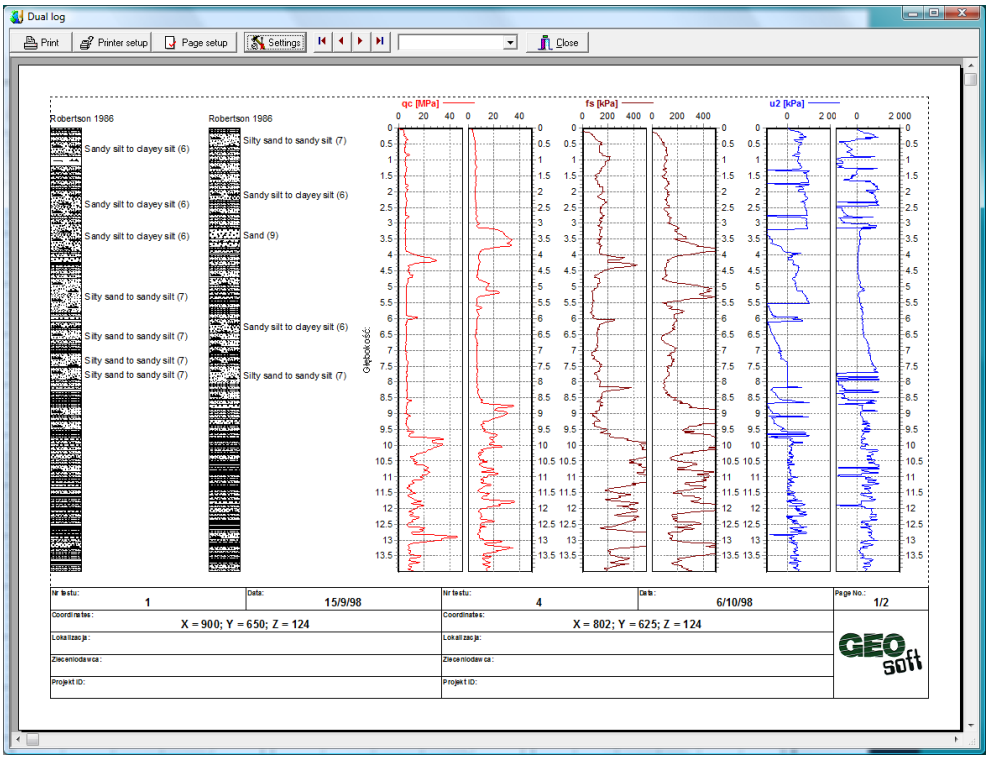
These include:

- Completing duplicate header data
- Correcting incorrect data (zero peaks, etc.)
- Interpreting classification data
- Interpreting geotechnical parameter estimates
- Performing interpretations using custom formulas
- Printing sounding logs according to a selected log template

Serial interpretation



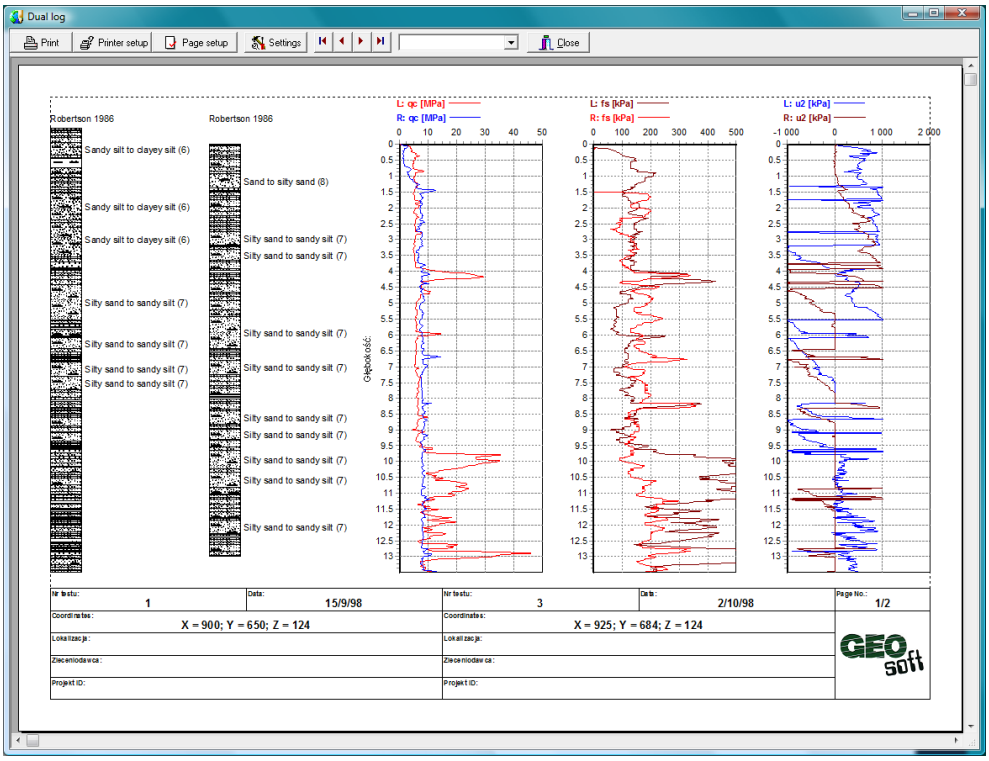
The **Batch processing function** allows for the simultaneous interpretation of any number of files using the same schema. Additionally, this function allows for the entry and correction of header data. The interpretation result can be saved in **XCPD** or **AGS** exchange format.



Dual log

The ***Dual Log*** function allows two different tests to be displayed on the same sounding log. This is particularly useful when comparing soundings taken in the same area, for example, before and after soil improvement.

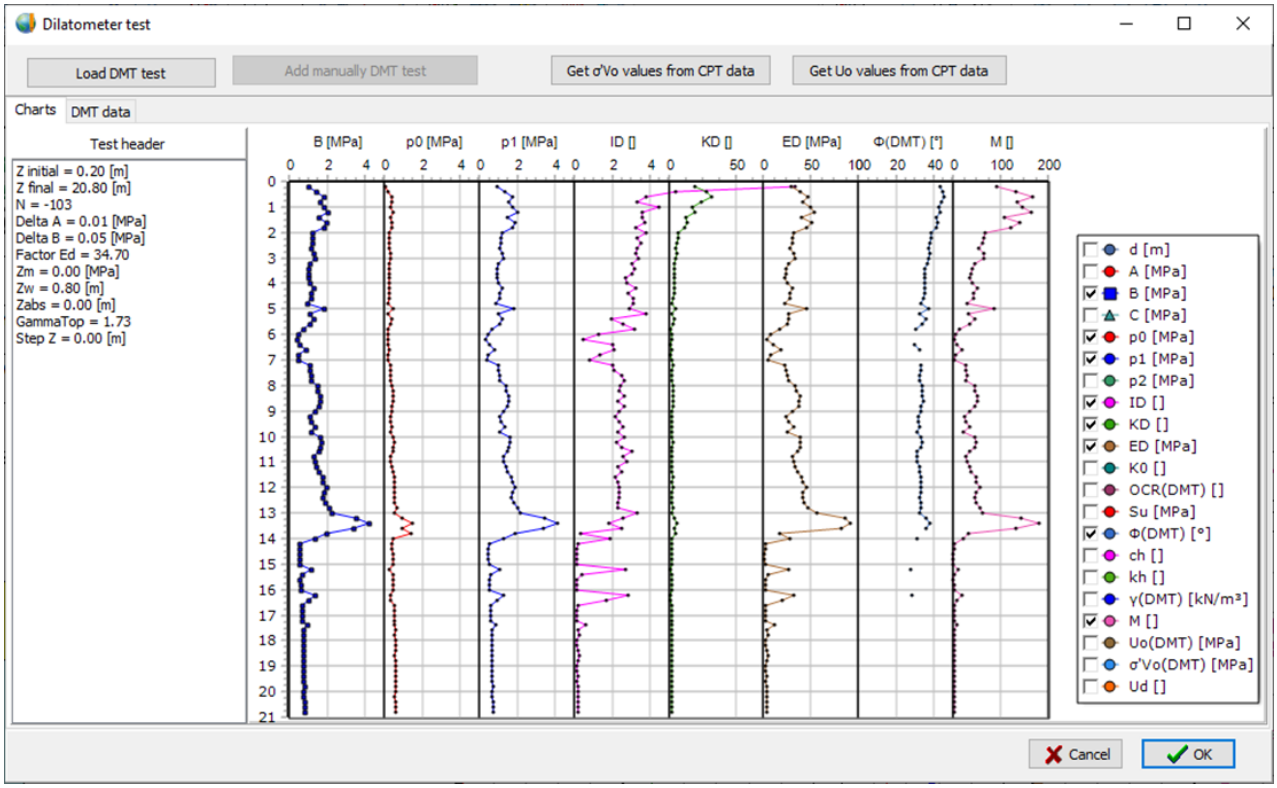
Graphs of selected parameters can be displayed in separate fields (next to the chart) or in the same field (below).

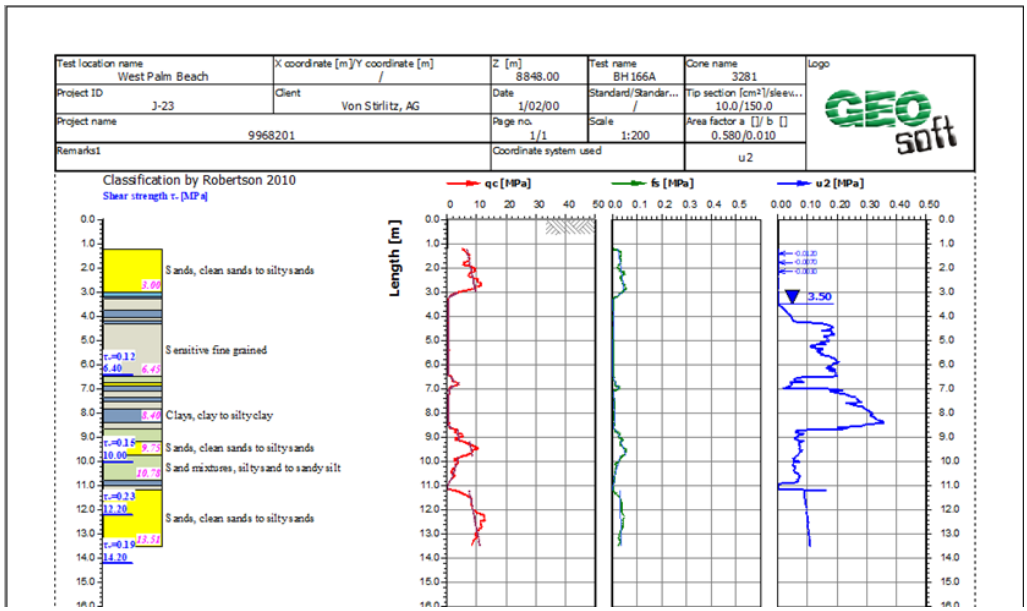


Dual Log with two graphs in the same field.

DMT

The **CPT-pro** program enables full interpretation of **DMT** (***Marchetti Dilatometer***) soundings according to procedures developed by ***Professor Silvano Marchetti***. Each **DMT** parameter, recorded or interpreted, can be presented in conjunction with **CPTU** sounding parameters.

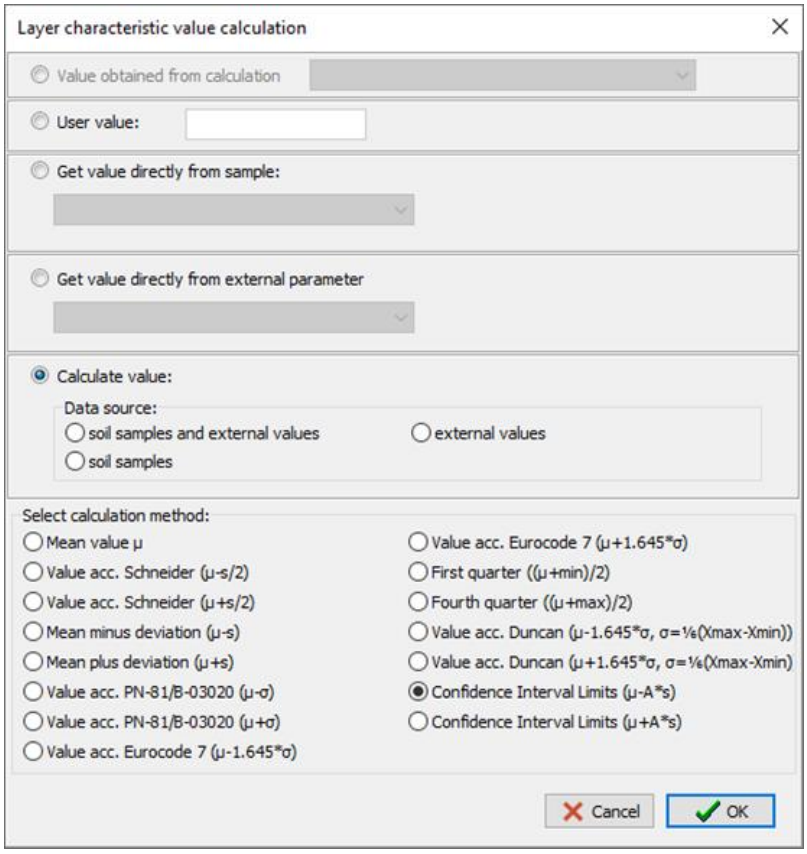




Integration with the **VANE-pro** program (for the interpretation of ***FVT shear tests)*** allows the presentation of shear strength values **τ** together with the CPTU results.

Characteristic values of parameters

The **CPT-pro** program contains procedures for automatic estimation of the characteristic values of parameters based on the values interpreted in the program.



Advanced statistical methods are implemented accordong to:

- **Eurocode 7**
- **PN-81/B-03020**
- **Schneider, 1997**
- **Sample mean value**
- **First and fourth quadrant method**
- **Duncan, 2000**
- **Student's t-distribution and confidence limits for the population mean estimator**

Additionally, a standard value or one derived from other studies can be specified as the characteristic value of parameter. All statistical calculations are performed automatically according to the method selected by the user.

Characteristic values can be estimated for a given lithological layer or, independently, for selected geological-engineering and geotechnical layers. In the latter case, characteristic values can be calculated for a single borehole or for a selected set of boreholes combined.

Generate tabulated summaries of characteristic parameter values and basic statistics for selected soil types, selected parameters, and selected probe sets.

Export results to XLS format.

2024_183_A								
PN-B-04452								
Soil type	**Top**	**Bottom**	**Parameter name**	**Mean value μ**	**Estimation by Schneider (μ-s/2)**	**Estimation by Eurocode 7 (μ-1.645*σ)**	**Standard deviation σ**	**Coefficient of variation V [%]**
Mean sands to silty sands	0	0,96	[1] Tip resistance, qc [MPa]	4,51	3,69	1,83	1,63	36,58
			[31] Relative density, Dr [%]	80,8	77,1	68,6	7,4	9,3
			[39] Effective angle of int.friction., Φ' [°]	47,57	47,31	46,73	0,51	1,08
Mean sands to silty sands	4,14	4,91	[1] Tip resistance, qc [MPa]	2,09	1,98	1,71	0,23	11,34
			[31] Relative density, Dr [%]	24,8	23,2	19,7	3,1	12,6
			[39] Effective angle of int.friction., Φ' [°]	33,56	33,18	32,33	0,75	2,25
Mean sands to silty sands	12,1	13	[1] Tip resistance, qc [MPa]	4,47	4,33	3,99	0,29	6,58
			[31] Relative density, Dr [%]	32,1	31,4	29,6	1,6	4,9
			[39] Effective angle of int.friction., Φ' [°]	31,96	31,82	31,51	0,28	0,87
Mean sands to silty sands	14,34	15,45	[1] Tip resistance, qc [MPa]	4,96	4,84	4,56	0,24	4,9
			[31] Relative density, Dr [%]	32,6	31,8	30	1,6	5
			[39] Effective angle of int.friction., Φ' [°]	31,6	31,44	31,06	0,33	1,04
Sand mixtures	16,84	23,52	[1] Tip resistance, qc [MPa]	6	5,67	4,92	0,66	10,96
			[31] Relative density, Dr [%]	33,6	32,4	29,5	2,5	7,5
			[39] Effective angle of int.friction., Φ' [°]	30,99	30,74	30,16	0,51	1,63

Generating tabular summaries of classification results for a selected survey package.

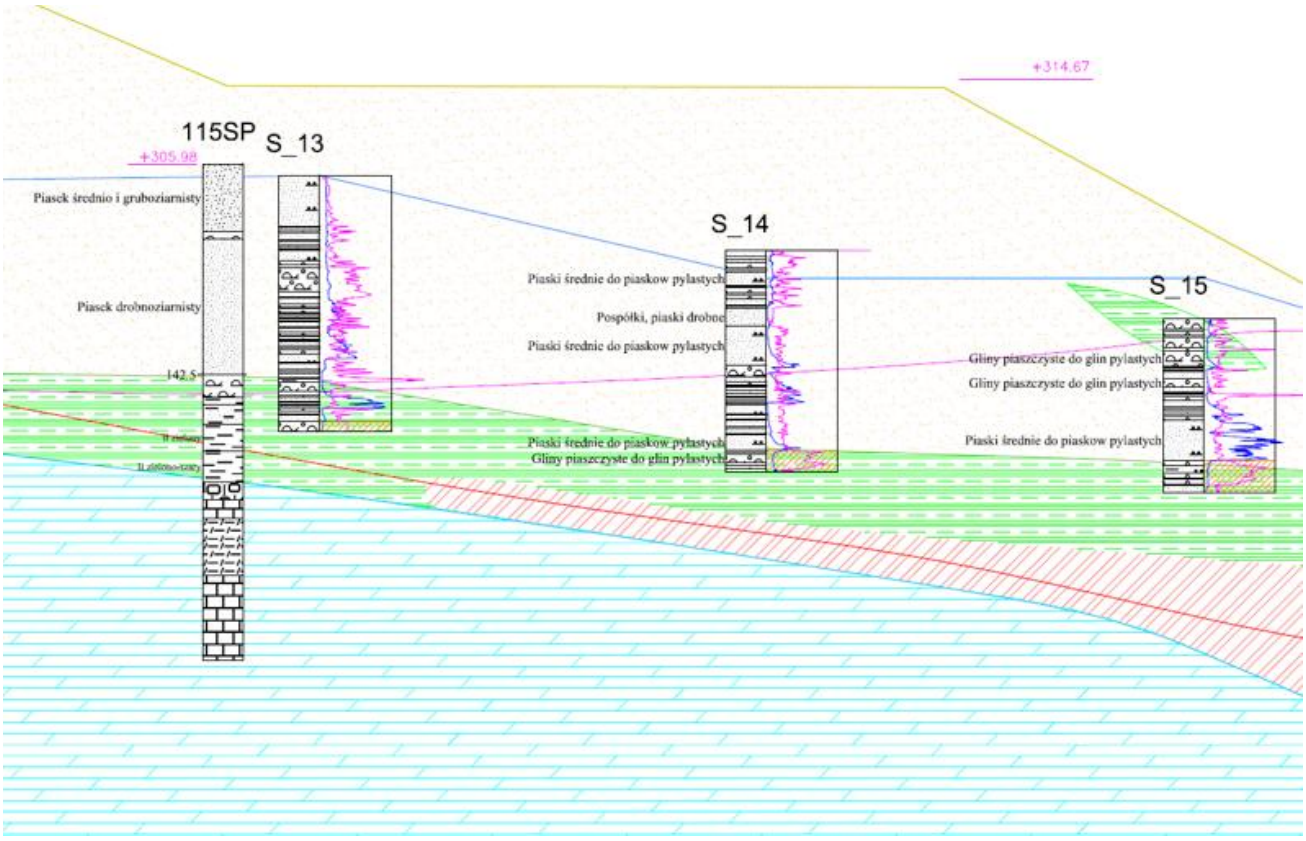
Exporting results to **XLS** format.

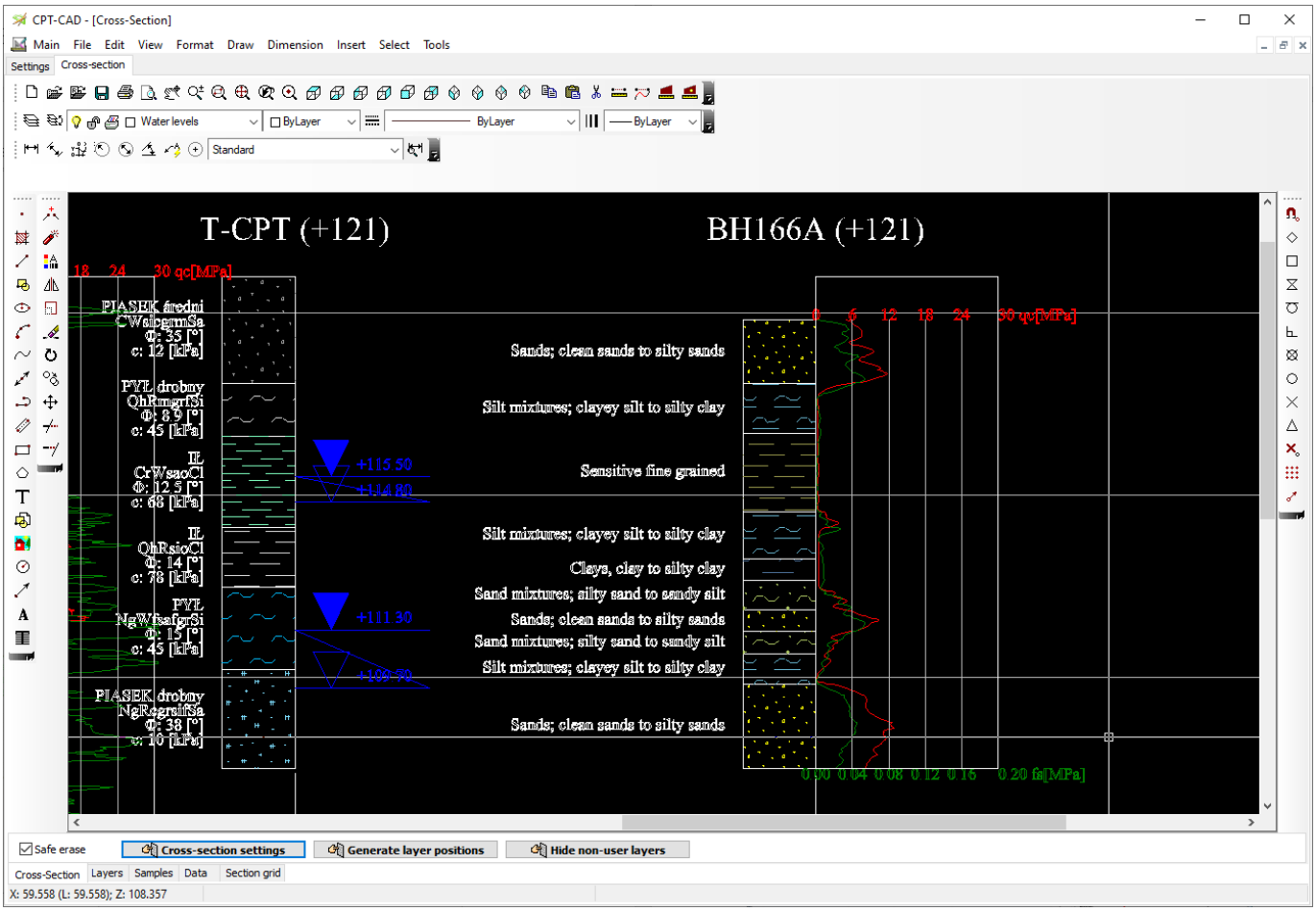
Test name	Silty loams to clays, clays		Silty loams to silty clays		Sandy loams to silty loams		Medium sands to silty sands		Sand mixtures, fine sands		Total	
	[m]	[%]	[m]	[%]	[m]	[%]	[m]	[%]	[m]	[%]	[m]	[%]
1	7.44	23.47			10.70	33.75	13.26	41.83	0.30	0.95	31.70	3.93
2	0.72	1.56	0.92	1.99	9.42	20.42	33.24	72.04	0.46	1.00	46.14	5.72
3	11.21	25.28			23.50	53.00	9.55	21.54			44.34	5.50
4	25.52	53.34	1.10	2.30	5.88	12.29	10.82	22.62	4.52	9.45	47.84	5.93
5	112.98	14.01	26.21	3.25	280.37	34.76	341.72	42.36	22.68	2.81	806.66	**100.00**

Geotechnical Cross-Sections and Maps. CPT-CAD Module

The **CPT-CAD** module is used to create geotechnical cross-sections, maps, and custom vector drawings. This module features **CAD** graphics compatible with **DWG** and **DXF** formats.

The horizontal and vertical scales are freely adjustable and independent of each other.



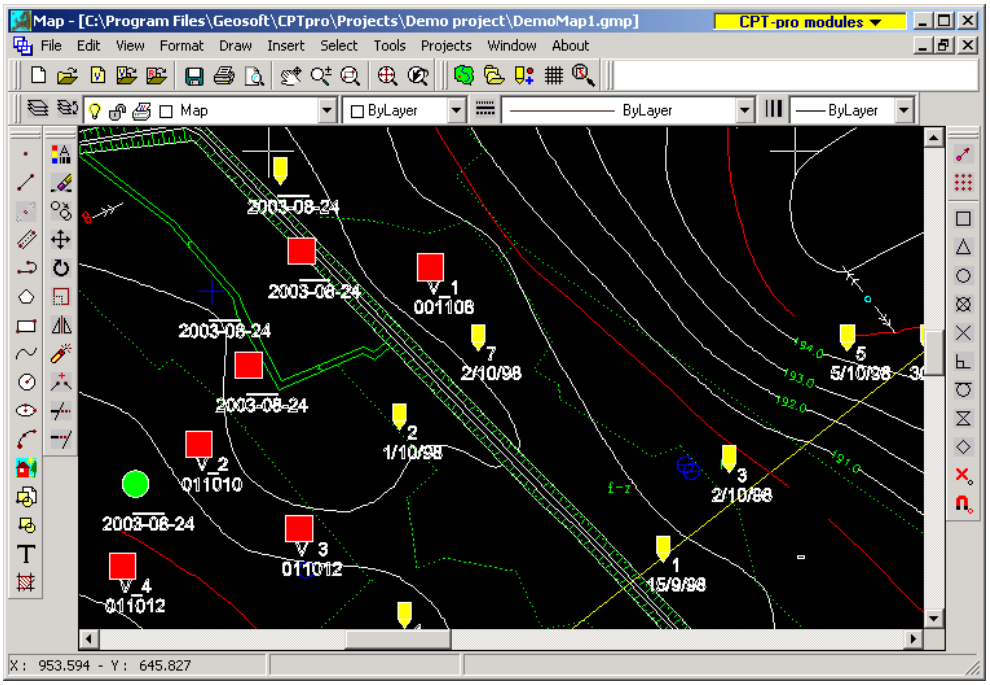


Cross-sections may contain:

- **CPT** and **DMT** parameter charts
- **DPT** and **SPT** dynamic sounding charts
- **SCPT** seismic sounding interpretation results charts
- **Borehole profiles** resulting from CPT sounding interpretations
- **Parameter charts** resulting from CPT sounding interpretations
- Borehole **profiles saved in the Geo DB** database
- **Layer properties** saved in the Geo DB database
- **Graphical objects** representing geological layers and structures
- Additional descriptions
- Additional graphical objects

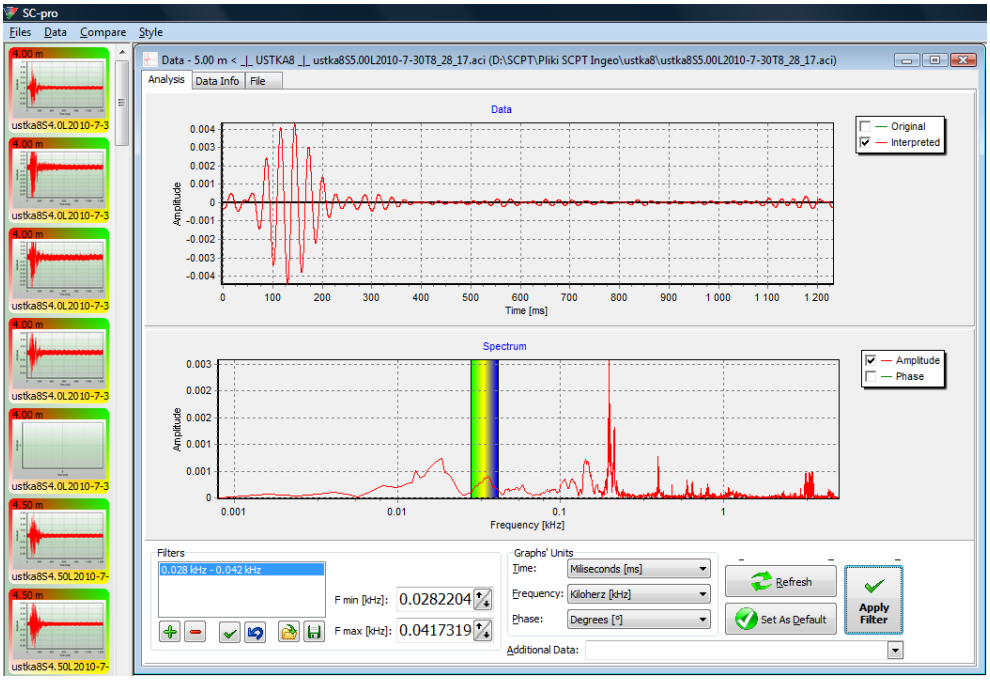
The **CPT-CAD** module allows for the presentation of **CPT**, **FVT**, and **DMT** test locations on a map based on coordinates stored in CPT data files and the **GEO DB** module database. **DWG** and **DXF** files generated in other programs (AutoCAD, Microstation, etc.) can be used as a map base. **BMP**, **JPG**, and other graphic files can also be used as backgrounds. The graphic tools implemented in the map module enable editing of existing vector maps (**DWG** and **DXF**) and creating your own.

CAD graphics in the CPT-CAD module.



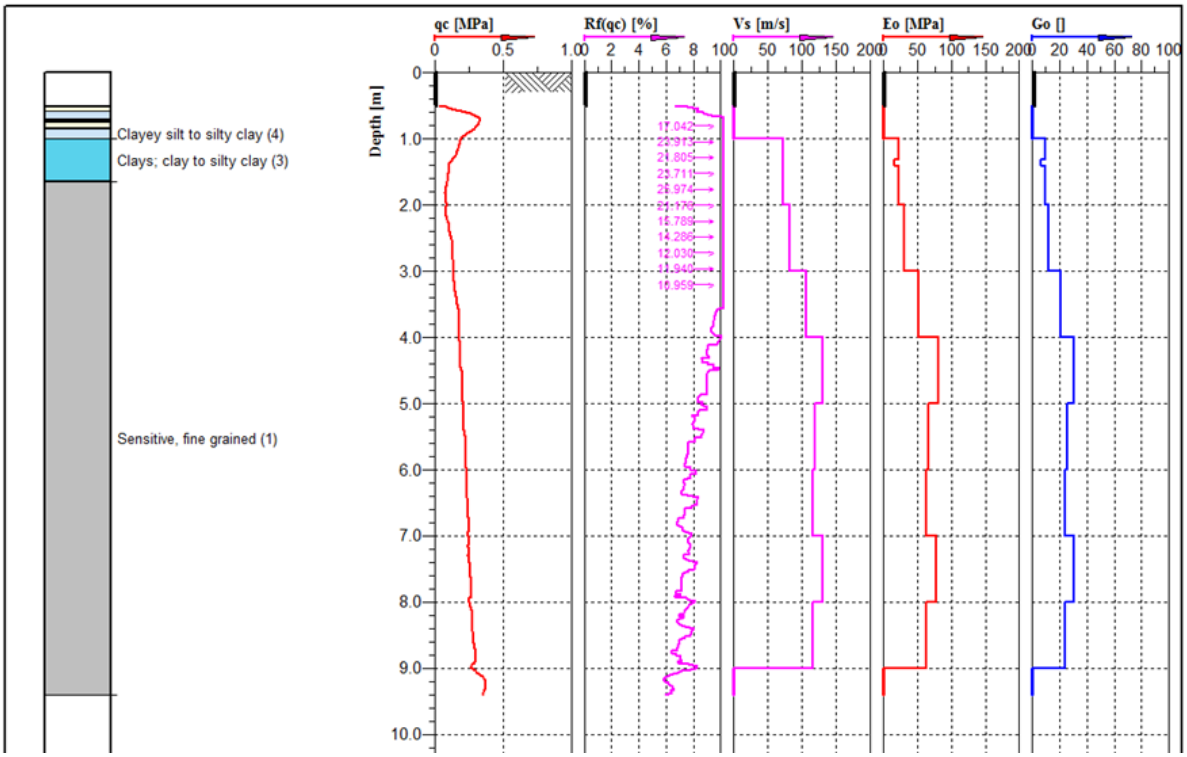
Symbols of boreholes, CPT, FVT and DMT tests are generated automatically

SCPT module is used to analyze and interpret **SCPT** seismic soundings.



It allows for the analysis of **S-** and **P-waves**. The program's advanced analytical tools, particularly the user-configurable multiple filter systems, enable the analysis of even weak seismic waves containing a high amount of noise.

The SCPT module is particularly effective for analyzing waves recorded by accelerometer-based sensors, as the spectrum of such waves is much broader and allows for a more comprehensive analysis (accelerometers have a measurement range of 10 kHz, while geophones typically have a range of 0.3 kHz). The analytical procedures used allow for precise estimation of wave velocities at specific depths and their presentation on sounding logs.



Seismic wave velocity values interpreted in the **Seismic** module can be entered into the **Interpretation** module's data structure. This allows for further interpretation using all of the module's tools. A sounding log generated in the **Interpretation** module can contain all the graphs related to the **CPTU** sounding analysis and, concurrently, the **SCPT** seismic sounding analysis.

Efficient workflow and advanced graphics.

CPT-pro includes a number of advanced procedures that allow for the effective analysis of **CPTU** soundings and the creation of geotechnical documentation. The most important of these are:

- Classification methods developed by P.K. Robertson, A.C. Meigh, Geosond GmbH, K. Senneset, and N. Janbu, and PN-B-04452.
- Profile division into engineering-geological layers
- Multiple interpretation methods for estimating geotechnical parameter values
- Estimation of characteristic geotechnical parameter values
- Equation editor for entering custom interpretation formulas
- Macros to speed up analytical work
- Basic interpretation of multiple files according to a user-defined schema
- Reporting
- Saving settings
- Customization of the borehole card to user requirements
- Dual log function for comparing different soundings
- Create high-quality documents
- Create your own document templates
- Three main types of borehole charts (standard, Dutch Format, and Dual Log)
- Optional entry of water level and piezometric levels
- Header data summary in tabular format
- Optional description of the CPTU cone
- Enter your own logo on the sounding chart
- Introduce additional graphic objects
- Choosing graph line colors and thicknesses, and the color, size, and font type of text descriptions
- CAD graphics that can be saved and edited in DWG formats