Datgel DATA SOLUTIONS
Geotechnics • Geoenvironment • Laboratory

User Guide

Datgel
CPT Tool gINT Add-In 2

DCT-UG-001 - 2.10

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Disclaimer

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Contents

Tables

About Datgel CPT Tool 2

The Datgel CPT Tool gINT Add-In 2 is designed streamline the processing and interpretation of Cone Penetration Test and Dissipation Test data:

- Designed for flexibility and user configuration
- ASCII data files in numerous standard and propriety formats may be imported
- Filter rod changes
- Calculate derived parameters
- The soil type and strength may be interpreted based on user defined parameters, and then a summary can be transferred to your soil description and consistency/density table
- More than 60 preconfigured published correlations are calculated, written to the database and ready for presentation on your graphs and logs
- User-definable correlation formulas
- Dissipation test analysis
- More than 100 customisable log, graph and fence reports
- User definable line colours, types and scales
- Our CPT processing code has been used to manage tens of thousands of tests by clients across the globe

You need to complete the installation procedure (see *Installation and Licensing* on *page 1*) and activate (see *Datgel Product Licensing System User Guide*) before you can use the CPT Tool.

New in Version 2

1. More than 60 preconfigured correlations
2. Formula Tool for user-definable correlation formulas
3. Dynamic user definable log, fence and graph reports
4. User definable line colours, types and scales
5. Schneider, Randolph, Mayne and Ramsey (2008) soil behaviour type interpretation
6. Dissipation test analysis
7. Import of more data file formats: Vertek (*.dat), Pagani (*.cpt), Geomil PlotCPT (*.T*)
8. Seismic cone

Support

12 months support and maintenance is included with the license purchase. For technical support please email support@datgel.com or call +61 2 8202 8600.

System Requirements

gINT

The product runs optimally using **gINT 8.2.008** or higher, however it will run using gINT 8.1.2.008 or higher.

gINT Professional is recommended. The product will run using gINT Logs, gINT Logs Plus, and gINT Professional. However the tool includes graph and fence reports that can only be used with gINT Professional.

Hardware and Operating System

Same system requirements as gINT 8.2, see: http://www.gintsoftware.com/products_requirements.html.

Required Windows Components

1. Windows Installer 3.1
2. .NET 3.5 Framework SP1

Conventions and typography used in this guide

Note: Tips and additional Information to help you.

>	Used to indicate a series of menu commands. e.g. Select **File > Open**.
|	Used to indicate a gINT Application Group, Application, Table Group or Table , e.g. **DATA DESIGN | Project Database**
Bold Text	Items you must select, command buttons, or items in a list. e.g. Navigate to **UTILITIES | Convert Projects** (4th tab).
Italics Emphasis	Use to emphasize the importance of a point such as parameters. e.g. Data Entry – Check *Omit Must Save prompt when save is required*
CAPITALS	Names of keys on the keyboard. for example, SHIFT, CTRL, or ALT.
KEY+KEY	Key combinations, for example CTRL+P, or ALT+F4.
`Code Snippet`	Indicates a code snippet within a paragraph
`Code sample`	Indicates a sample program codes inserted in user guide e.g. `public override string ToString ()`
`File name or path`	Used for formatting file name and paths e.g. `di_lib.glb or V:\10 gINT\Datgel Install Files\`
Table_Name	Database table name, e.g. POINT_TABLE.
Field_Name	Database field name; e.g. PointID
Command line	Command line, presented exactly as it must be entered e.g. **cdir**

Field Colours

Each of the fields in the project tables have been coloured to improve the data entry process as indicated below in Table 1.

Table 1 - Field Colours

Field Colour		Field Name and Explanation
	Yellow	gINT Key Field – mandatory data entry
	Pastel Purple	AGS Data – data associated with the AGS Data Interchange format
	Pastel Green	Calculated Field – data is written to this field by Datgel's code
	Pastel Beige	Data Entry Field – data should be entered into this field, or data in this field influences the calculation
	Pastel Red	Legacy Data Field – historic data entered here, is from typically an old database
	Pastel Blue	Output Option – used to control how the data displayed on a report
	Pastel Orange	Remark or Metadata Field – additional data associated with the primary information
	Grey	Read-only

Note: The Datgel CPT Tool is built in two versions – *DGD* with long table (e.g. CPT_POINT_PARAMETERS) and field names and *AGS RTA* with short AGS-compliant names (e.g. STCS).

Both names are usually given, although only one is relevant to any given site. Screen images are not duplicated and usually show only the *DGD* version.

1 Installation and Licensing

There are four parts to the installation process:

- DLL program installation
- Merge gINT library objects
- Merging project tables and fields
- Configure settings in library and project/data template
- Activate the product license

The first three steps can be completed in any order and are described below. The activation procedure must be done last and is described in the *Datgel Product Licensing System User Guide*.

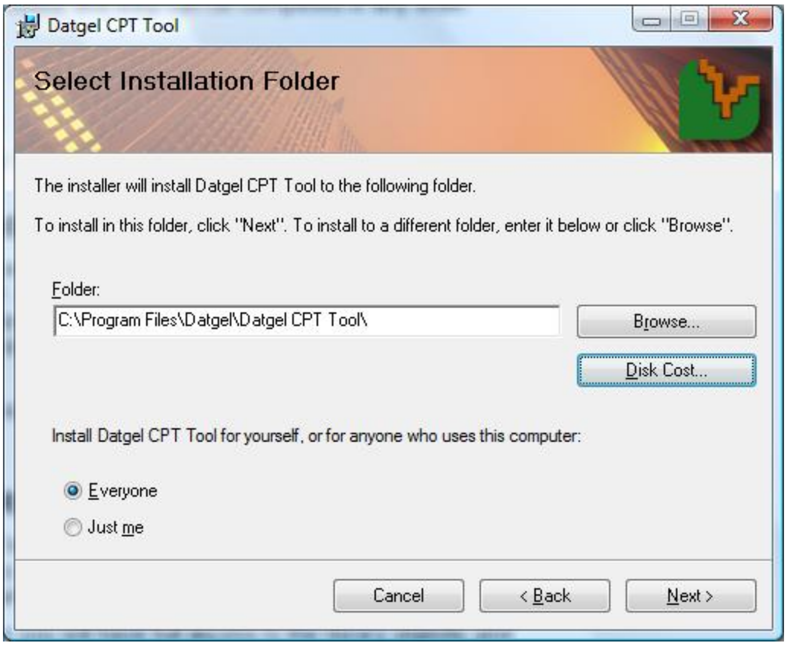
1.1 DLL Program Installation

The CPT Tool requires that the Microsoft .net 3.5 framework is installed on the PC prior to the installation of the CPT Tool. If your PC does not have the .net 3.5 framework SP1 installed, then it will be automatically installed during the CPT Tool installation process. You need local administrator rights to the PC to install the CPT Tool.

To install the CPT Tool:

- Ensure that gINT is closed
- Run the **setup.exe** file
- Follow the prompts

In the following screen, you can either accept the default location for the new file, or change it by clicking **Browse**. The Disk Cost button shows the space required versus space available on each of your disks.



1.2 Which Database Structure? – DGD or AGS RTA

At this point you must decide which CPT Tool database structure to use. The options are:

1. *DGD* (stands for Datgel Database) with long table (e.g. CPT_POINT_PARAMETERS) and field names.
2. *AGS RTA*, based on the structure prescribed by the Roads and Traffic Authority of NSW, Australia, and the Association of Geotechnical and Geoenvironmental Specialists. The database has short AGS-compliant names (e.g. STCS).

Unless you're currently using an *AGS RTA* style database, we recommend you adopt the *DGD* database.

1.3 Merge gINT Library Objects

Note: If you're in one of the following situations then proceed to Section *1.6* Validate or Activate License.

In the trial version of the CPT Tool, the library will be locked and you cannot merge any gINT Library Objects into your Library file, or make changes to this Library file. In this case, you have to use the locked library as-is.

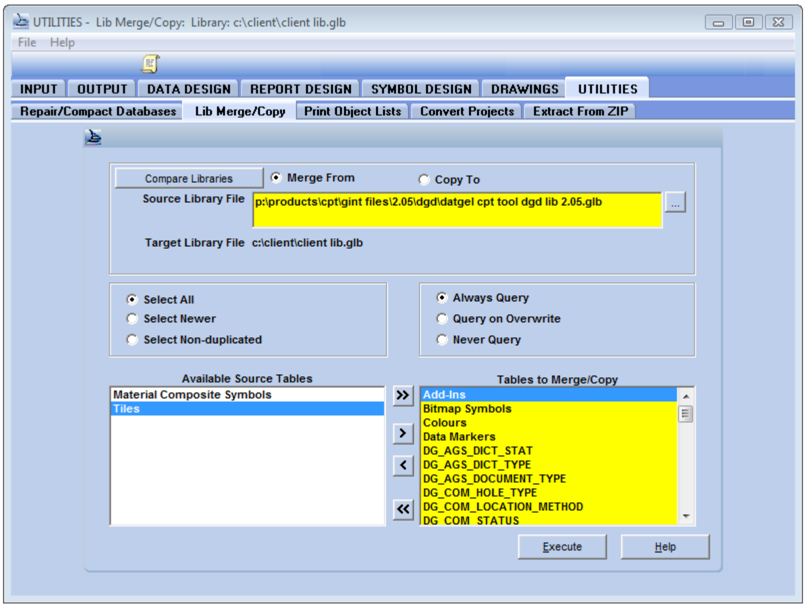
Steps 1.3 to 1.5 have been done by Datgel's developers or done previously by you or a colleague.

If you don't have existing gINT files then you may wish to just use the example CPT Tool gINT Files provided on the DVD.

If you have purchased the CPT Tool, then you have full access to the library objects, and you may proceed with the following steps to merge the gINT Library components into your Library file.

1. Make a backup copy of your existing library file. By default this is located at:

   `C:\Program Files\gINT8\libraries\`
2. Start gINT and open the library and project file you wish to use the Datgel CPT Tool with.
3. Select **UTILITIES | Lib Merge/Copy**.
4. Browse the Source Library File for `datgel cpt tool dgd lib #.##.glb`
5. Check the **Query On Overwrite** box, then move all source tables, except *Material Composite Symbols* and *Titles*, to the yellow box on the right side by clicking the **>>** button.



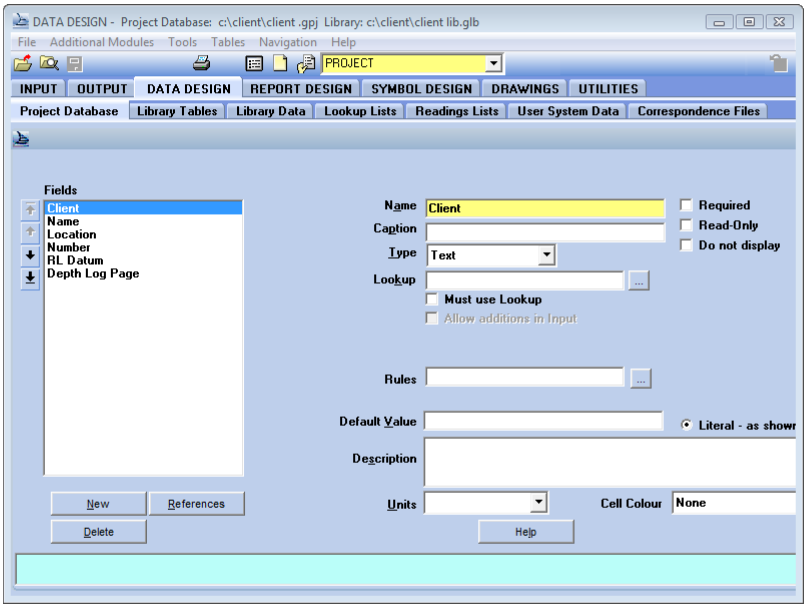
6. Click **Execute**. The process may take several minutes.

This merges the CPT Tool Add-In menu item, gINT Rules modules, user system data and other library tables relevant for the use of the CPT Tool.

Depending on which page sizes you tend to use, you may find it convenient to not merge the Letter (LET) and 11x17 or the A4 and A3 reports.

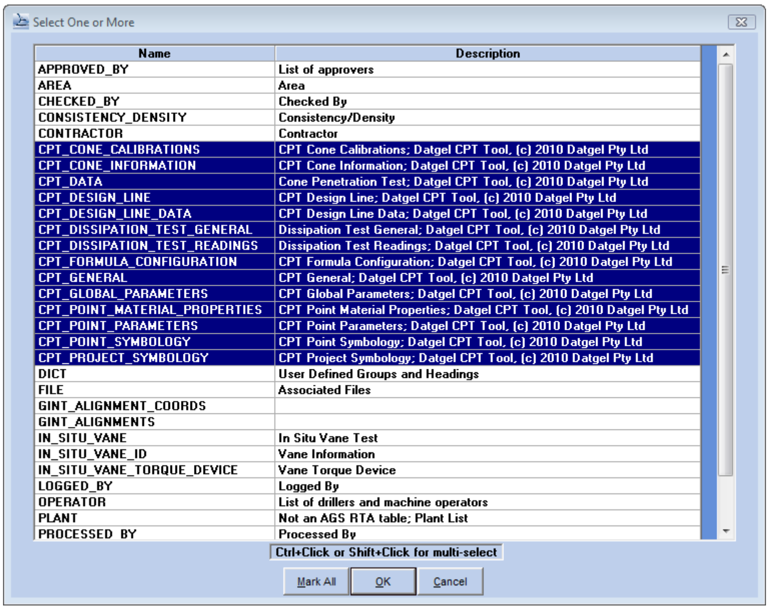
1.4 Merge gINT Project File Tables and Fields

1. Open your existing project/data template in DATA DESIGN | Project Database.



2. Select **Tables > Import Multiple Tables...** then browse for either file `datgel cpt tool dgd #.##.gpj` or `datgel cpt tool dgd #.##.gdt.`

3. At the minimum, select the following tables to import, and click **OK.**

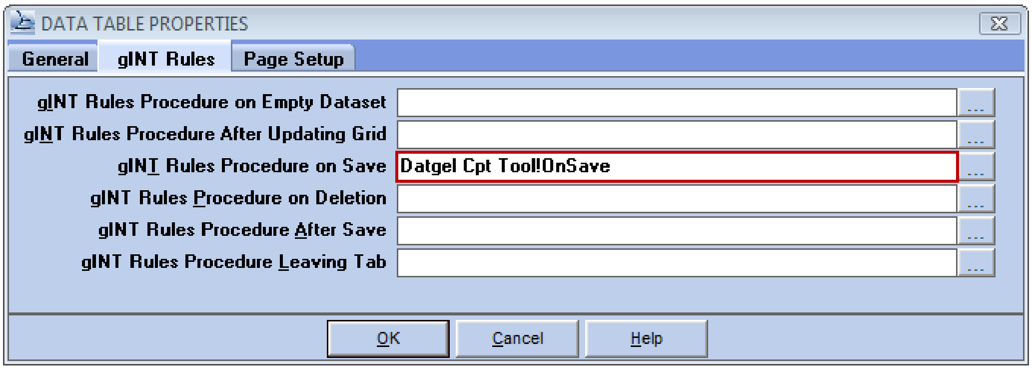


The other tables are not critical to the operation of the CPT Tool and you may already have similar tables in your project file. However many of the gINT reports provided with the CPT Tool reference the other tables, and you may need to update the field references in the reports to work with your custom project database. In particular you need to consider fields on the POINT and PROJECT tables.

The **DATA DESIGN | Project Database | Tools > Compare Databases** function will list the table, field, and property differences between databases. Use this to compare your company's project file to the CPT Tool project file.

The **DATA DESIGN | Project Database | Tools > Replace Field Names** function will assist you to update the CPT library objects to use the fields and tables in your custom project file.

4. In **DATA DESIGN | Project Database** change the yellow object selector list to the POINT table, call the command **Tables > Properties...** move to the gINT Rules tab, and place **Datgel Cpt Tool!OnSave** in the *gINT Rules Procedure on Save* text box.



5. Move to INPUT, and run the **Add-Ins > Datgel Administrator Tools > Lookup List Check Tool** to search for broken lookup list references, and rectify as needed.

1.5 Initial Configuration

Following the library and project merge steps, the following items should be configured:

1. Configure the Graphic_1 and Graphic_2 fields on DG_CPT_SOIL_CLASS_ZONES library table; see *4.10* DG_CPT_SOIL_CLASS_ZONES on page *19*. Select the most appropriate graphics in your library for each soil type zone.

2. Configure the table and field names for Lithology/Stratigraphy and Consistency/Density as described in 14.3 Configuration of description and consistency summary transfer on page *84* .

3. In SYMBOL DESIGN | Bitmap Symbols, import your company logo into the existing symbol called **LOGO**. This symbol is referenced by all the Tools reports.

   Alternatively you can adjust the **DRAWINGS | Drawing Library** *DG COM* LOGO to reference a different Bitmap Symbols.

   Review how your logo appears on the **DRAWINGS | Drawing Library** block *DG COM FIGURE TITLE BLOCK.* If required change the block x and y offset.

4. Update the import correspondence files (*.gci) for the numerous CPT formats to work with your custom gINT project file.

5. Assign correct page sizes and printer to reports. In order to export a report to pdf or other image format the correct page size must be assigned.

   a) Ensure a printer driver installed on your pc has A3 and 11x17 size.
   a) Use the command **REPORT DESIGN | File > Set printer for reports**, pick the printer with A3 from the printer list, and select the A3 size reports from the reports list.
   b) Then go to each A3 and 11x17 size report in **REPORT DESIGN** by changing the yellow drop down list. Display the report properties, **File > Page > Properties**, and set the page size to A3 or 11x17. You may also need to adjust the margins. Click Ok.
   c) Review the page margins and outlines by clicking on Zoom Page, and move to the next report.

1.6 Validate or Activate License

After installation (and before using the CPT Tool Add-in), validate or activate the user license as described in Chapter 2 of the *Datgel Product Licensing System User Guide*.

2 Quick Start Tutorial

2.1 Introduction

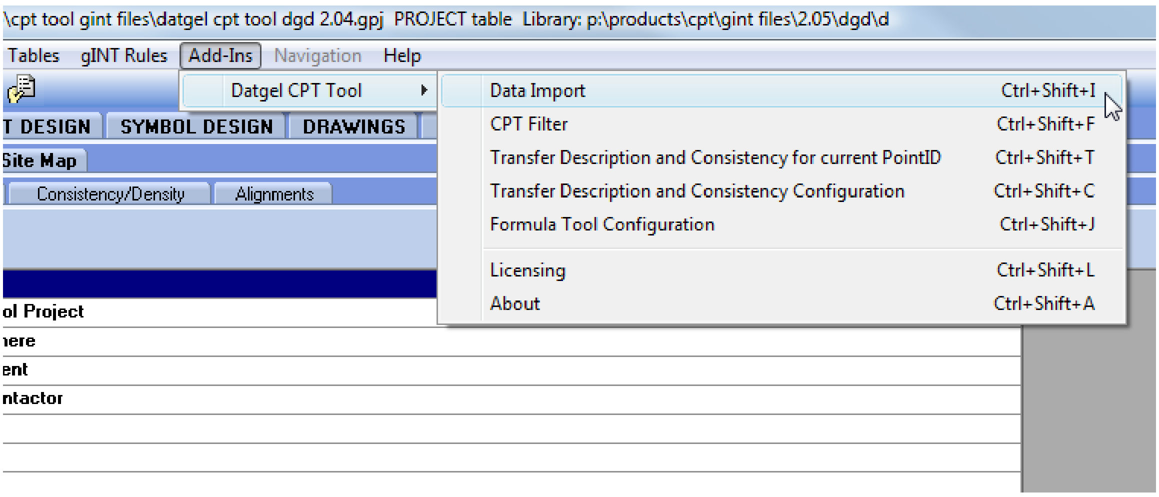
This tutorial will introduce you to the basic operations of the CPT Tool; it assumes you have a basic understanding of gINT **INPUT** and **OUTPUT**. If this is the first time you've used gINT then we suggest you read the `welcome_to_gint_8.pdf` located in this directory `C:\Program Files\gINT8\docs` and also available from this web page http://www.gintsoftware.com/support_doc.html.

2.2 Preliminaries

1. First work your way though section *1* Installation and Licensing.
2. Start gINT 8, and check you're running 8.2.008 or 8.1.2.008 or later by reviewing the version number on the **Help > About gINT** dialog. If you're running an older update, then you should download and install the latest gINT update using **Help > Check for gINT Update** or manually downloading the update from http://www.gintsoftware.com/support_updates_v8.html.
3. This tutorial will use our standard DGD CPT Tool gINT Files, located on the DVD in folder `gINT Files\DGD\`. If you haven't done so, copy the folders on the DVD to a location on your local or network drives. You can also use a set of custom gINT files that already have the CPT Tool tables and objects merged in, as described in section *1* Installation and Licensing.
4. Now, open the `datgel cpt tool dgd lib X.XX.glb`, using **File > Change Library**.
5. Create a new project, select the command **File > New Project > Clone Data Template...**, and select the `datgel cpt tool dgd X.XX.gdt` file, and click *Open*. Then provide the name `Tutorial 1.gpj` and click *Save*.

2.3 Importing CPT and Dissipation Data

1. Launch the Data Import Tool, by calling the command **Add-Ins > Datgel CPT Tool > Data Import**.

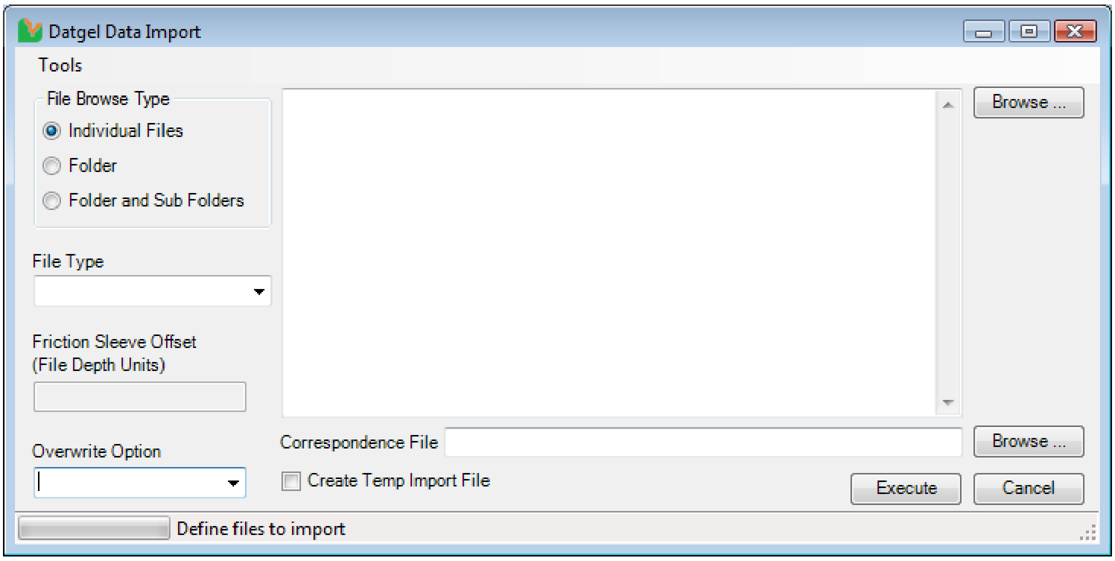


The CPT Tool splash screen should now appear, signifying you are now using the CPT Tool license.

- If you're using a trial license then a form will appear telling you how many uses are left.
- If nothing happens, then double check you have installed the CPT Tool program by running the `setup.exe` file located in the `Installation Files` folder on the DVD.
- If you haven't previously validated your license, i.e. by entering the serial number, license number, contact details, and server name in the case of a network license. Then you will

be prompted to do so now, and you should refer to Chapter 2 of the *Datgel Product Licensing System User Guide*, which was included on the DVD in the `Documentation` folder.

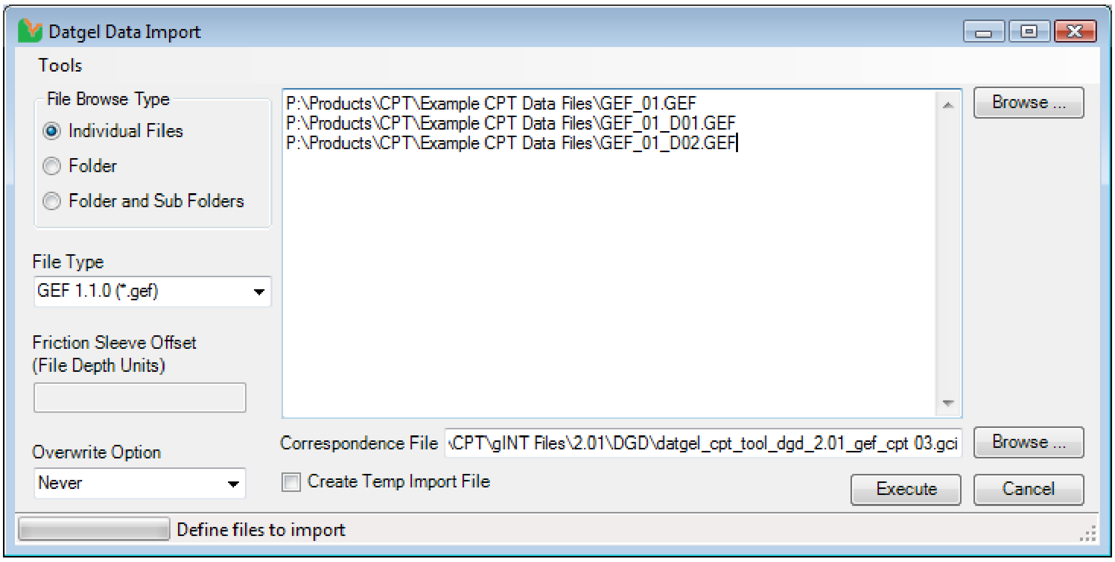
You should now see the Data Import Tool form.



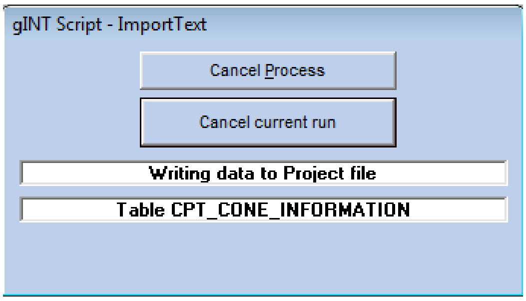
2. In this tutorial we will import a GEF files.

a) Set *File Type* to **GEF 1.1.0 (*.gef)**
b) Set *Overwrite Option* to **Never**
c) Correspondence File to …`\datgel_cpt_tool_dgd_X.XX_gef_cpt XX.gci`. The gci can be found in the `gINT Files\DGD\` folder on the DVD. The gci file translates the data during the import process between a temporary CSV file created by the CPT Tool code and the DGD database tables and fields.

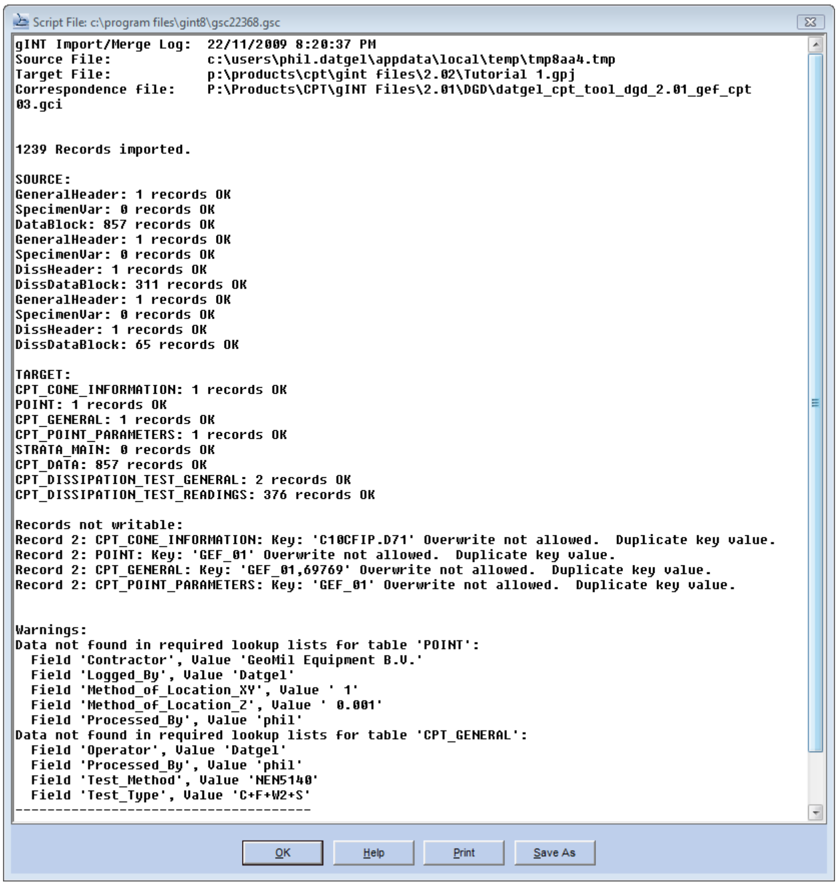
Select the **Browse…** button in the top right of the form, and browse to the `\Example CPT Data Files\` folder from the DVD. Select: `"GEF_01.GEF" "GEF_01_D01.GEF" "GEF_01_D02.GEF"`. The *D* files are dissipation test files related to the `GEF_01.GEF` file. The form should now look similar to the screenshot (apart from the folder paths).



d) Click Execute. There will be a short pause while the Datgel code translates the data, then you will see a gINT progress form.



Finally when the import is complete a gINT Import Log form will display.



It can be useful to review the Source and Target record counts to confirm the data has imported. The Log also lists over write and lookup warnings. In this case the warnings are of little consequence.

You may now like to step through the tables in the project file, and observe the imported data. Note that some values, such as those on the CPT_GLOBAL_PARAMETERS table are default values stored in the data template file we used to make the new project.

2.4 Configuring Parameters and CPT Data Analysis

The following information must be entered for the basic CPT Calculations to occur:

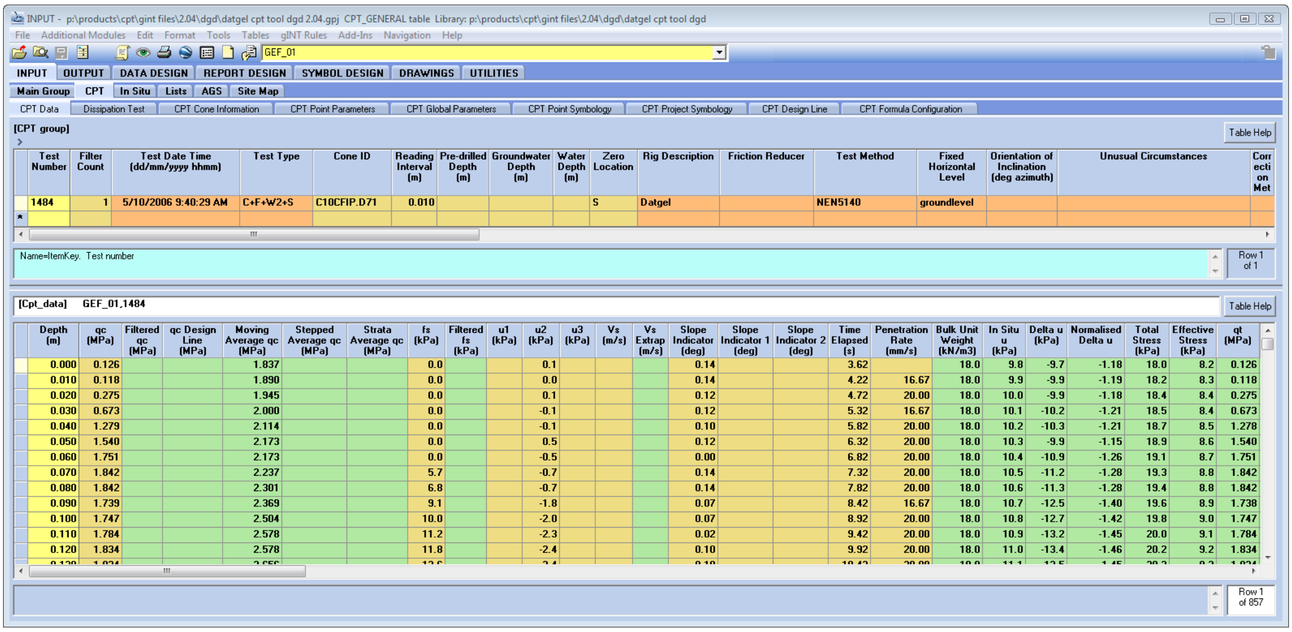
- CPT Data - Upper: Test Number, Cone ID, and (optionally) Groundwater Depth
- CPT Data - Lower: Depth, qc, fs, u2 (for CPTU)
- CPT Cone Information: Cone ID, Cone Area Ratio (for CPTU), and Cone Sleeve Offset (used to filter rod change noise for fs)

- CPT Point Parameters: (optionally) Groundwater Depth
- CPT Global Parameters: Most fields should be set, and these will be used as default values. In particular to enable basic calculations you should define:
    - Bulk Unit Weight
    - Bulk Unit Weight Saturated
    - Soil Class Method 1
    - Soil Class Method 2

Refer to section 7 Groundwater and Overwater Testing on page *27* for a detailed explanation of where to set groundwater data.

When you change the value of related fields the CPT Tool table calculation will automatically initiate. You can suppress the automatic calculation by checking Suppress Automatic Calculation on CPT Global Parameters.

The resulting CPT Data screen should look like this:



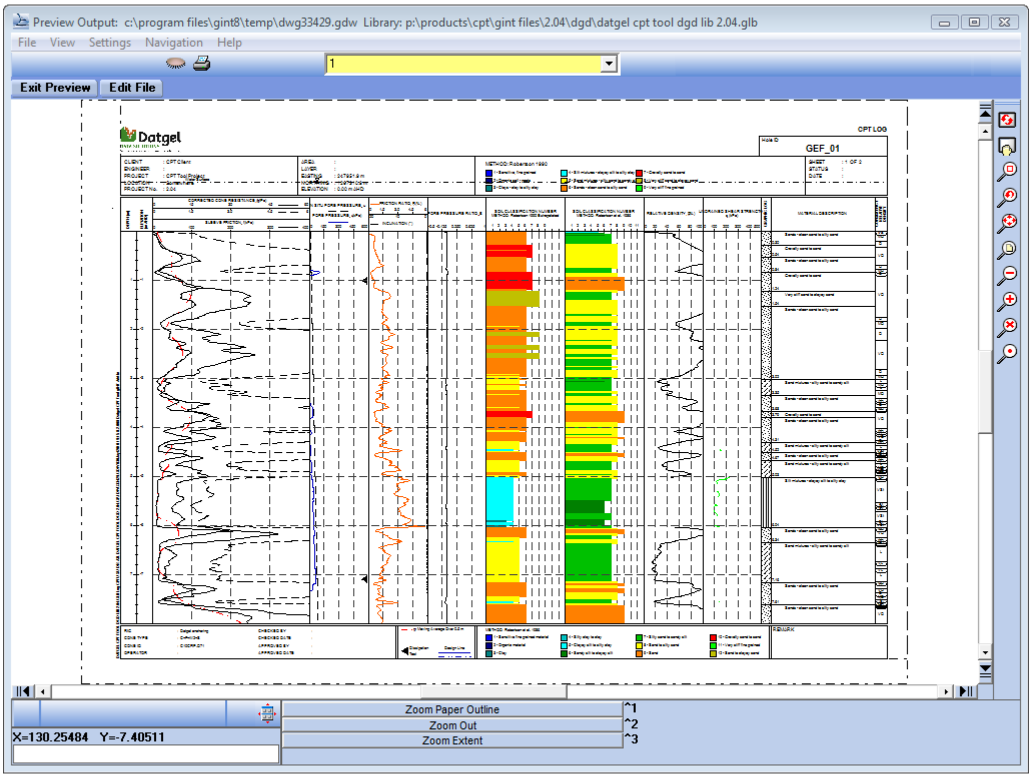
2.5 Transfer Summary of Material Description

We will now transfer a summary of the soil layers to the Strata Main table. Call the command **Add-Ins > Datgel CPT Tool > Transfer Description and Consistency for current PointID**, then move to **Main Group | Strata Main** to see the transferred descriptions.

2.6 Output a Log

To produce a log output click on the **OUTPUT** tab.

From the **Logs** tab, select the Report **CPTU SU DR A3L**, and the PointID **GEF_01**. Then click preview, and you should see this:



2.7 More Information

Refer to section Dissipation Test Analysis for a tutorial on that subject.

Refer to section Tutorial: Creating a new Correlation in the Formula Tool for a tutorial on that subject.

3 Project Tables

The test and interpreted data is stored in the project database.

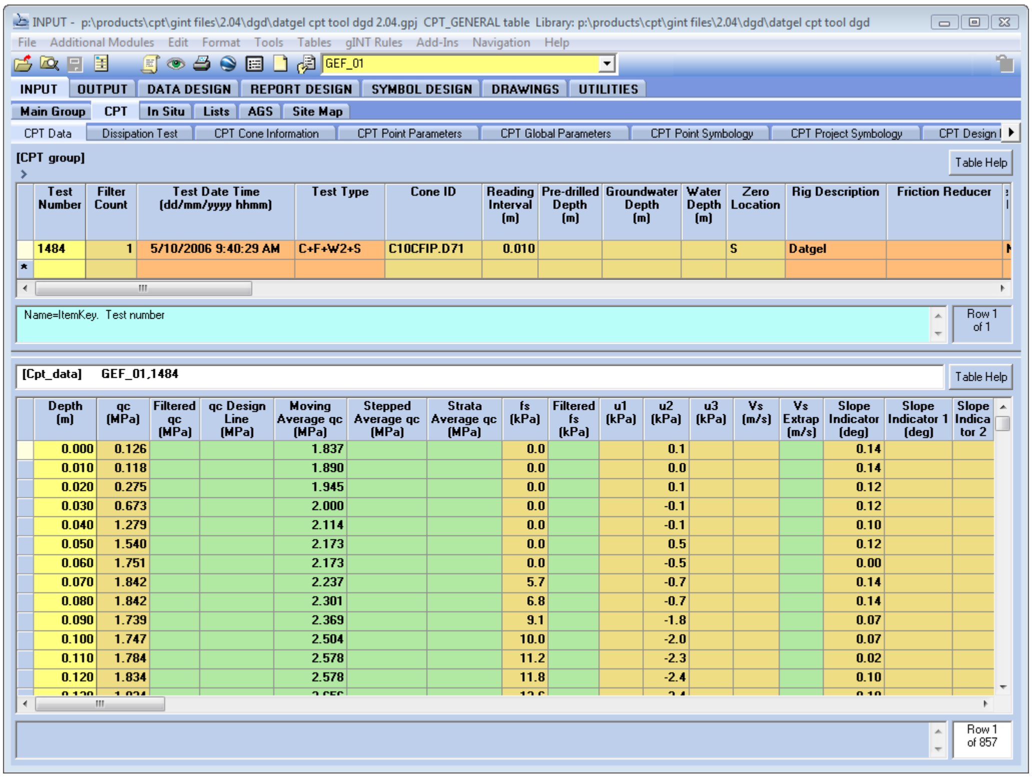
A number of constants and assumptions are required in derivations. Many may be set globally (on CPT Global Parameters), for each PointID (on CPT Point Parameters), by depth for a PointID (on CPT Point Material Properties) and some for each push (on CPT Data – Upper). This gives the user full control on which level in the hierarchy to use.

3.1 POINT

When an Elevation is changed the Tool will calculate. The PointID and HoleDepth fields must be defined.

3.2 CPT Data – Upper (CPT_GENERAL or STCG)

This table defines each CPT push within a PointID, since under some circumstances multiple CPT pushes take place in the same hole. Each push has a unique Test Number.

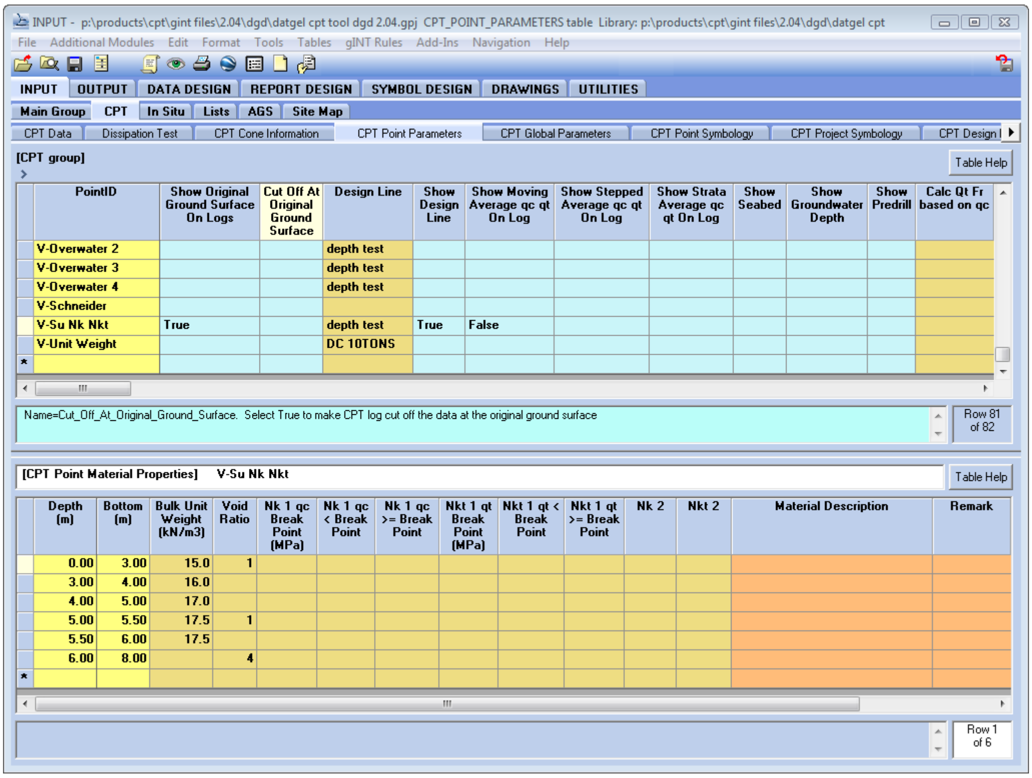


3.3 CPT Data – Lower (CPT_DATA or STCT)

This table stores the actual raw depth related data for each push and derived results related to each reading.

3.4 CPT Point Parameters - Upper (CPT_POINT_PARAMETERS)

This table stores the Point level constants and assumption values. Hence if you wish to set the groundwater depth for all pushes for a PointID then that value should be entered into the Groundwater_Depth field on the CPT_POINT_PARAMETERS Table.



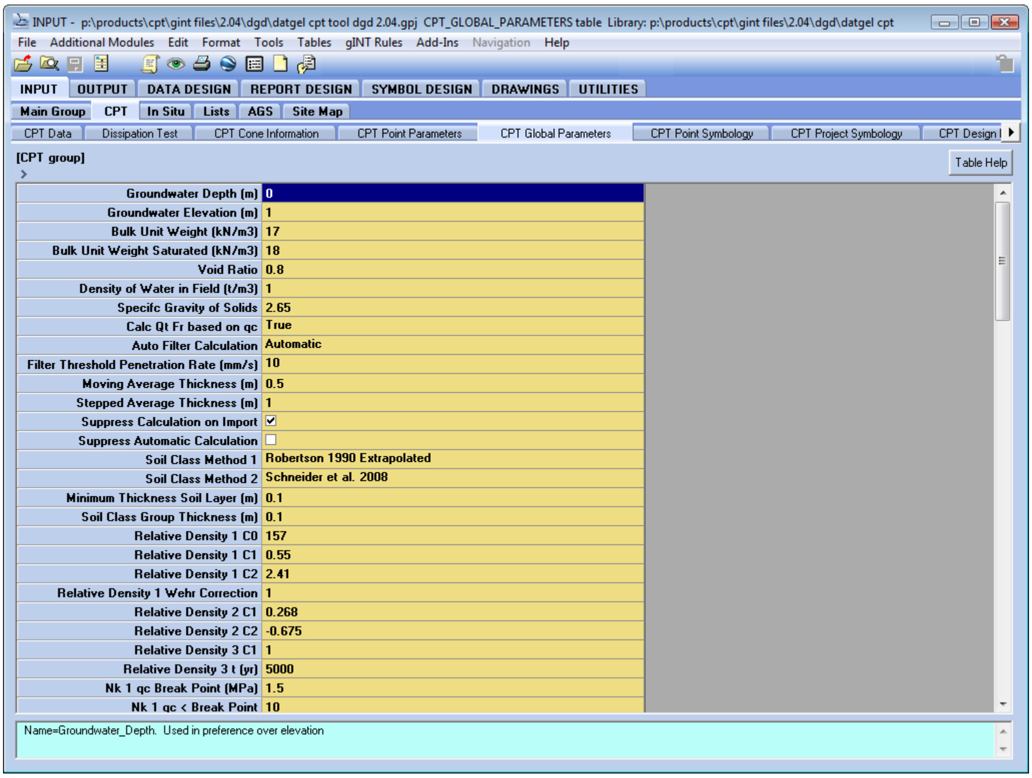
3.5 CPT Point Parameters - Lower (CPT_POINT_MATERIAL_PROPERTIES)

A bulk unit weight depth profile may be defined for each PointID on the CPT_POINT_MATERIAL_PROPERTIES (STCM) table. The depth ranges must cover the full depth of the test data.

Additionally, the depth ranges for a particular PointID must not overlap in any way. You will not be able to save the table if overlapping depth ranges are entered.

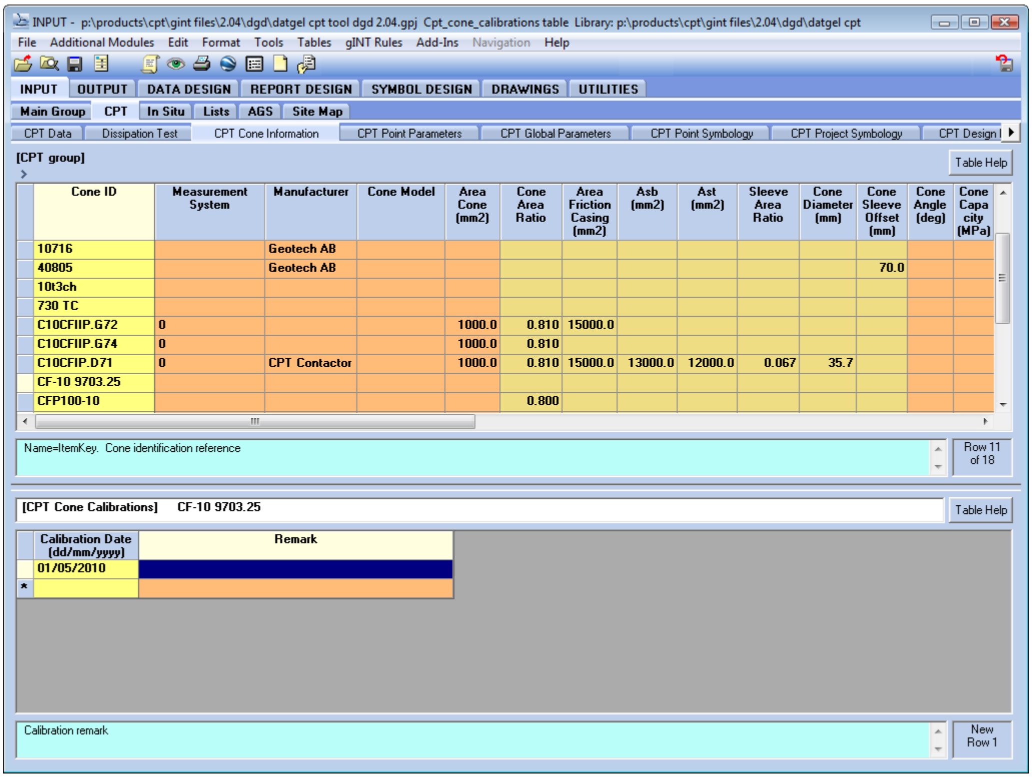
3.6 CPT Global Parameters (CPT_GLOBAL_PARAMETERS)

Global / project hierarchy constants and parameters are stored on this table.



3.7 CPT Cone Information - Upper (CPT_CONE_INFORMATION or STCI)

The cone and equipment constants are stored on this table. For example, two important constants are the Cone Area Ratio and Cone Sleeve Offset.

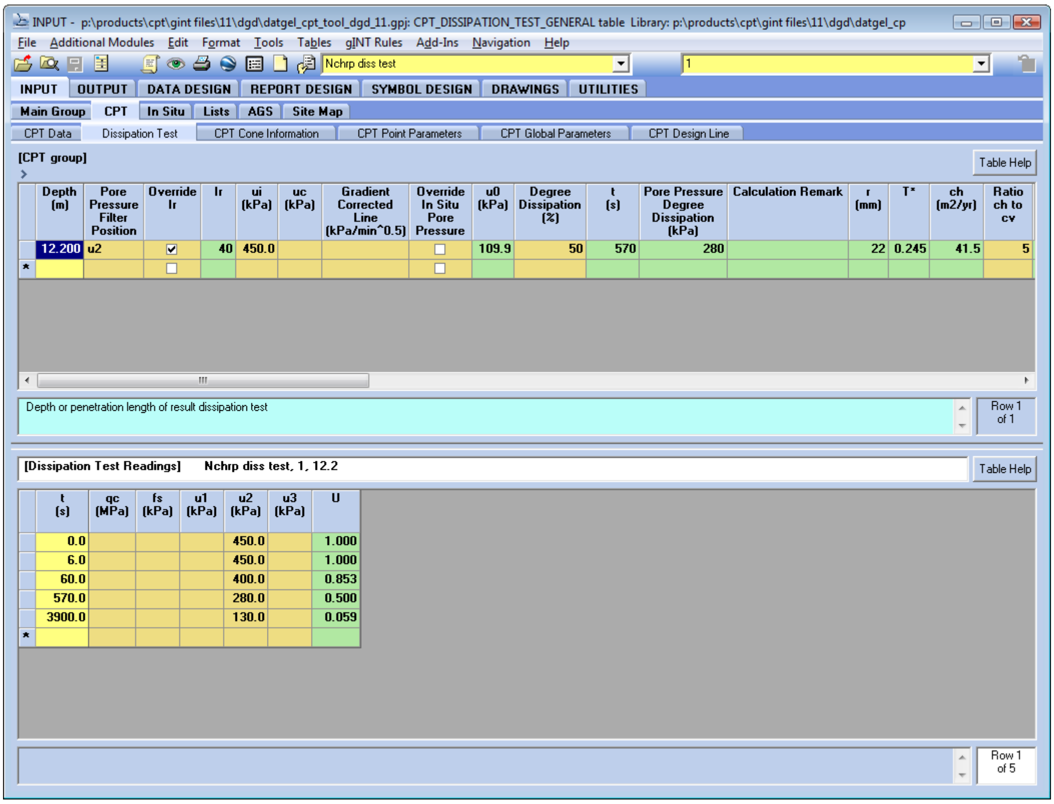


3.8 CPT Cone Information - Lower (CPT_Cone_Calibration or STCC)

This table can be used to record the calibration dates for each cone.

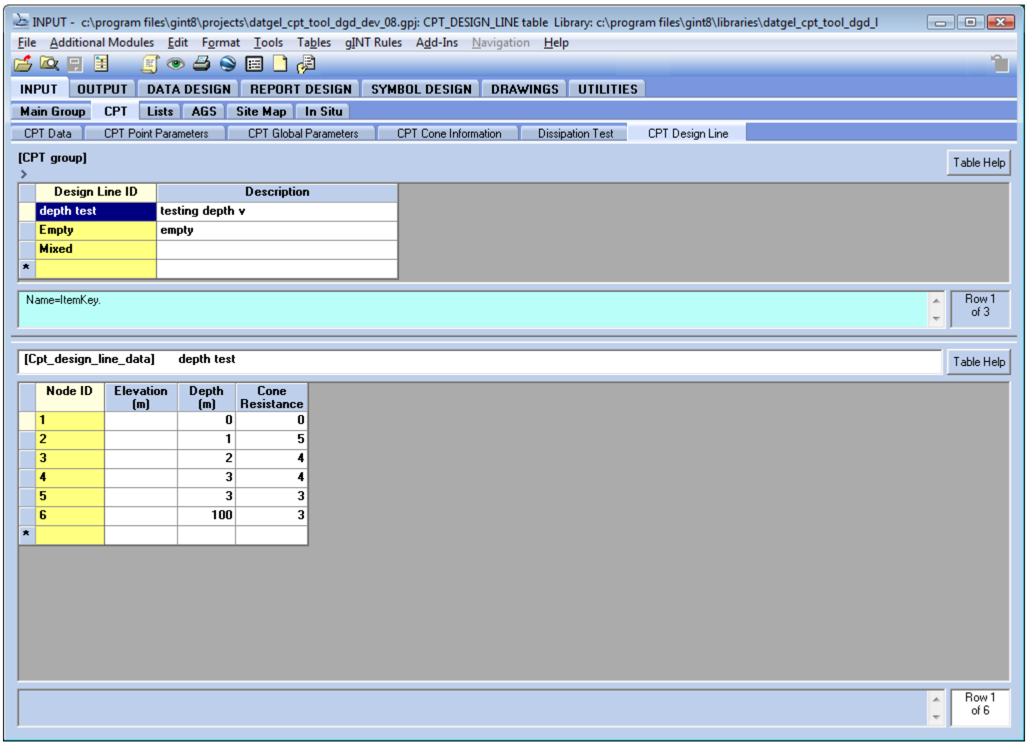
3.9 Dissipation Test (CPT_DISSIPATION_TEST_GENERAL and CPT_DISSIPATION_TEST_READINGS, STDG and STDS)

These tables store the Dissipation Test raw and derived data.



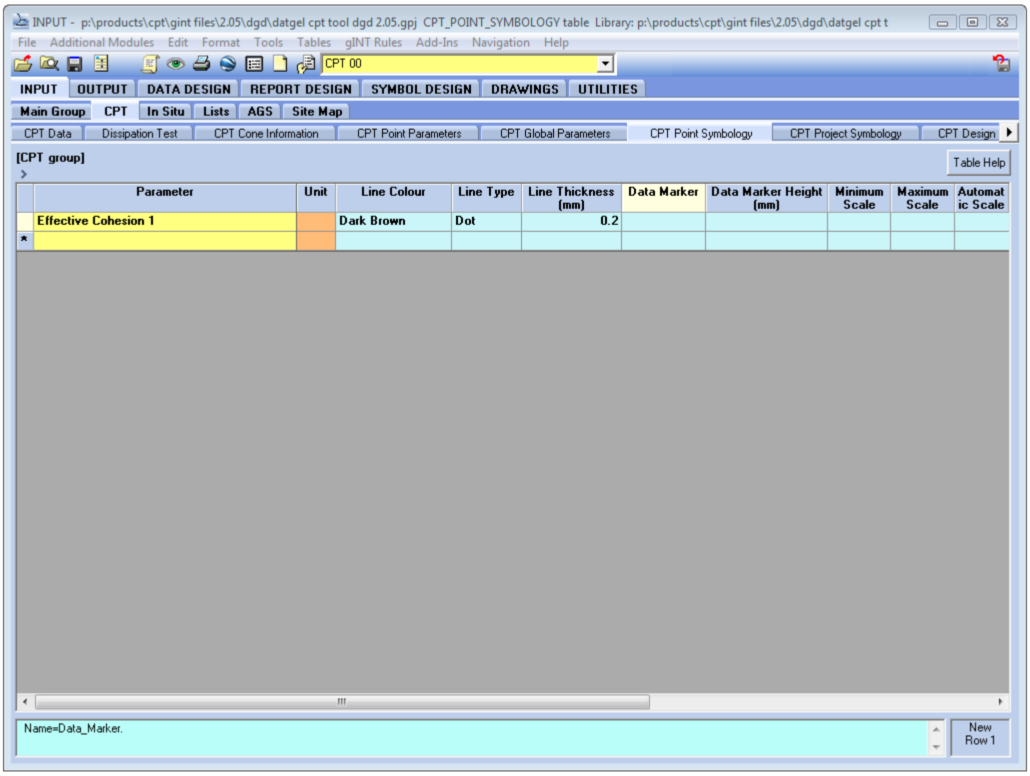
3.10 CPT Design Line (CPT_DESIGN_LINE and CPT_DESIGN_LINE_DATA)

These tables define the design line (required cone resistance) that can be assigned to each PointID and written to the CPT_Data table.



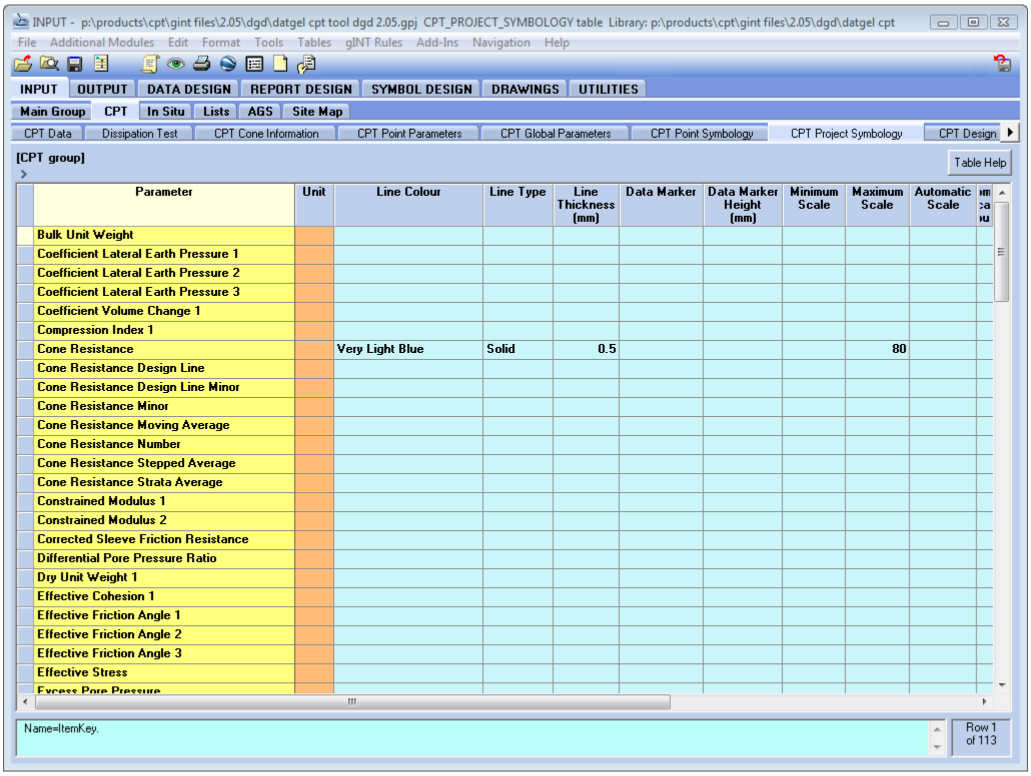
3.11 CPT Point Symbology (CPT_POINT_SYMBOLOGY)

These tables store Point level overrides for the settings on CPT_PROJECT_SYMBOLOGY and DG_CPT_SYMBOLOGY.



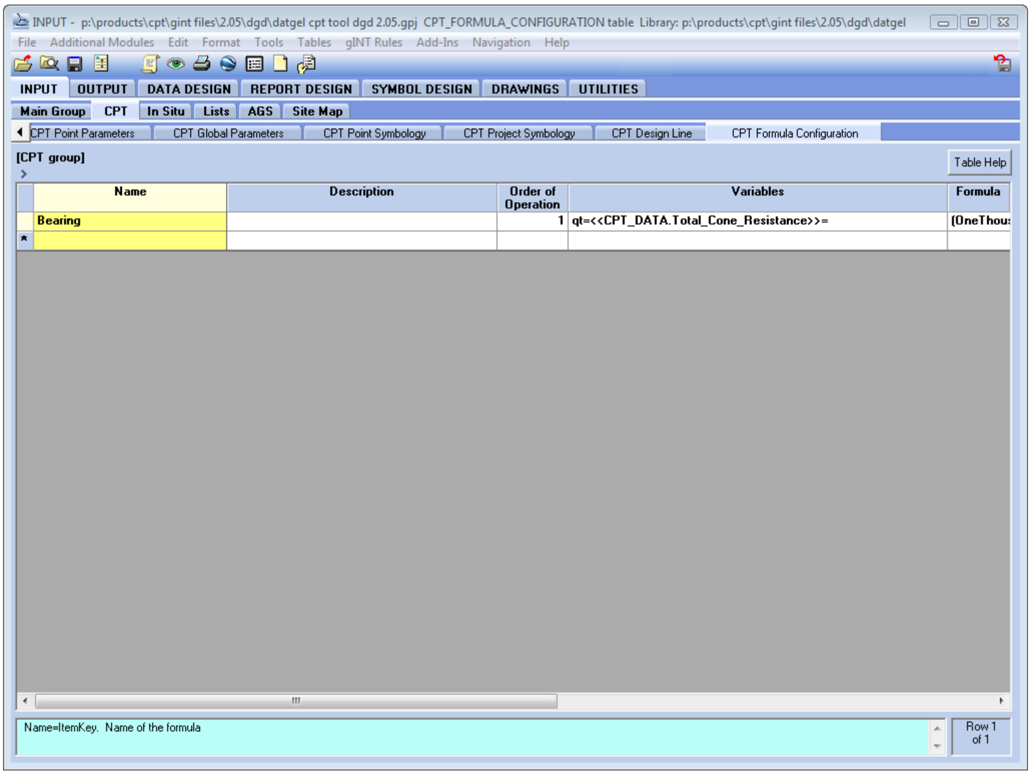
3.12 CPT Project Symbology (CPT_PROJECT_SYMBOLOGY)

These table stores Project level overrides for the settings on DG_CPT_SYMBOLOGY.



3.13 CPT Formula Configuration (CPT_FORMULA_CONFIGURATION)

These table stores Project level formulas.



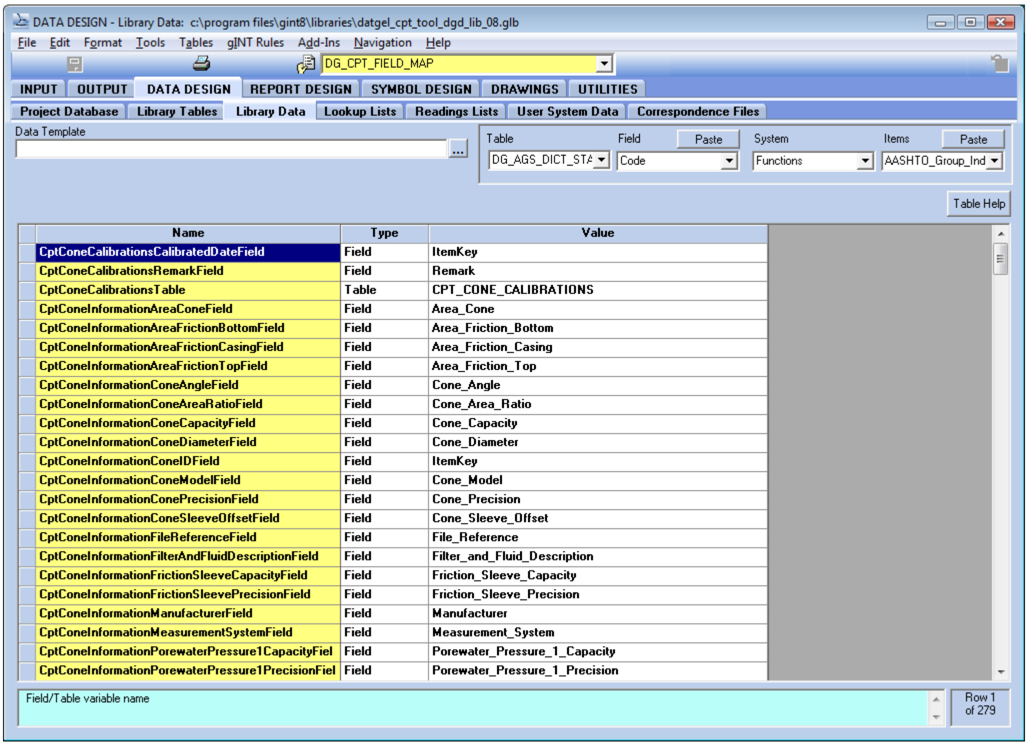
4 Library Tables

4.1 DG_CPT_AUTO_FILTER

This table is a simple lookup for the filter options.

4.2 DG_CPT_FIELD_MAP

Stores the table and field name configuration used by the CPT Tool calculation. This allows the user to set non-standard field and table names. If a parameter is missing the *AGS RTA* name is used as default.



Name	Type	Value
CptConeCalibrationsCalibratedDateField	Field	ItemKey
CptConeCalibrationsRemarkField	Field	Remark
CptConeCalibrationsTable	Table	CPT_CONE_CALIBRATIONS
CptConeInformationAreaConeField	Field	Area_Cone
CptConeInformationAreaFrictionBottomField	Field	Area_Friction_Bottom
CptConeInformationAreaFrictionCasingField	Field	Area_Friction_Casing
CptConeInformationAreaFrictionTopField	Field	Area_Friction_Top
CptConeInformationConeAngleField	Field	Cone_Angle
CptConeInformationConeAreaRatioField	Field	Cone_Area_Ratio
CptConeInformationConeCapacityField	Field	Cone_Capacity
CptConeInformationConeDiameterField	Field	Cone_Diameter
CptConeInformationConeIDField	Field	ItemKey
CptConeInformationConeModelField	Field	Cone_Model
CptConeInformationConePrecisionField	Field	Cone_Precision
CptConeInformationConeSleeveOffsetField	Field	Cone_Sleeve_Offset
CptConeInformationFileReferenceField	Field	File_Reference
CptConeInformationFilterAndFluidDescriptionField	Field	Filter_and_Fluid_Description
CptConeInformationFrictionSleeveCapacityField	Field	Friction_Sleeve_Capacity
CptConeInformationFrictionSleevePrecisionField	Field	Friction_Sleeve_Precision
CptConeInformationManufacturerField	Field	Manufacturer
CptConeInformationMeasurementSystemField	Field	Measurement_System
CptConeInformationPorewaterPressure1CapacityFiel	Field	Porewater_Pressure_1_Capacity
CptConeInformationPorewaterPressure1PrecisionFiel	Field	Porewater_Pressure_1_Precision

4.3 DG_CPT_FORMULA_CONFIGURATION

These table stores Library level formulas.

4.4 DG_CPT_MEASUREMENT_SYSTEM

This table is a simple lookup for the measurement system type options, based on the GEF standard.

4.5 DG_CPT_MODIFIED_TIME_FACTOR

Used for dissipation analysis

4.6 DG_CPT_PORE_PRESSURE_FILTER_POSITION

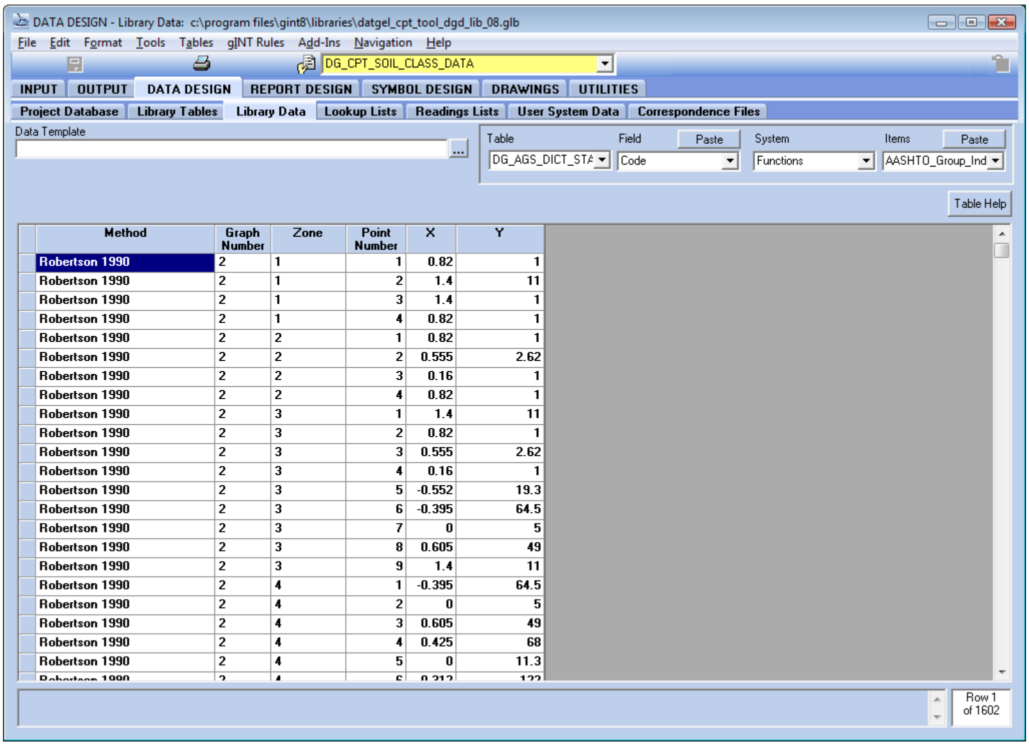
Used for dissipation analysis

4.7 DG_CPT_SCALE_TYPE

This table is a simple lookup for the soil classification graph type options.

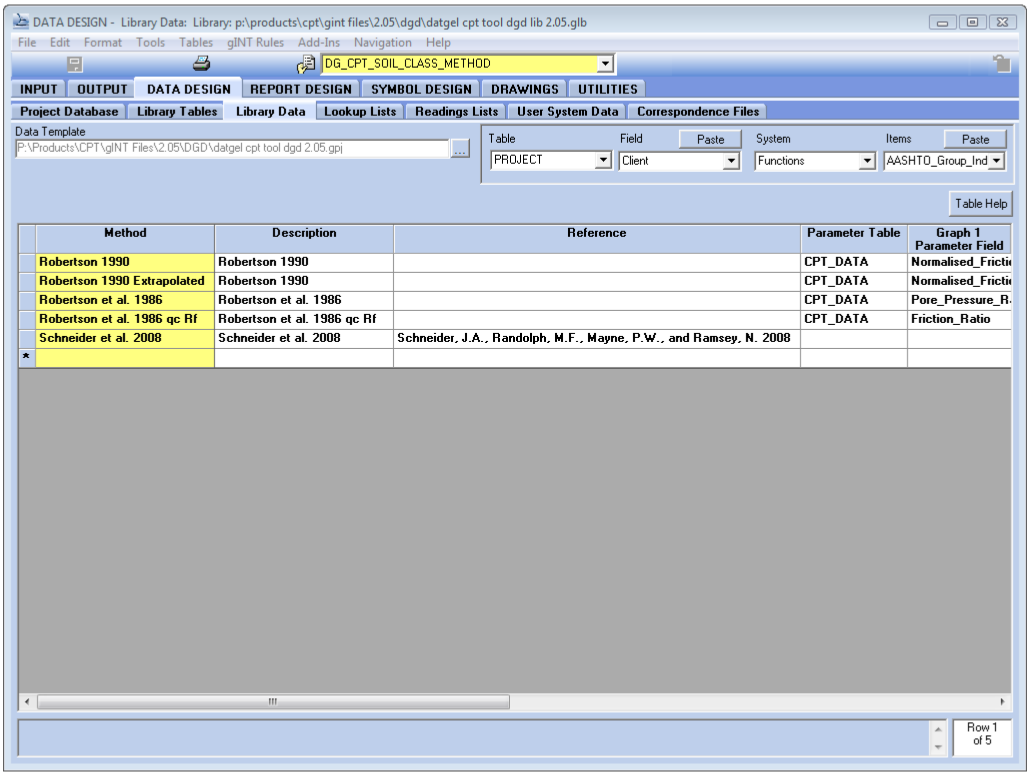
4.8 DG_CPT_SOIL_CLASS_DATA

This table stores the soil classification polygon data. Users can add their own classification methods.



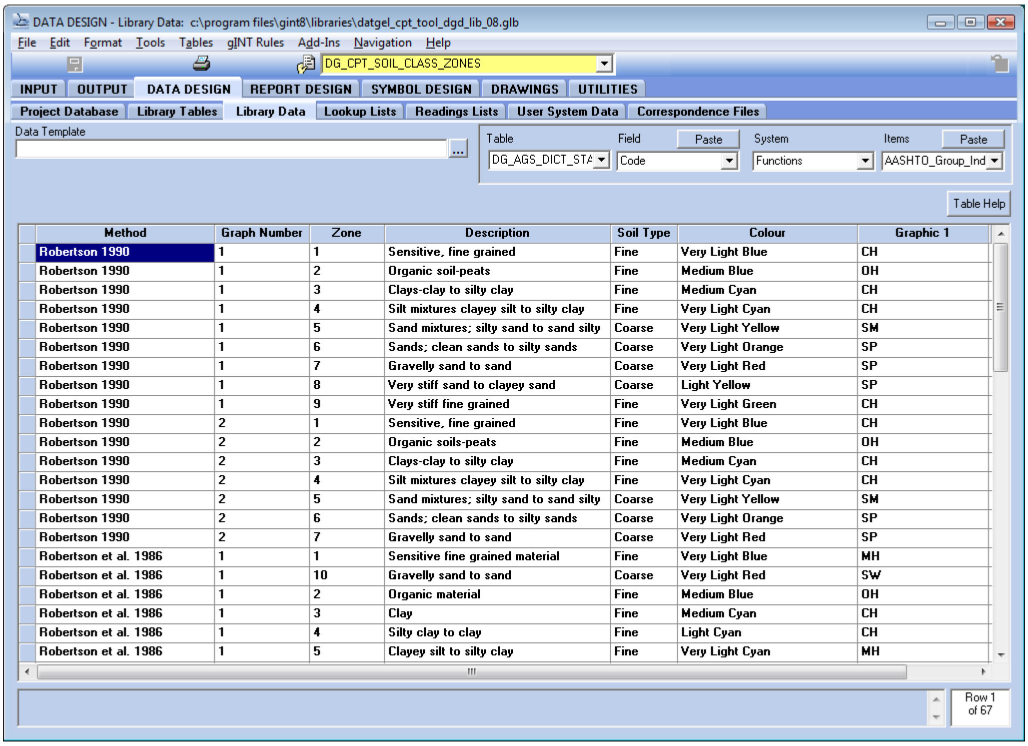
4.9 DG_CPT_SOIL_CLASS_METHOD

This table stores the names and graphing options for each soil classification method.



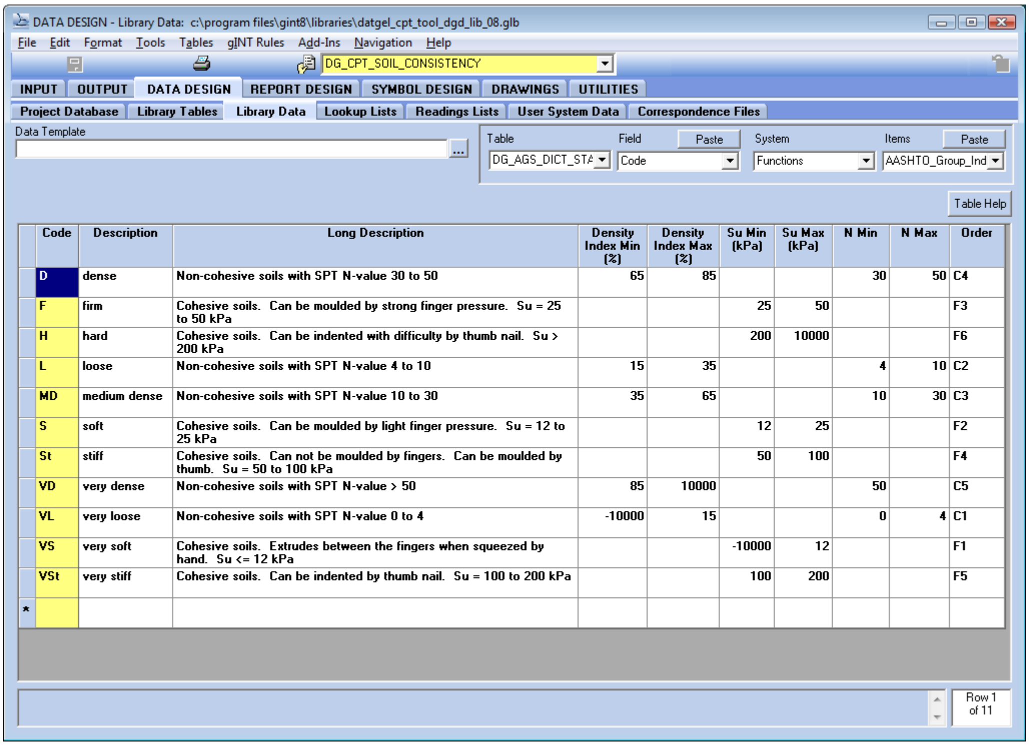
4.10 DG_CPT_SOIL_CLASS_ZONES

This table stores the descriptions and graphics for each soil classification zone.



4.11 DG_CPT_SOIL_CONSISTENCY

This table stores the soil consistency and relative density terms and ranges. These are used to calculate the fields Relative_Density_Term and Undrained_Shear_Strength_Term on CPT_DATA table.



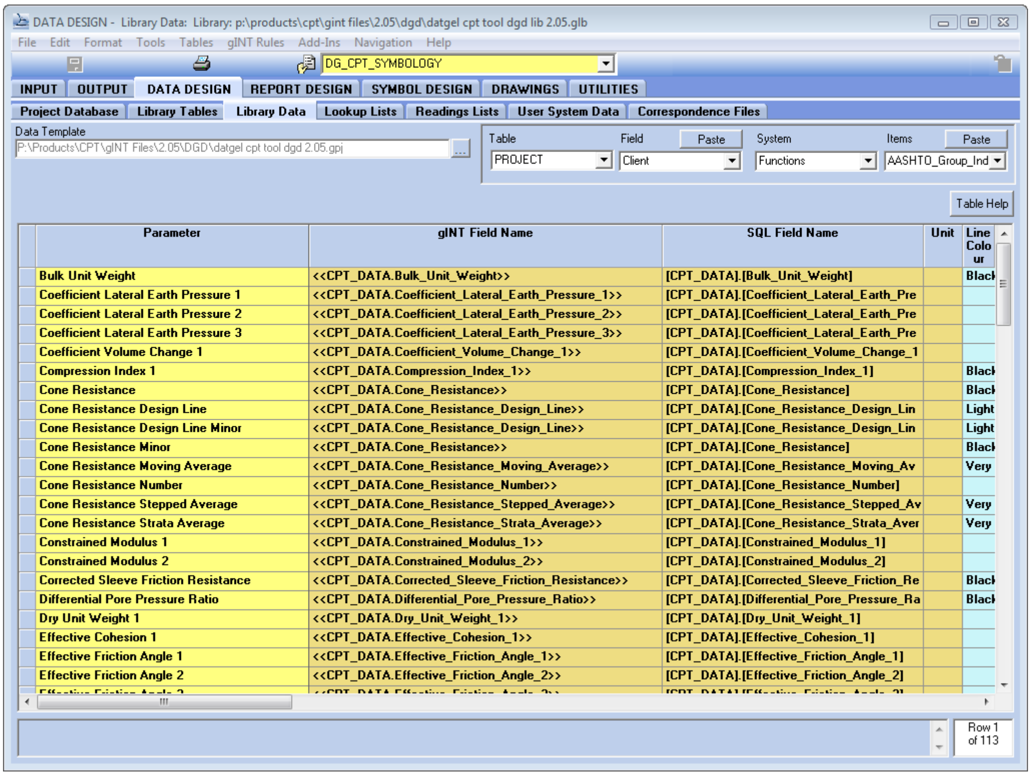
Code	Description	Long Description	Density Index Min (%)	Density Index Max (%)	Su Min (kPa)	Su Max (kPa)	N Min	N Max	Order
D	dense	Non-cohesive soils with SPT N-value 30 to 50	65	85			30	50	C4
F	firm	Cohesive soils. Can be moulded by strong finger pressure. Su = 25 to 50 kPa			25	50			F3
H	hard	Cohesive soils. Can be indented with difficulty by thumb nail. Su > 200 kPa			200	10000			F6
L	loose	Non-cohesive soils with SPT N-value 4 to 10	15	35			4	10	C2
MD	medium dense	Non-cohesive soils with SPT N-value 10 to 30	35	65			10	30	C3
S	soft	Cohesive soils. Can be moulded by light finger pressure. Su = 12 to 25 kPa			12	25			F2
St	stiff	Cohesive soils. Can not be moulded by fingers. Can be moulded by thumb. Su = 50 to 100 kPa			50	100			F4
VD	very dense	Non-cohesive soils with SPT N-value > 50	85	10000			50		C5
VL	very loose	Non-cohesive soils with SPT N-value 0 to 4	-10000	15			0	4	C1
VS	very soft	Cohesive soils. Extrudes between the fingers when squeezed by hand. Su <= 12 kPa			-10000	12			F1
VSt	very stiff	Cohesive soils. Can be indented by thumb nail. Su = 100 to 200 kPa			100	200			F5

4.12 DG_CPT_SOIL_TYPE

This table is a simple lookup for the soil type options.

4.13 DG_CPT_SYMBOLOGY

This table stores the library defaults for line colour and types etc. The field references are used by reports and should not be altered.



Parameter	gINT Field Name	SQL Field Name	Unit	Line Colour
Bulk Unit Weight	<<CPT_DATA.Bulk_Unit_Weight>>	[CPT_DATA].[Bulk_Unit_Weight]		Black
Coefficient Lateral Earth Pressure 1	<<CPT_DATA.Coefficient_Lateral_Earth_Pressure_1>>	[CPT_DATA].[Coefficient_Lateral_Earth_Pre		
Coefficient Lateral Earth Pressure 2	<<CPT_DATA.Coefficient_Lateral_Earth_Pressure_2>>	[CPT_DATA].[Coefficient_Lateral_Earth_Pre		
Coefficient Lateral Earth Pressure 3	<<CPT_DATA.Coefficient_Lateral_Earth_Pressure_3>>	[CPT_DATA].[Coefficient_Lateral_Earth_Pre		
Coefficient Volume Change 1	<<CPT_DATA.Coefficient_Volume_Change_1>>	[CPT_DATA].[Coefficient_Volume_Change_1		
Compression Index 1	<<CPT_DATA.Compression_Index_1>>	[CPT_DATA].[Compression_Index_1]		Black
Cone Resistance	<<CPT_DATA.Cone_Resistance>>	[CPT_DATA].[Cone_Resistance]		Black
Cone Resistance Design Line	<<CPT_DATA.Cone_Resistance_Design_Line>>	[CPT_DATA].[Cone_Resistance_Design_Lin		Light
Cone Resistance Design Line Minor	<<CPT_DATA.Cone_Resistance_Design_Line>>	[CPT_DATA].[Cone_Resistance_Design_Lin		Light
Cone Resistance Minor	<<CPT_DATA.Cone_Resistance>>	[CPT_DATA].[Cone_Resistance]		Black
Cone Resistance Moving Average	<<CPT_DATA.Cone_Resistance_Moving_Average>>	[CPT_DATA].[Cone_Resistance_Moving_Av		Very
Cone Resistance Number	<<CPT_DATA.Cone_Resistance_Number>>	[CPT_DATA].[Cone_Resistance_Number]		
Cone Resistance Stepped Average	<<CPT_DATA.Cone_Resistance_Stepped_Average>>	[CPT_DATA].[Cone_Resistance_Stepped_Av		Very
Cone Resistance Strata Average	<<CPT_DATA.Cone_Resistance_Strata_Average>>	[CPT_DATA].[Cone_Resistance_Strata_Aver		Very
Constrained Modulus 1	<<CPT_DATA.Constrained_Modulus_1>>	[CPT_DATA].[Constrained_Modulus_1]		
Constrained Modulus 2	<<CPT_DATA.Constrained_Modulus_2>>	[CPT_DATA].[Constrained_Modulus_2]		
Corrected Sleeve Friction Resistance	<<CPT_DATA.Corrected_Sleeve_Friction_Resistance>>	[CPT_DATA].[Corrected_Sleeve_Friction_Re		Black
Differential Pore Pressure Ratio	<<CPT_DATA.Differential_Pore_Pressure_Ratio>>	[CPT_DATA].[Differential_Pore_Pressure_Ra		Black
Dry Unit Weight 1	<<CPT_DATA.Dry_Unit_Weight_1>>	[CPT_DATA].[Dry_Unit_Weight_1]		
Effective Cohesion 1	<<CPT_DATA.Effective_Cohesion_1>>	[CPT_DATA].[Effective_Cohesion_1]		
Effective Friction Angle 1	<<CPT_DATA.Effective_Friction_Angle_1>>	[CPT_DATA].[Effective_Friction_Angle_1]		
Effective Friction Angle 2	<<CPT_DATA.Effective_Friction_Angle_2>>	[CPT_DATA].[Effective_Friction_Angle_2]		

4.14 DG_CPT_TERMINATION

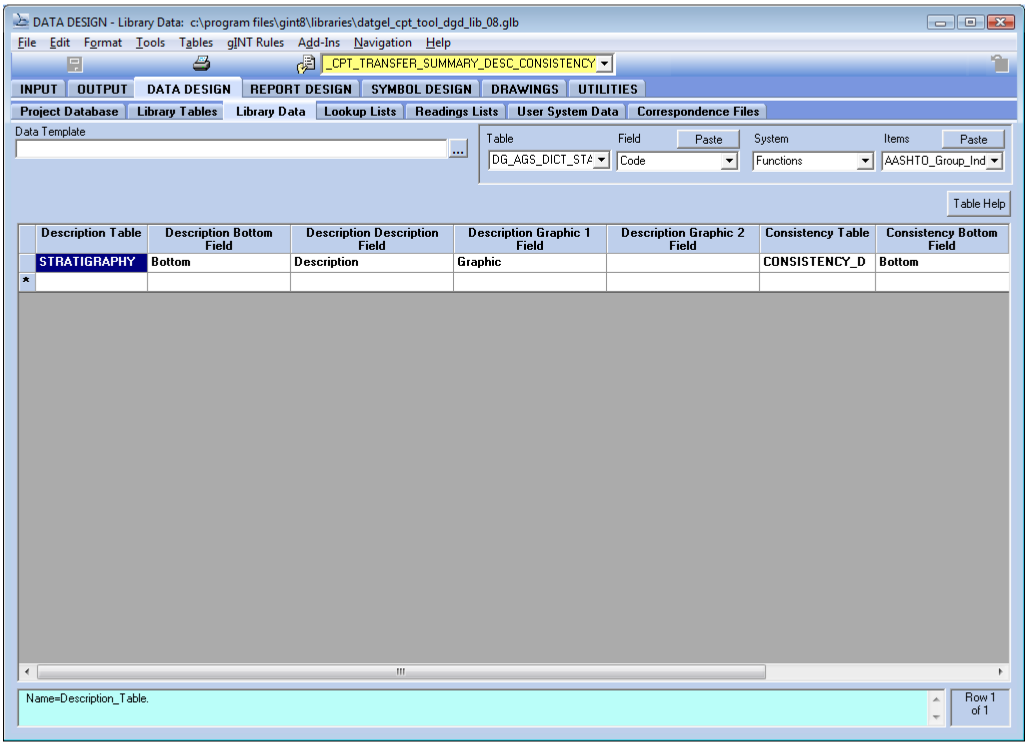
This table is a simple lookup of reasons for terminating a CPT push, based on the GEF standard.

4.15 DG_CPT_TEST_METHOD

List of test standards, e.g. AS 1289.6.5.1-1999.

4.16 DG_CPT_TRANSFER_SUMMARY_DESC_CONSISTENCY

This table stores the target table and field names soil description and consistency data summary transfer.

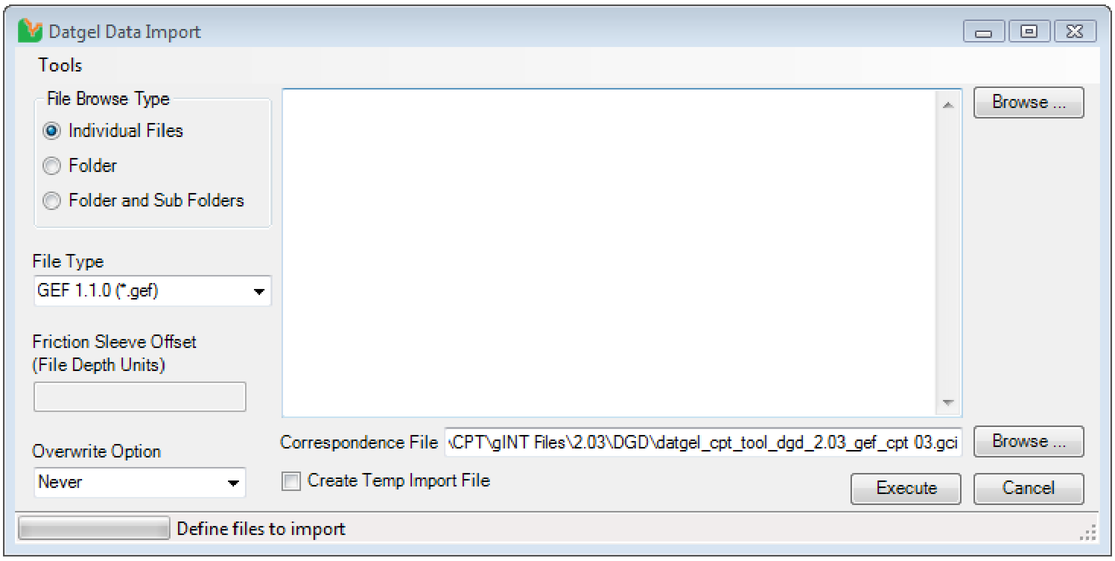


4.17 DG_CPT_ZERO_LOCATION

This table is a simple lookup for zero location.

5 Data Import

The Data Import Tool allows you to import data from various file formats into gINT. The command is located in **INPUT Add-Ins > Datgel CPT Tool > Data Import**.



On load the default setting will populate the form. In addition, the previous correspondence file used for each file type be loaded as default.

5.1 Tools Menu

- Load Defaults: Loads all selections, field values and the initial directory that has been previously saved as default.
- Save Defaults: Saves defaults for File Browse Type, Friction Sleeve Offset, and Overwrite Option.
- Set Initial Directory: Sets the initial browse directory so that every time you browse, it will start at the set directory.
- About: Displays the version information of the Data Import Tool.

5.2 File Browse Types

- Individual Files: Select one or more files in a single folder manually.
- Folder: Select a folder and all relevant files in that folder are selected automatically.
- Folder and sub-folders: Select a folder and all relevant files in that folder and its sub-folders are selected automatically.

Files paths may be manually entered or deleted from the large text box.

5.3 File Types

- A.P. van den Berg Gorilla! (*.*) – CPT and Dissipation
- Access database files (*.gpj; *.mdb)

- AGS (*.ags)
- Delimited Depth qc fs u (*.*) – simple file with no header, and data delimited by tab, ",", ";", or ":". The u data is not required, and the columns must be in the order Depth qc fs u. The file name (without the extension) will be used as the PointID.
- Douglas Partners (*.*)
- GEF 1.1.0 (*.gef) – CPT and Dissipation. The friction shift is applied for 1.0.0 version files only

  See: http://www.geonet.nl/index.html?http&&&www.geonet.nl/3.020.html
- Geomil PlotCPT (*.T*)
- gINT CSV (*.csv; *.txt) – regular gINT compliant csv file.
- gINT Excel (*.xls) – regular gINT compliant excel file.
- Hogentogler (*.cpd)
- Pagani (*.cpt)
- Pagani (*.dat)
- ProbeDrill (*.txt; *.dis), you must import *.txt and *.dis files together. The *.dis file and *.txt file for the one location MUST has the same file name
- Swedish Geotechnical Format (SGF) and Geotech AB (*.cpt; *.dpt; *.ini)

  See: http://www.sgf.net/home/page.asp?sid=862&mid=2&PageId=21095
- Vertek (*.dat)

5.4 Overwrite Option

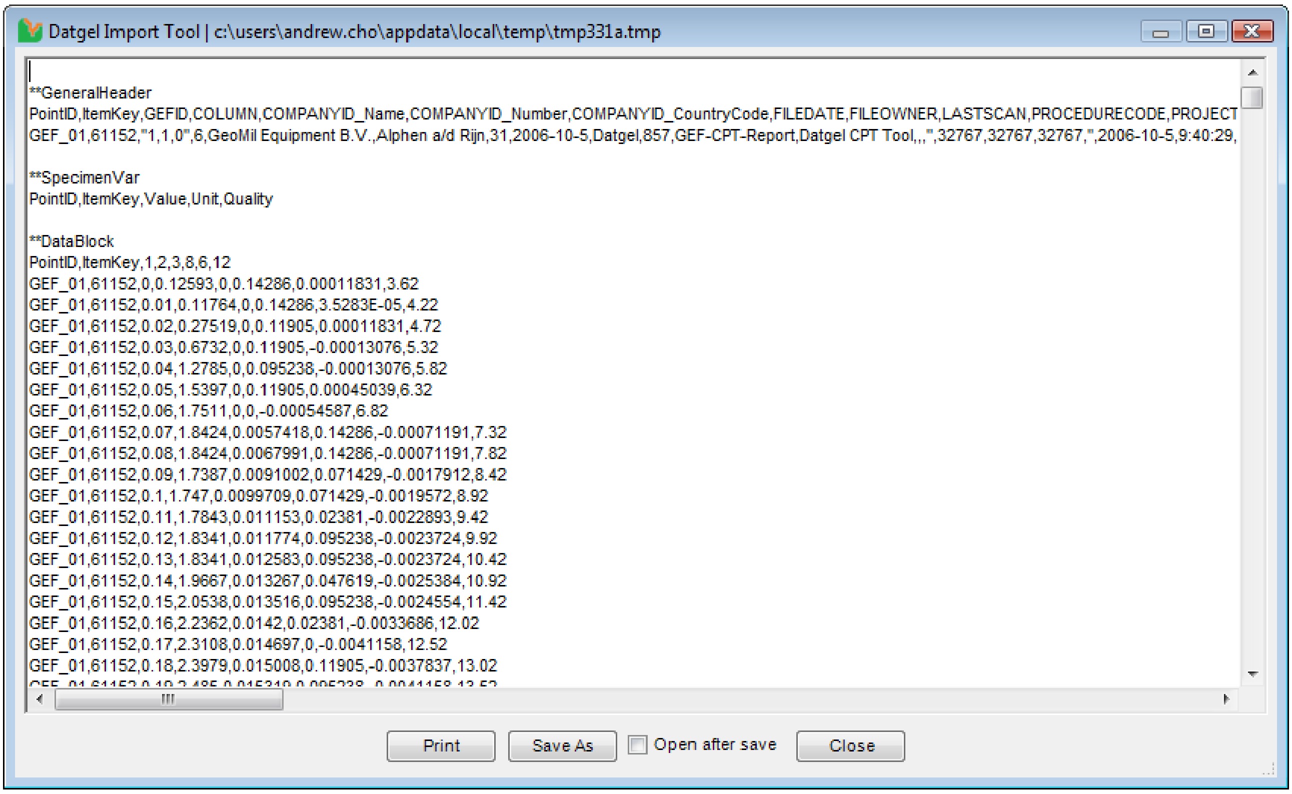
These are the standard gINT overwrite options.

5.5 Correspondence File

gINT correspondence files need to be developed or altered to meet the needs of each companies gINT project database for each data source file type. We have provided example files that meet the needs of Datgel's standard project file.

5.6 Create Temp Import File

During the import process the initial data files are read and transferred to a temporary file in gINT CSV format. If this box is checked, the Data Import Tool will bring up a new window showing the contents of this temporary file, and will not continue with the import. This file can be used as the source when designing an import correspondence file.



In this interface, click *Save As* to save the text as a file, or *Print* to print the text on a printer. You must save the text as a file before you can modify the text. This file can be imported into gINT with the Data Import Tool with gINT CSV selected as the File Type.

5.7 Importing Multiple Pushes/Tests into one PointID

The Depths in all pushes within the one PointID must have the same zero depth reference, hence if multiple pushes are done down a borehole, then when importing the Depth field must be populated with pre-drill Depth plus the push depth. This can be achieved in the correspondence file if the predrill depth in recoded in the source data file.

Gorilla files are a common offshore data file format, and we have seen files with the start depth of each test recorded in fields titled `Reference Level` and `Depth Borehole`.

```
[TEST]
<GORILLA! header>
job number=BH-CPTU-S8-BL
client=PETRONAS CARIGALI
job description=SEPAT 8 LOCATION
.
.
.
operator=ZAHID/HILMI
reference level=3.0
reference point=M.S.L
pre drilled=0.0
GORILLA!-remark 1=
.
.
.
GORILLA! serie #=
<user header>
NORM=KTN/PCSB/08/268/SI
START DEPTH=
Seabed ref level=
Seabed ref point=
Depth borehole=3.0
```

```
Vanedepth=

[SCALING FACTORS]
.
.
.
[DATA]
*D:0.02#1:0.01#2:0.000#4:4#0:28!
*D:0.04#1:0.01#2:0.000#4:4#0:29!
*D:0.06#1:0.03#2:0.000#4:3#0:30!
*D:0.08#1:0.04#2:0.001#4:4#0:31!
*D:0.10#1:0.05#2:0.001#4:4#0:32!
```

Gorilla File Example with relevant depth information highlighted

Two correspondence files read the start depth from the different fields and calculate the true depth of each reading below the borehole reference level (typically seabed).

- `datgel_cpt_tool_dgd_2.01_gorilla_cpt_Depth_Borehole_##.gci`
- `datgel_cpt_tool_dgd_2.01_gorilla_cpt_Reference_Level_##.gci`

After importing a set of test files for one PointID, you will need to manually set the POINT.HoleDepth field with the correct maximum depth of the test.

5.8 Importing only the File Name from the Full File Path

If the full file path of the source file is being imported, but you only want to import the file name, you can modify the gINT correspondence file (.gci) to extract the file name from the full file path to import into gINT.

Open the gINT correspondence file in a text editor, and then search for the field name where the file path is being directed to (for example, File_Reference). Replace the existing expression with the following:

```
<<GetListItem<<Original Expression>>,"\",<<ListCount(<<Original Expression>>)>>,"\")>>)>>
```

Where `<<Original Expression>>` is the original expression that retrieves the full file path for that particular field.

6 CPT Filter

The tool can filter out rod change noise for q_c and f_s. The filter algorithm works based on Penetration_Rate (mm/s), and if it is not in the data file, then it is calculated based on elapsed time. You can set the Filter_Threshold_Penetration_Rate on the CPT_GLOBAL_PARAMETERS and CPT_POINT_PARAMETERS, or use the default of 6 mm/s. If you manually run the filter then the threshold rate increases 1 mm/s each run per CPT push, i.e. the applied threshold rate = Filter_Threshold_Penetration_Rate + Filter_Count

Data is only filtered if it is less than 95% of the mean of the previous two values, and the third and fourth values ahead.

In order for the f_s filtering to take place, the Cone_Sleeve_Offset on the CPT_CONE_INFORMATION table must be defined.

If the Auto_Filter_Calculation on the CPT_GLOBAL_PARAMETERS or CPT_POINT_PARAMETERS tables is set to *Automatic* (whichever is lower in the hierarchy with data), then the Filter will run once on import and set the Filter_Count field on the CPT_GENERAL table to "1". If Filter_Count field on the CPT_GENERAL table is set to less than "1" or null, the filter will run On Save.

The filter may be run manually more times using the command **INPUT | Add-Ins > Datgel CPT Tool > CPT Filter**. However the cursor must be in the bottom half of the CPT_DATA table.

7 Groundwater and Overwater Testing

7.1 Groundwater Depth for Standard Onshore Testing

The ground water depth is critical to many derived results, and can be defined in a number of ways. In order of priority:

1. CPT_GENERAL table, Groundwater_Depth field
2. CPT_POINT_PARAMETERS table, Groundwater Depth field
3. CPT_GLOBAL_PARAMETERS table, Groundwater_Depth field
4. CPT_GLOBAL_PARAMETERS table, Groundwater_Elevation field

If CPT_GENERAL.Water_Depth field has data then only CPT_GENERAL.Groundwater_Depth will be used. However, this should only be the case for over water testing.

In the CPT_GLOBAL_PARAMETERS table, the Water_Density_Field field is also required, and should be set appropriately for fresh or salt water.

On the CPT_GENERAL table Define

- CPT_GENERAL.Water_Depth: **Nothing**
- CPT_GENERAL.Zero_Location: **S – Surface or Nothing**
- CPT_GENERAL.Pre_drilled_Depth: **Nothing or value as required, doesn't influence calculation**
- CPT_GENERAL.Groundwater_Depth: **Distance from ground level (0 depth) to the groundwater surface, or use Groundwater_Depth fields on other tables listed above**

In situ pore pressure is calculated relative to the atmospheric pressure using the following formula:

$$If\ z < z_w\ then\ u_o = 0$$

$$If\ \ z \geq z_w\ then\ u_o = (z - z_w) \cdot \gamma_w$$

Where:

z is the depth below the reference level

z_w is the groundwater depth below the reference level

γ_w is the unit weight of water (defined as density in CPT_GLOBAL_PARAMETERS.Water_Density_Field)

7.2 Overwater Testing

The critical fields related to pore pressure calculation for over water testing are

- CPT_GENERAL.Water_Depth
- CPT_GENERAL.Zero_Location
- CPT_GENERAL.Pre_drilled_Depth
- CPT_GENERAL.Groundwater_Depth

If CPT_GENERAL.Water_Depth field has data then only CPT_GENERAL.Groundwater_Depth will be used.

In the CPT_GLOBAL_PARAMETERS table, the Water_Density_Field field is also required, and should be set appropriately for fresh or salt water.

The following sections describe how to handle the various overwater scenarios. The aim of corrections is to make the derived data in all TestIDs/Pushes within the one PointID comparable.

Derived parameters for tests using scenarios *Zero at Seabed* and *Zero at Bottom of Borehole* are comparable after the zero corrections have been applied, and the results are relative to the seabed.

7.2.1 Zero on Deck / Surface

In this case the transducers, including depth, are zeroed on deck (at atmospheric pressure). Measured parameters don't require zero corrections.

Define

- CPT_GENERAL.Water_Depth: **Distance from seawater surface to seabed surface (required for Total Stress)**
- CPT_GENERAL.Zero_Location: **S - Surface**
- CPT_GENERAL.Pre_drilled_Depth: **Nothing or value as required, doesn't influence calculation**
- CPT_GENERAL.Groundwater_Depth: **Distance from deck level (0 depth) to the seawater surface**

In situ pore pressure is calculated relative to the atmospheric pressure using the following formula:

$$If\ z < z_w\ then\ u_o = 0$$

$$If\ \ z \geq z_w\ then\ u_o = (z - \ z_w)\ \cdot \gamma_w$$

Where:

z is the depth below the reference level

z_w is the groundwater depth below the reference level

γ_w is the unit weight of water (defined as density in CPT_GLOBAL_PARAMETERS.Water_Density_Field)

Total Stress and Effective Stress are calculated relative to deck/ground surface.

7.2.2 Zero at Seabed

In this scenario the transducers are zeroed at the seabed, with the hydrostatic pressure at that water depth.

Define

- CPT_GENERAL.Water_Depth: **Distance from seawater surface to seabed surface (required for Total Stress)**
- CPT_GENERAL.Zero_Location: **SB - Seabed**
- CPT_GENERAL.Pre_drilled_Depth: **Nothing or value as required, doesn't influence calculation**
- CPT_GENERAL.Groundwater_Depth: **Nothing**

The in situ pore pressure, total stress and effective stress are calculated relative to the seabed, hence:

$$u_o = z \cdot \gamma_w$$

$$\sigma_{vo} = z \cdot \gamma_{sat}$$

$$\sigma'_{vo} = \sigma_{vo} - u_o$$

Where:

z is the depth below the seabed

z_w is the water depth, distance from seawater surface to seabed surface

γ_w is the unit weight of water (defined as density in CPT_GLOBAL_PARAMETERS.Water_Density_Field)

γ_{sat} is the unit weight of saturated soil

7.2.3 Zero at Bottom of Borehole

This scenario applies when testing overwater and the transducers are zeroed the bottom of a predrilled borehole. It is common for multiple 3 m pushes/tests to be done down a borehole, possibly alternated with other in situ tests and sampling. The corrections allow the multiple pushes to be comparable, by correcting the readings relative to the seabed surface.

Define

- CPT_GENERAL.Water_Depth: **Distance from seawater surface to seabed surface (required for Total Stress)**
- CPT_GENERAL.Zero_Location: **BB – Bottom Borehole**
- CPT_GENERAL.Pre_drilled_Depth: **Distance from seabed to bottom of borehole (where CPT started)**
- CPT_GENERAL.Groundwater_Depth: **Nothing**

In this scenario the q_c and u_2 will be corrected using the following formulas before they are used by the calculation code:

$$q_c = q_c^* + d \cdot a \cdot \gamma_w$$

$$u_2 = u_2^* + \gamma_w \cdot d$$

The in situ pore pressure, total stress and effective stress are calculated relative to the seabed, hence:

$$u_o = (d + z) \cdot \gamma_w$$

$$\sigma_{vo} = (z + d) \cdot \gamma_{sat}$$

$$\sigma'_{vo} = \sigma_{vo} - u_o$$

The CPT Tool calculation assumes data in the Depth field = d + z

Lunne et al. (1997) and Fugro (1995)

Where:

q_c is the cone resistance corrected

q_c^* is the cone resistance measured

u_2 is the pore pressure corrected

u_2^* is the pore pressure measured

a is the cone area ratio

γ_w is the unit weight of water (defined as density in CPT_GLOBAL_PARAMETERS.Water_Density_Field)

d is the pre-drilled depth, depth from the seabed to bottom of the borehole where the CPT started

z is the depth below the bottom of the borehole

z_w is the water depth, distance from seawater surface to seabed surface

γ_{sat} is the unit weight of saturated soil

1. The depth reference level for all TestIDs/Pushes in a PointID must be the same. Hence, when importing pushes with the reference depth at the bottom of the borehole the correspondence file must include the calculation Depth = d + z.

2. Dissipation tests measured pore pressure and in situ pore pressure are corrected as described above. And again Depth of the Dissipation test must = d + z.

8 Bulk Unit Weight and Void Ratio

Unit Weight and Void ratio may be defined in two locations and are used in the order listed:

1. CPT_POINT_MATERIAL_PROPERTIES table. This allows the user to enter a depth profile. If a depth range is missing a value, then the CPT_GLOBAL PARAMETERS table is used.
2. CPT_GLOBAL PARAMETERS table. A saturated and unsaturated unit weight must be defined, the former is applied bellow the water table and the later above the water table.

If Unit Weight and Void Ratio are not defined in either table, then the Bulk Unit Weight and Void Ratio will not be defined, and most other parameters cannot be calculated.

9 Initiation of the CPT Data Calculation

9.1 Primary Table Calculations

The primary CPT calculation is initiated by changing data then saving on the following tables (or the split screen parent of these tables):

- POINT
- CPT_DATA
- CPT_MATERIAL_PROPERTIES
- CPT_GLOBAL_PARAMETERS
- CPT_CONE_INFORMATION
- CPT_DESIGN_LINE_DATA

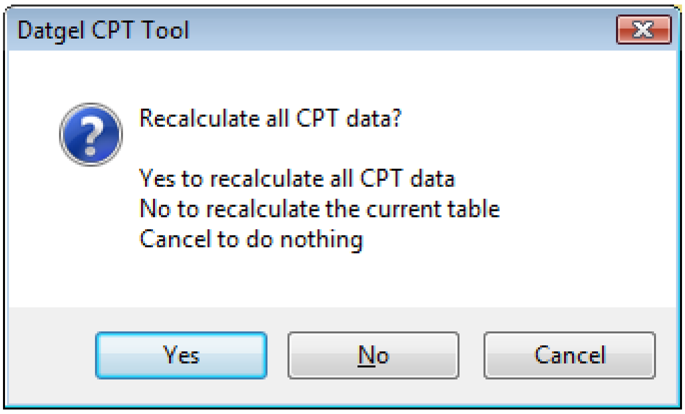
The CPT calculation on POINT will only run when an existing POINT record has records on the CPT_DATA table, and the Elevation has changed and the new Elevation has a value.

The automated CPT calculation when saving on these tables can be stopped by checking Suppress_Automatic_Calculation on CPT_GLOBAL_PARAMETERS.

The calculation will not run when converting projects.

Unless the Suppress_Calculation_on_Import on CPT_GLOBAL_PARAMETERS is checked, the calculation will take place upon import.

When calling **gINT Rules > Recalculate Current Table** from a CPT Table a form will display giving you options.



- **Yes**: will recalculate all CPTs in the project, this is equivalent to changing a value on the Global Parameter table. This is the fastest way to revaluate the entire database of CPTs. A progress bar will be shown to display the progress of the calculation. This is normally the option to pick.
- **No**: will use gINT's native recalculate current table, which can be a very inefficient way to calculate the database of CPTs. This option is not recommended.
- **Cancel**: Cancels the call, and nothing is calculated.

9.2 Order of Calculation

The order of calculation is:

1. Derived parameters
2. Soil Behaviour Type
3. Correlations hard coded: Undrained shear strength 1 and 2, Constrained Modulus, Coefficient of Volume Change, Compression Index, Soil Type Index Ic, N60 and N60 Average
4. Formula Tool – Library formulas
5. Formula Tool – Project formulas

9.3 Dissipation Test

The Dissipation test calculation is independent of the rest of the CPT table calculations. You may need to manually make the Dissipation test recalculate after changing relevant CPT parameters / data for a PointID.

10 Derived Parameters

The following table presents the derived parameters. These calculations are hard coded, and are calculated before the Formula Tool.

Table 2 - Derived Parameters

DGD Field Name	AGS RTA Field Name	Caption	Symbol	Unit	Description
Penetration_Rate					Rate calculated based on Time_Elapsed and Depth
Bulk_Unit_Weight	STCT_BUW	Bulk Unit Weight	γ_b	kN/m^3	Bulk unit weight, γ_b
In_Situ_Pore_Pressure	STCT_PWPI	In Situ u	u_o	kPa	In situ pore pressure, u_o, refer to section 7 for a full explanation.
Excess_Pore_Pressure	STCT_PWPE	Delta u	Δu	kPa	Excess pore pressure, $\Delta u = u_2 - u_o$
Normalised_Excess_Pore_ Pressure		Normalised Delta u	Normalised Δu		Normalised excess pore pressure, normalised $\Delta u = \frac{u_2 - u_o}{\sigma'_{vo}}$
Total_Stress	STCT_TOTS	Total Stress	σ_{vo}	kPa	In situ total vertical stress, σ_{vo}
Effective_Stress	STCT_EFFS	Effective Stress	σ'_{vo}	kPa	In situ effective vertical stress, σ'_{vo}
Total_Cone_Resistance	STCT_QT	qt	q_t	MPa	Total cone resistance, $q_t = q_c + u_2(1 - a) \cdot 10^{-3}$; or if the instrument is zeroed at the bottom of the borehole (downhole) $q_t = q_c^* + (1 - a)\, u_2 *\cdot 10^{-3} + \gamma_w \cdot d \cdot 10^{-3}$
Total_Cone_Resistance_Moving_Average		Moving Average qt		MPa	Moving average qt over distance defined on CPT_GLOBAL_PARAMETERS
Total_Cone_Resistance_Moving_Average_Inc		Moving Average qt Included		MPa	Moving average qt that are not excluded over distance defined on CPT_GLOBAL_PARAMETERS
Net_Cone_Resistance	STCT_QNET	Qn	q_n	MPa	Net cone resistance, $q_n = q_t - \sigma_{vo} \cdot 10^{-3}$
Corrected_Sleeve_Friction	STCT_FT	Ft	f_t	kPa	Sleeve friction corrected for pore pressure effects, $f_t = f_s - \frac{(u_2 \cdot A_{sb} - u_3 \cdot A_{st})}{A_s}$
Friction_Ratio	STCT_FRR	Rf	R_f	%	Friction ratio, $R_f = \frac{f_t}{q_t \cdot 10^3} \cdot 100$, $\frac{f_s}{q_t \cdot 10^3} \cdot 100$, or $\frac{f_s}{q_c \cdot 10^3} \cdot 100$
Normalised_Friction_Ratio	STCT_FR	Fr	F_r	%	Normalised friction ratio, $F_r = \frac{f_s}{(q_t \cdot 10^3 - \sigma_{vo})}$ If q_t is not found, and if Calc_Qt_Fr_based_on_qc on CPT_GLOBAL_PARAMETERS is set to true, then q_c is used in place of q_t.

DGD Field Name	AGS RTA Field Name	Caption	Symbol	Unit	Description
Normalised_Cone_Resistance	STCT_QNOR	Qt	Q_t	-	Normalised cone resistance, $Q_t = \frac{(q_t \cdot 10^3 - \sigma_{vo})}{\sigma'_{vo}}$ If q_t is not found, and if Calc_Qt_Fr_based_on_qc on CPT_GLOBAL_PARAMETERS is set to true, then q_c is used in place of q_t.
Stress_Normalised_Cone_Resistance	Stress_Normalised_Cone_Resistance	qt1	q_{t1}	-	Stress normalised cone resistance (Kulhawy and Mayne 1990, Jamiolkowski et al 2001), $q_{t1} = \frac{q_t \cdot 10^3}{\sqrt{\sigma'_{vo} \cdot \sigma_{atm}}}$
Pore_Pressure_Ratio	STCT_BQ	Bq	B_q	-	Pore pressure ratio, $B_q = \frac{\Delta u}{q_t \cdot 10^3 - \sigma_{vo}}$
Differential_Pore_Pressure_Ratio	STCT_DPPR	DPPR	$DPPR$	-	Differential pore pressure ratio, $DPPR = \frac{\Delta u}{q_t \cdot 10^3}$

11 Formula Tool

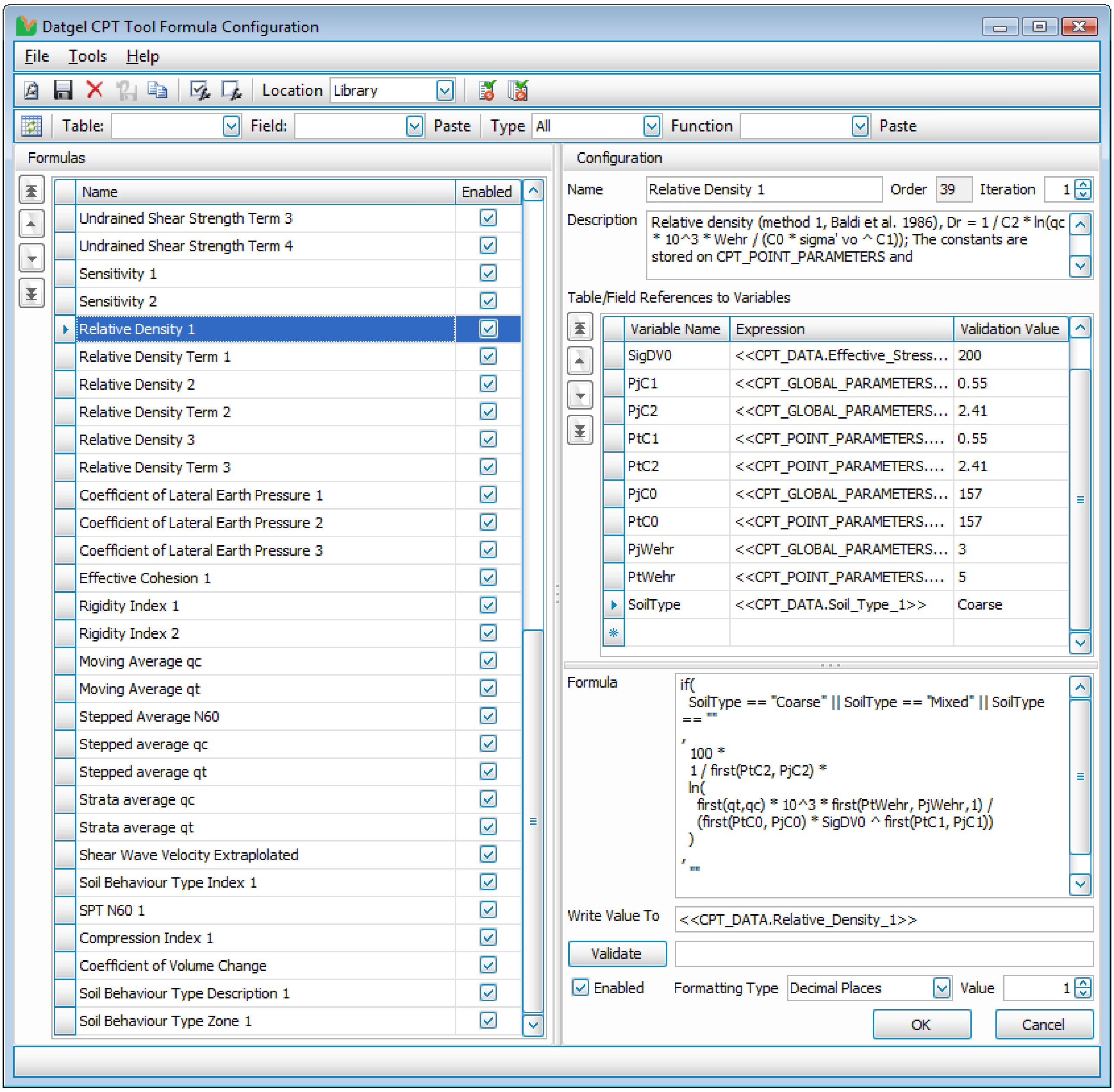
11.1 Introduction

The Formula Tools allows you to review and edit the preconfigured correlation formulas provided with the CPT Tool, and provides a way for you to define new correlation formulas.

A tutorial is provided in Section *11.7* Tutorial: Creating a new Correlation in the Formula Tool.

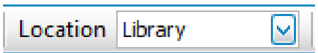
To Launch the Formula Tool Configuration, call the command **INPUT | Add-Ins > Datgel CPT Tool > Formula Tool Configuration**.

You should see a window similar to the following.

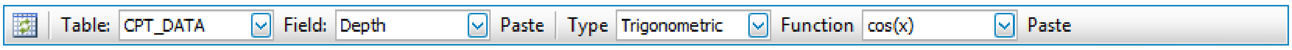


11.2 Formula Toolbar

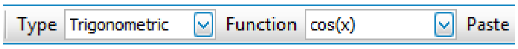
Hovering the mouse cursor over each item will show a tooltip with a short description of the item.

Name	Icon/Image	Keyboard Shortcut	Description
New Formula		Ctrl + N	Creates a new empty formula
Save Formula		Ctrl + S	Saves all changes to the gINT Library or Project database, depending on the selected Location
Delete Formula		Ctrl + D	Deletes the currently selected formula
Undo Changes		Ctrl + U	Reverts any changes made to the current formula to the state it was last saved
Copy Current Formula		Ctrl + Shift + C	Makes a copy of the currently selected formula, and adds it to the end of the Formula Grid. After copying, the copied formula will be selected, and you must enter a new unique name.
Enable all Formulas			Checks the Enabled check box column for all formulas in the Formulas Grid
Disable all Formulas			Unchecks the Enabled check box column for all formulas in the Formulas Grid
Location			Location the Formula Configurations are stored. Select Library to load the Configuration stored in the current gINT Library, and Project to load the Configuration stored in the current gINT Project. At the time of CPT calculation, The Library formulas will be evaluated and calculated first, followed by the Project formulas.
Generate Validation Report for Current Formula			Generates a report containing full details of the currently selected formula, evaluated validation result and any errors or missing Table Field references in the current formula. Clicking the button will prompt you for a new text file path, and then automatically open the text file in a text editor program after the report has been generated.
Generate Validation Report for All Formulas			Generates a report containing full details of the all formulas showing in the formula grid, evaluated validation result and any errors or missing Table Field references for each formula. Clicking the button will prompt you for a new text file path, and then automatically open the text file a text editor program after the report has been generated.

11.3 Data Tool Toolbar



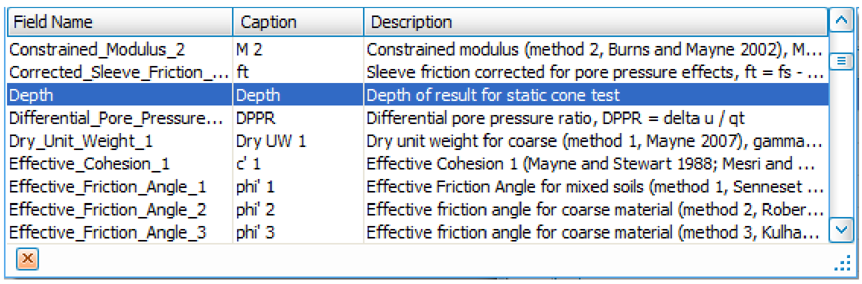
Hovering the mouse cursor over each item will show a tooltip with a short description of the item.

Name	Icon/Image	Keyboard Shortcut	Description
Refresh Data Tool		Ctrl + R	Clears, re-reads and reloads the Table and Field drop down list items from the current gINT Project. Use this to update the drop down list if you have added a new table or field after the Formula Configuration Form has been opened.
Table Field Data Tool			Pastes the selected table and field as formatted text into the last focused configuration field. Refer to the Table Field Data Tool section of the manual for detailed information
Function Data Tool			Pastes the selected function text into the last focused configuration field. Refer to the Function Data Tool section of the manual for detailed information

11.3.1 Table Field Data Tool

The Table Field Data Tool pastes the selected table and field as formatted text into the last focused configuration field. The drop down list contains all tables and fields in the current gINT Project database. When a Table is selected, the Field list will automatically filter to show only the fields for the selected table.

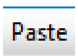
The Table and Field drop down lists consist of three columns:



Field Name	Caption	Description
Constrained_Modulus_2	M 2	Constrained modulus (method 2, Burns and Mayne 2002), M...
Corrected_Sleeve_Friction_...	ft	Sleeve friction corrected for pore pressure effects, ft = fs - ...
Depth	Depth	Depth of result for static cone test
Differential_Pore_Pressure...	DPPR	Differential pore pressure ratio, DPPR = delta u / qt
Dry_Unit_Weight_1	Dry UW 1	Dry unit weight for coarse (method 1, Mayne 2007), gamma...
Effective_Cohesion_1	c' 1	Effective Cohesion 1 (Mayne and Stewart 1988; Mesri and ...
Effective_Friction_Angle_1	phi' 1	Effective Friction Angle for mixed soils (method 1, Senneset ...
Effective_Friction_Angle_2	phi' 2	Effective friction angle for coarse material (method 2, Rober...
Effective_Friction_Angle_3	phi' 3	Effective friction angle for coarse material (method 3, Kulha...

- **Table Name/Field Name** – database name of the Table or Field
- **Caption** – The caption text as configured in the Caption field in the gINT Table or Field Properties
- **Description** – The description text as configured in the Description field in the gINT Table or Field Properties

The drop down list can be sorted by a column by clicking on the column header. The columns can be resized by clicking and dragging the edges of the column header left or right. The drop down list window can be resized by clicking and dragging the bottom right corner of the window.

The **Paste**  button will insert the selected table field into a formatted, table field reference text into the last focused configuration text field or grid cell. The Paste button can insert text into the following Configuration fields:

- Description
- Any cell in the Variables Grid

- Formula
- Write Value To

The table field reference format is as below:

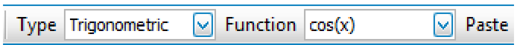
```
<<Table Name.Field Name>>
```

Table field references in the Formula field are required to be surrounded by quotation marks. The Table Field Data Tool will automatically add the quotation marks if pasting in the Formula field. The table field reference format for the Formula field is as below:

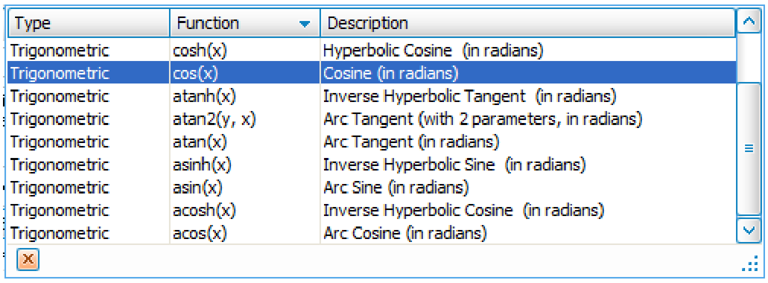
```
"<<Table Name.Field Name>>"
```

The pasted text will be inserted at the current position of the cursor in the fields. Any highlighted text will be replaced by the inserted text. Selecting an entire cell in the Variables grid will replace the contents of that cell with the inserted text.

11.3.2 Function Data Tool



The Table Field Data Tool pastes the selected function text into the last focused configuration field. The Function drop down list contains all functions, constants and operators that are available in the Formula Tool, it the correct syntax. Each function is categorised as a type, and selecting a type in the Type drop down list will filter the function drop down list by that type.



The Function drop down list consists of three columns:

- **Type** – type of function, can be filtered by a particular type by selecting a type in the Type drop down list
- **Function** – the function, constant or operator in the correct syntax as required by the Formula Tool. The typical syntax composition of a function consists of the function name, followed by an open bracket, followed by a comma separated list of function parameters, followed by a closed bracket.

  `FunctionName(Parameter 1, Parameter 2 [,...])`

  The function name is case sensitive. All function parameters are required, unless noted otherwise. If a function accepts an arbitrary number of parameters, it is denoted by `. . . .`
- **Description** – A short description about the function

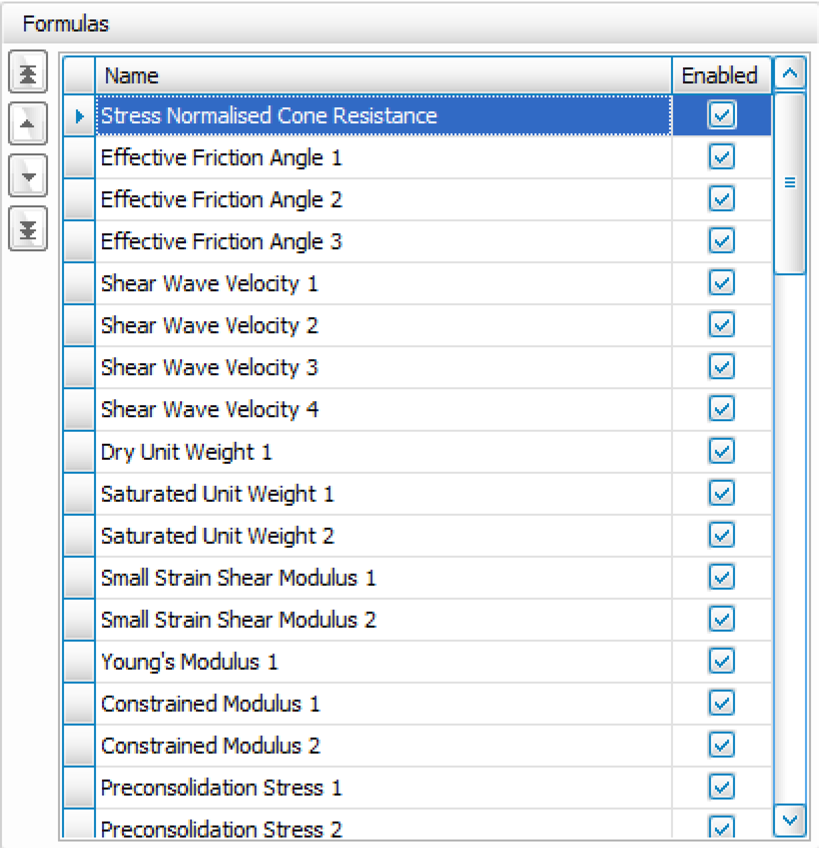
The **Paste** 

button will insert the selected table field into a formatted, table field reference text into the last focused configuration text field or grid cell. The Paste button can insert text into the following Configuration fields:

- Description
- Any cell in the Variables Grid
- Formula

- Write Value To

11.4 Formulas Group



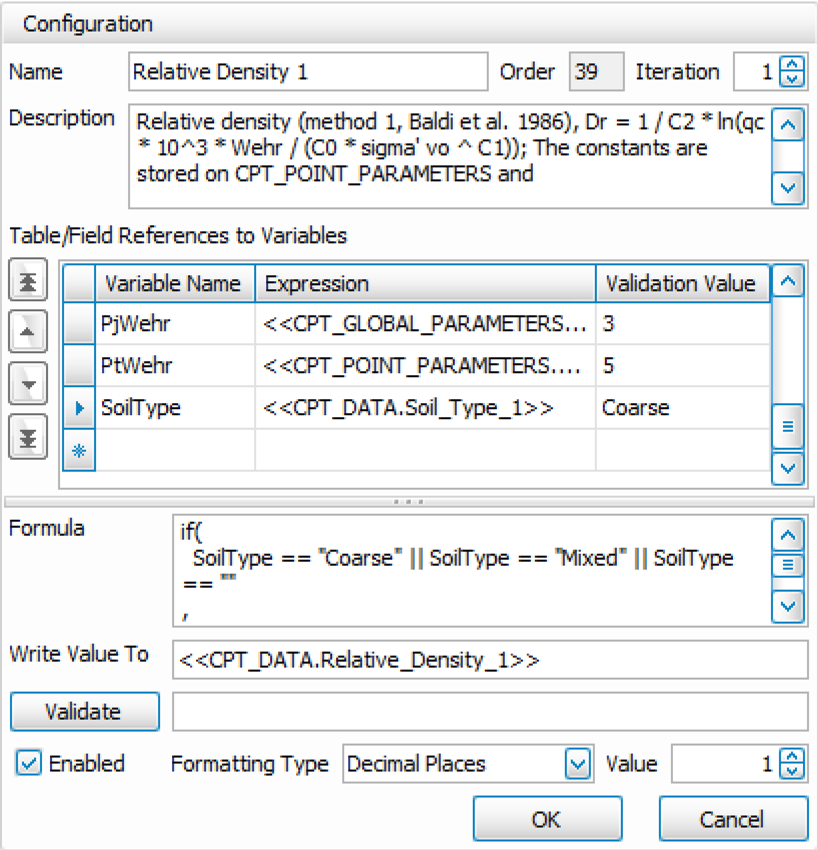
The Formulas Group contains a list of formulas listed in the currently selected location. Each row in the Grid represents one formula, and is listed in the order they are to be evaluated from first to last.

Selecting a formula by either by clicking on a row, or pressing the up or down keys in the Grid will display the configuration associated with the selected formula in the Configuration Group. The Name and Enabled column values cannot be changed in this grid. It must be done in the Configuration Group after the formula has been selected.

The Order of the formula can be changed in the Formulas Group with the up down buttons on the top left. Descriptions of the bottom are listed below from top to bottom:

- **Move to Top** – Moves the currently selected formula to the top of the grid
- **Move Up** – Moves the currently selected formula up by one row
- **Move Down** – Moves the currently selected formula down by one row
- **Move to Bottom** – moves the currently selected formula to the bottom of the grid

11.5 Configuration Group



The Configuration Group contains all the configurable options for the formula that is currently selected in the Formulas Grid.

- **Name** – Name of the formula. The formula name must be unique for the configuration location. This means that you may have two formulas with the same name in the current Library and Project, but not in the Library or Project only.

  You will not be able to select another formula, or save the formula until a unique name is entered.
- **Order** – a numeric value of the order the formula will be evaluated. If the result of the current formula is required to evaluate another formula, then the current formula should be placed at a higher order to than the other formula.

  The order cannot be changed in the Configuration Group. Move the selected formula up or down using the up down buttons left of the Formulas Grid. The numeric Order value will update itself when the order has changed.
- **Iteration** - The round of iteration in which the current formula will be evaluated. Default value is 1. Functions which calculate the average of a correlation that is evaluated by the Formula Tool need to be run at a later iteration to the correlation.
- **Description** – Description of the formula. It is not used or required in the formula calculation, and hence it is an optional field.
- **Table/Field References to Variables** – Declare the variables that are used in the formula expression in this grid. The rows in this grid can be changed with the up down buttons on the left of this grid. Column definitions are listed below:
  - <u>Variable Name</u> – Name of the variable. The variable name can consist of alphanumeric characters [a-z, A-Z, 1-9], but must have at least one alphabetic character, and is case sensitive. It cannot contain the following:

- Symbols, such as `, $, #
- White spaces or carriage return

In addition, a duplicate variable names for a particular formula is not permitted, and a variable name cannot be exactly the same as a function name.

- Expression – Table Field reference to where the variable value is to be retrieved from, or a text or numeric value. The following is a list of rules and specifications regarding the Expression:
  - Table Field references must be in the format of `<<Table.Field>>`
  - If the referenced field is from the CPT_DATA table, then it will take the value from the field of the current row the CPT Tool is calculating.
  - If the referenced field is from any other table, it will retrieve the first result from a query to that table, filtered by the PointID and ItemKey values of the current CPT calculation, where appropriate.
  - To use the variable as a constant, enter a numeric value, or text that is not in the format of `<<Table.Field>>`
- Validation Value – Value used to evaluate the formula when the Validate button is clicked, and in the Validation Reports. The Validation Value has no effect on the actual CPT calculation, and is solely used in the Formula Configuration Form.

- **Formula** – The formula expression. Refer to the Functions section of this manual for a full list of available functions. Variables declared in the Variables Grid above can be referenced in the formula expression. String constants must be surrounded with quotation marks "" in order to differentiate it from a variable reference. Spaces and carriage returns may be used liberally to improve readability.

  Table field references in the formula expression must be surrounded by quotation marks, i.e. `"<<Table.Field>>"`. The Table Field Data Tool will automatically add the quotation marks when pasted in the formula expression field.

- **Write Value To** – The Table Field reference to where the result of the formula evaluation is to be written to. The value in this field must be in the `<<Table.Field>>` format, and must be from the CPT_DATA table.

- **Validate** – Click this button to evaluate the current formula expression, with the Validation Value set as the Variables. If the evaluation was successful, the result will be written to the adjacent text field. The Formatting Type and Value will be applied to the result, if defined. Use Validate to spot check your formula expression for syntax errors, and to verify the formula returns an expected result.

- **Enabled** – Check or uncheck to enable or disable the formula respectively from evaluating in the CPT calculation

- **Formatting Type and Value** – Formats the result to either decimal or significant figures, to the nearest specified value. The formatting only applies to formula expressions that return a numeric value.

- **OK** – Saves the current state of the formulas in the Formula Configuration form to the selected location, and closes the form.

- **Cancel** – Discards any changes made in the Formula Configuration form and closes the form. The formulas will remain at the exact same state as before the Formula Configuration form was opened. You will be prompted to save if changes are detected.

11.6 Functions

Type	Description	Function Name
Constants	π, 3.14159	Pi

Constants	Euler's Constant e, 2.71828	e
Constants	Boolean constant true	true
Constants	Boolean constant false	false
Log and Exponential	Natural Logarithm	ln(x)
Log and Exponential	Logarithm base 10	log(x)
Log and Exponential	Logarithm base 2	lg(x)
Log and Exponential	Exponential (e^x)	exp(x)
Log and Exponential	Power	pow(x)
Miscellaneous	If	if(cond, trueval, falseval)
Miscellaneous	Absolute Value / Magnitude	abs(x)
Miscellaneous	Binomial coefficients	binom(n, i)
Miscellaneous	First Data, returns first non-empty value from list	first(x1,x2,x3,...)
Miscellaneous	Lookup Interval Range	LookupIntervalRange("<<Current Interval Table.Field>>","<<Lookup Value Table.Field>>","<<Top Interval Table.Field>>","<<Bottom Interval Table.Field>>")
Miscellaneous	Modulus	mod(x,y)
Miscellaneous	Modulus	x % y
Miscellaneous	Moving Average	MovingAverage("<<Current Interval Table.Field>>","<<Values to Average Table.Field>>",Thickness)
Miscellaneous	Random number (between 0 and 1)	rand()
Miscellaneous	Stepped Average	SteppedAverage("<<Current Interval Table.Field>>","<<Values to Average Table.Field>>",Thickness)
Miscellaneous	Stepped Extrapolation	SteppedExtrapolation("<<Current Interval Table.Field>>","<<Values to Extrapolate Table.Field>>")
Miscellaneous	Square Root	sqrt(x)
Miscellaneous	Sum	sum(x,y,...)
Miscellaneous	Str (number to string)	str(x)
Miscellaneous	Table Interval Average	TableIntervalAverage("<<Current Interval Table.Field>>","<<Values to Average Table.Field>>","<<Top Interval Table.Field>>","<<Bottom Interval Table.Field>>")
Operators	Addition	+
Operators	Subtraction	-
Operators	Division	/
Operators	Multiplication	*
Operators	Unary Plus	+x
Operators	Unary Minus	-x
Operators	Power	^
Operators	Modulus	%
Operators	Boolean Not	!
Operators	Boolean And	&&

Operators	Boolean Or	||
Operators	Equal	==
Operators	Not Equal	!=
Operators	Less Than	<
Operators	Greater Than or Equal	>
Operators	Less or Equal	<=
Operators	Greater Than or Equal	>=
Rounding	Round	round(x)
Rounding	Round	round(x, p)
Rounding	Floor	floor(x)
Rounding	Ceiling	ceil(x)
Statistical	Average	avg(x1,x2,x3,...)
Statistical	Minimum	min(x1,x2,x3,...)
Statistical	Maximum	max(x1,x2,x3,...)
Trigonometric	Sine (in radians)	sin(x)
Trigonometric	Cosine (in radians)	cos(x)
Trigonometric	Tangent (in radians)	tan(x)
Trigonometric	Arc Sine (in radians)	asin(x)
Trigonometric	Arc Cosine (in radians)	acos(x)
Trigonometric	Arc Tangent (in radians)	atan(x)
Trigonometric	Arc Tangent (with 2 parameters, in radians)	atan2(y, x)
Trigonometric	Hyperbolic Sine (in radians)	sinh(x)
Trigonometric	Hyperbolic Cosine (in radians)	cosh(x)
Trigonometric	Hyperbolic Tangent (in radians)	tanh(x)
Trigonometric	Inverse Hyperbolic Sine (in radians)	asinh(x)
Trigonometric	Inverse Hyperbolic Cosine (in radians)	acosh(x)
Trigonometric	Inverse Hyperbolic Tangent (in radians)	atanh(x)

11.6.1 Special Functions

Functions that require explanation in greater detail are listed in this section.

11.6.1.1 MovingAverage

```
MovingAverage("<<Current Interval Table.Field>>","<<Values to Average
Table.Field>>",Thickness)
```

The Moving Average function returns an arithmetic mean of values above and below the current interval field value.

Below is a definition of the parameters for MovingAverage:

- **"<<Current Interval Table.Field>>"** – Table field reference to the interval that determines the current interval value, and the range of averages. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.
- The values in the interval field must be uniformly increasing or decreasing in value with no duplicates. A Typical interval field would be Depth.

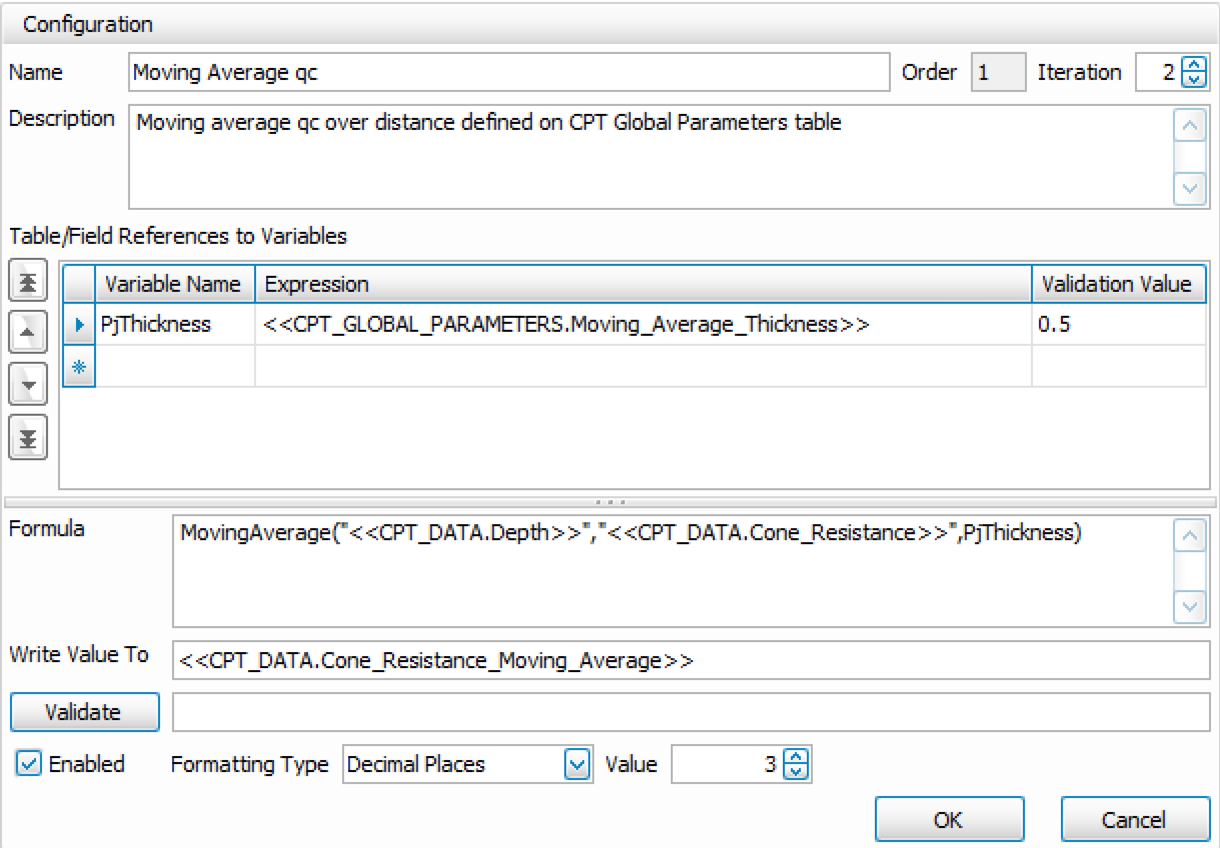
- **"<<Values to Average Table.Field>>"** – Table field reference for the values to average. The data set of the average is obtained from this field. The field does not need to be a numeric type, but the values must be numeric. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.
- **Thickness** – Defines the interval range of the values taken for the average, where the current interval is the middle of the range. Therefore, the minimum and maximum range of the average would be the current interval + thickness / 2 and current interval - thickness / 2 respectively.

The Current Interval and the Values to Average table field references must refer to a field from the CPT_DATA table.

If the moving average is used with a correlation evaluated by the Formula Tool, then the Iteration of the moving average formula must be greater than the iteration of the correlation.

The Moving Average cannot be evaluated via the Validate button or in Validation Reports from the Formula Tool Configuration Form.

Below is a working example configuration of q_c Moving Average:



In this example, an average of q_c values above and below the given depth will be written to the Cone_Resistance_Moving_Average field in the CPT_DATA field. The distance above and below can be configured in the CPT_GLOBAL_PARAMETERS table, in the field Moving_Average_Thickness. The thickness defines the depth range of the q_c values taken, where the given depth is in the middle of the range.

For example, specifying a Moving_Average_Thickness of 1 m, the q_c values are taken from ±0.5 m from the given depth.

11.6.1.2 SteppedAverage

```
SteppedAverage("<<Current Interval Table.Field>>","<<Values to Average
Table.Field>>",Thickness)
```

The Stepped Average function returns an arithmetic mean of values within an interval range that increments by the specified thickness. A graph of a set of stepped average values against the interval will appear as horizontal steps of equal width that step up or down.

Below is a definition of the parameters for SteppedAverage:

- **"<<Current Interval Table.Field>>"** – Table field reference to the interval that determines the current interval value, and the range of averages. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.

  The values in the interval field must be uniformly increasing or decreasing in value with no duplicates. A Typical interval field would be depth.

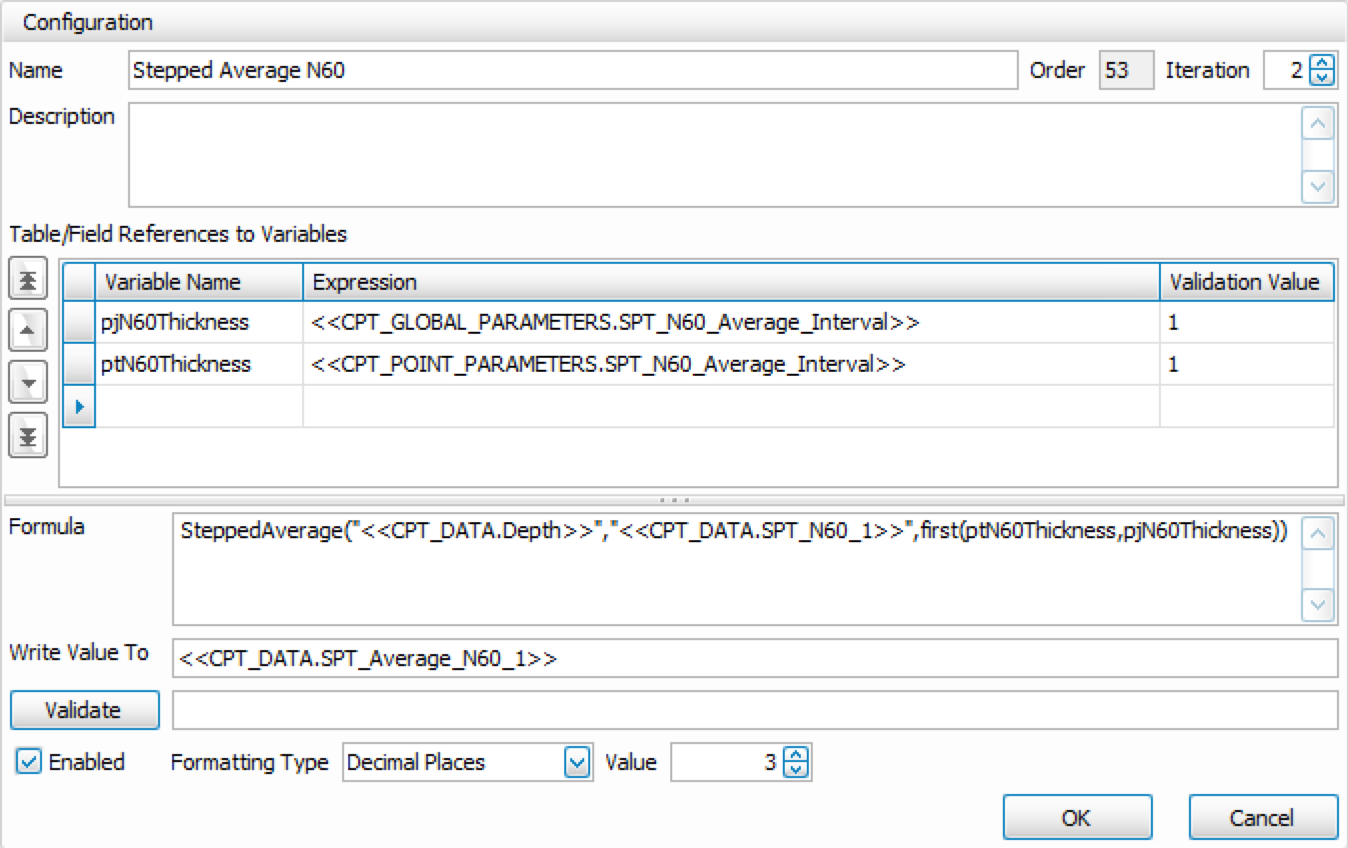
- **"<<Values to Average Table.Field>>"** – Table field reference for the values to average. The data set of the average is obtained from this field. The field does not need to be a numeric type, but the values must be numeric. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.
- **Thickness** – Defines the interval increment range of the values taken for the average.

The Current Interval and the Values to Average table field references must refer to a field from the CPT_DATA table.

The Stepped Average cannot be evaluated via the Validate button or in Validation Reports from the Formula Tool Configuration Form.

If the moving average is used with a correlation evaluated by the Formula Tool, then the Iteration of the moving average formula must be greater than the iteration of the correlation.

Below is a working example configuration of SPT N60 Stepped Average:



The SPT average N60 value is a stepped average of values in the SPT_N60_1 field on the CPT_DATA table for each defined depth interval step.

The average of the N60 values is calculated for each depth interval step, and the result is recorded in the SPT_Average_N60_1 field in the CPT_DATA table for each row in that interval step.

The depth interval distance (thickness) is defined on the SPT_N60_Average_Interval field on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables. The first function dictates that the value in the CPT_POINT_PARAMETERS table has precedence over the CPT_GLOBAL_PARAMETERS table.

For example, specifying a SPT_N60_Average_Interval of 1 m, the stepped average value at a depth of 0.5 m would be the average SPT N60 values between 0 m and 1 m.

11.6.1.3 TableIntervalAverage

```
TableIntervalAverage("<<Current Interval Table.Field>>","<<Values to Average
Table.Field>>","<<Top Interval Table.Field>>","<<Bottom Interval Table.Field>>")
```

The Table Interval Average function returns an arithmetic mean of values within an interval range specified on another Table. A graph of a set of table interval average values against the interval will appear as horizontal steps whose width is top and bottom intervals specified on the corresponding table. Conceptually, the Table Interval Average is similar to the Stepped Average, but the step widths are defined by the Top and Bottom interval values.

Below is a definition of the parameters for TableIntervalAverage:

- **"<<Current Interval Table.Field>>"** – Table field reference to the interval that determines the current interval value, and the range of averages. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.

  The values in the interval field must be uniformly increasing or decreasing in value with no duplicates. A Typical interval field would be Depth.

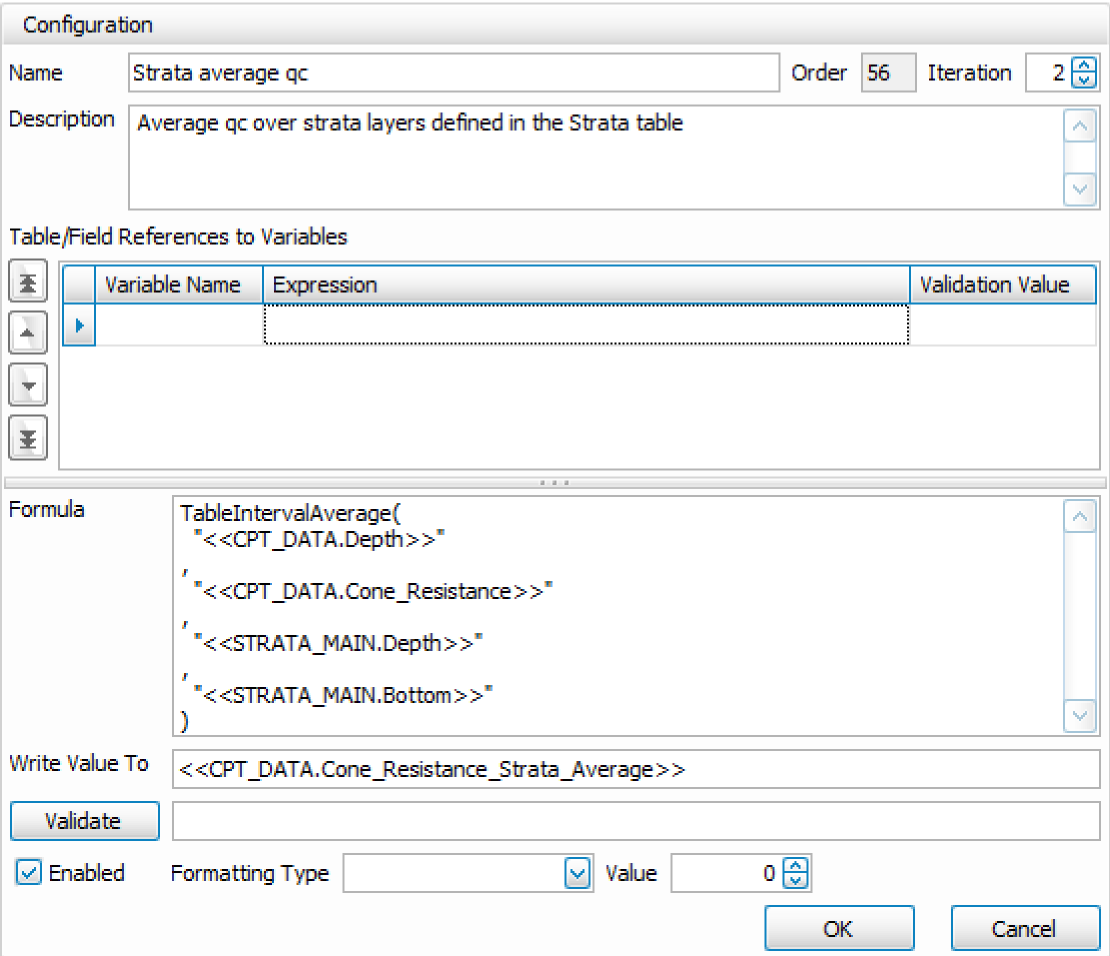
- **"<<Values to Average Table.Field>>"** – Table field reference for the values to average. The data set of the average is obtained from this field. The field does not need to be a numeric type, but the values must be numeric. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.
- **"<<Top Interval Table.Field>>"** – Table field reference to the field that contains the top interval values
- **"<<Bottom Interval Table.Field>>"** – Table field reference to the field that contains the bottom interval values

The Current Interval and the Values to Average table field references must refer to a field from the CPT_DATA table, and the Top and Bottom interval table field references must refer to fields from the same table.

The Stepped Average cannot be evaluated via the Validate button or in Validation Reports from the Formula Tool Configuration Form.

The Stepped Average assumes that there is only one set of top and bottom intervals for each CPT data keyset, and that the top and bottom interval values do not create overlapping layers.

Below is a working example configuration of q_c Strata Average:



In this example, the cone resistance is averaged between the strata layers as defined by the Depth and Bottom fields in the STRATA_MAIN table, for the current PointID.

11.6.1.4 SteppedExtrapolation

```
SteppedExtrapolation("<<Current Interval Table.Field>>","<<Values to Extrapolate Table.Field>>")
```

The Stepped Extrapolation function returns a value that is extrapolated to the midpoint between the current value to extrapolate, and the next value to extrapolate. From the current value to extrapolate to the midpoint, Stepped Extrapolation returns the current value to extrapolate, and from the midpoint to the next value to extrapolate, Stepped Extrapolation returns the next value to extrapolate.

Below is a definition of the parameters for SteppedExtrapolation:

- **"<<Current Interval Table.Field>>"** – Table field reference to the interval that determines the current interval value, and is a reference point to determine the midpoint between two values to extrapolate. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.

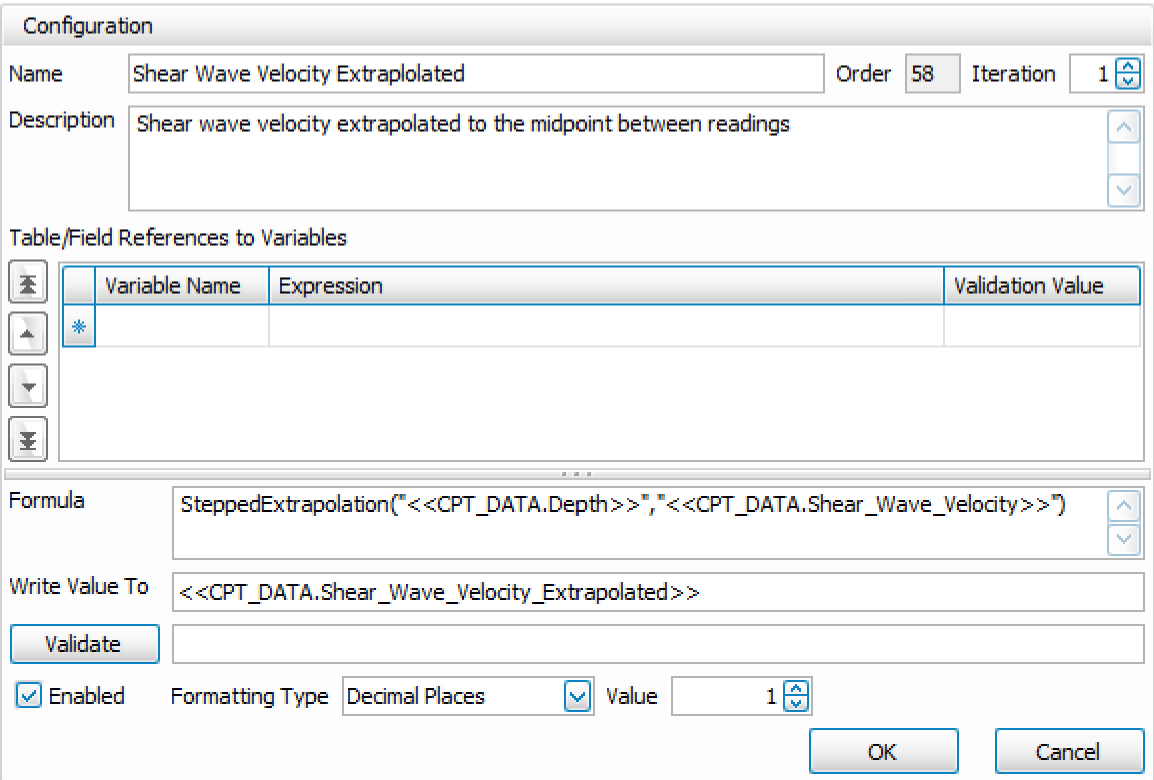
  The values in the interval field must be uniformly increasing or decreasing in value with no duplicates. A Typical interval field would be Depth.

- **"<<Values to Extrapolate Table.Field>>"** – Table field reference for the values to extrapolate. The field does not need to be a numeric type, but the values must be numeric. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.

The Current Interval and the Values to Extrapolate table field references must refer to a field from the CPT_DATA table.

The Stepped Extrapolation cannot be evaluated via the Validate button or in Validation Reports from the Formula Tool Configuration Form.

Below is a working example configuration Shear Wave Velocity Extrapolated:



Results:

Depth (m)	<= Vs (m/s)	Vs Extrap (m/s)
0.000		100
0.010		100
0.020		100
0.030		100
0.040		100
0.050	100.00	100
0.060		100
0.070		100
0.080		200
0.090		200
0.100	200.00	200
0.110		200
0.120		200
0.130		500
0.140		500
0.150	500.00	500
0.160		500
0.170		500
0.180		400
0.190		400
0.200	400.00	400
0.210		400
0.220		400
0.230		400

11.6.1.5 LookupIntervalRange

```
LookupIntervalRange("<<Current Interval Table.Field>>","<<Lookup Value
Table.Field>>","<<Top Interval Table.Field>>","<<Bottom Interval Table.Field>>")
```

The Lookup Interval Range function returns the a value for a specified field from another depth related table, where the current interval value in the CPT_DATA table lies in between the Top and Bottom intervals in the other table.

Below is a definition of the parameters for LookupIntervalRange:

- **"<<Current Interval Table.Field>>"** – Table field reference to the interval that determines the current interval value that is used as a search criteria for the value on the other table. As denoted by the parameter name, the table field reference must be surrounded with quotation marks.

  The values in the interval field must be uniformly increasing or decreasing in value with no duplicates. A Typical interval field would be depth.
- **"<<Lookup Value Table.Field>>"** – Other table field reference for the value to retrieve.
- **"<<Top Interval Table.Field>>"** – Other table field reference to the field that contains the top interval values
- **"<<Bottom Interval Table.Field>>"** – Other table field reference to the field that contains the bottom interval values

The Current Interval must refer to a field from the CPT_DATA table, and the Top and Bottom interval, and Lookup Value table field references must refer to fields from the same table.

The Lookup Interval Range cannot be evaluated via the Validate button or in Validation Reports from the Formula Tool Configuration Form.

The Lookup Interval Range assumes that there is only one set of top and bottom intervals for each CPT data keyset, and that the top and bottom interval values do not create overlapping layers. If more than one matching value for the current interval is found, then the first value is returned.

Below is an example usage of the Lookup Interval Range function that retrieves the Void Ratio value from the Void_Ratio field in the CPT_MATERIAL_PROPERTIES table, where the current CPT_DATA depth lies between the top and bottom depths in the CPT_MATERIAL_PROPERTIES table.

```
LookupIntervalRange(
  "<<CPT_DATA.Depth>>"
,
  "<<CPT_POINT_MATERIAL_PROPERTIES.Void_Ratio>>"
,
  "<<CPT_POINT_MATERIAL_PROPERTIES.Depth>>"
,
  "<<CPT_POINT_MATERIAL_PROPERTIES.Bottom>>"
)
```

11.7 Tutorial: Creating a new Correlation in the Formula Tool

In this tutorial, we will create a formula titled *Undrained Shear Strength 5*, which is the same as Undrained Shear Strength 3. For more details on the correlation refer to Undrained Shear Strength 3 section in this user guide.

For quick reference, the equation is as below:

$$s_u = 0.5 \cdot \, sin\,\phi' \cdot OCR^{\Lambda} \cdot \, \sigma_{vo}{}'$$

We will start by creating the fields necessary to support this correlation.

Go to the **DATA DESIGN | Project Database** tab, and then call the command **File > Open File > Current Project**.

Select CPT_DATA from the yellow table drop down list from the top, and then add a new field by clicking on the **New** button.

Fill in the fields with the following values, and click **OK** when finished.

Field Name	Value
Name	Undrained_Shear_Strength_5
Caption	Su 5 Tutorial
Type	Double
Description	Undrained shear strength from CSSM (method 5), Su = 0.5 * sin phi' * OCR^lambda * sig vo'; phi' is taken from the first of these fields with data: Effective_Friction_Angle_3 and Effective_Friction_Angle_1; OCR is taken from Overconsolidation_Ratio_1; Lambda stored on CPT_POINT_MATERIAL_PROPERTIES, CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables
Units	kPa
Cell Color	Field - Calculated

Select CPT_GLOBAL_PARAMETERS from the yellow table drop down list from the top, and then add a new field by clicking on the **New** button.

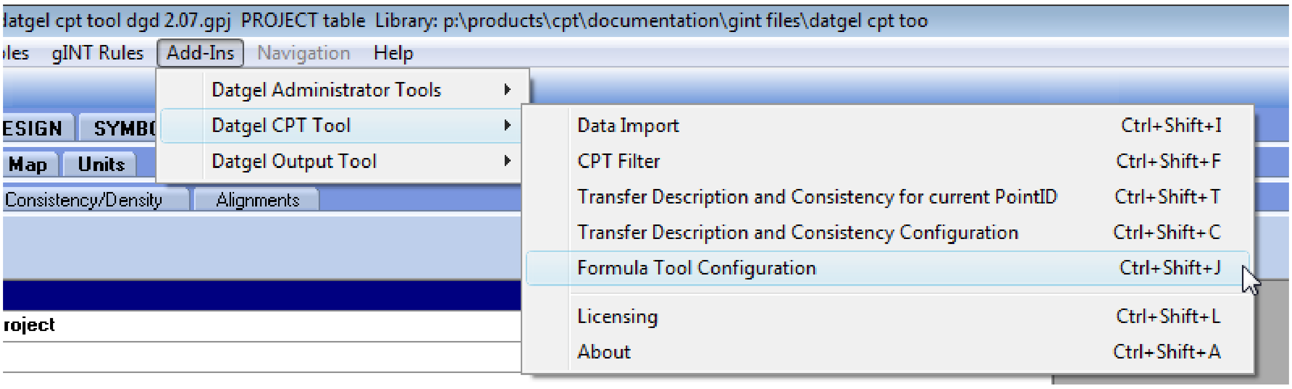
Fill in the fields with the following values, and click **OK** when finished.

Field Name	Value
Name	Undrained_Shear_Strength_5_Lambda
Type	Double
Description	Undrained shear strength from CSSM (method 5), Su = 0.5 * sin phi' * OCR^lambda * sig vo'; phi' is taken from the first of these fields with data: Effective_Friction_Angle_3 and Effective_Friction_Angle_1; OCR is taken from Overconsolidation_Ratio_1; This field represents lambda; Typically low to medium sensitivity clays are 0.7 <= lambda <= 0.8 , and sensitive and structured clays are 0.9 <= lambda <= 1.0
Default Value	0.85
Cell Color	Field – Enter Data

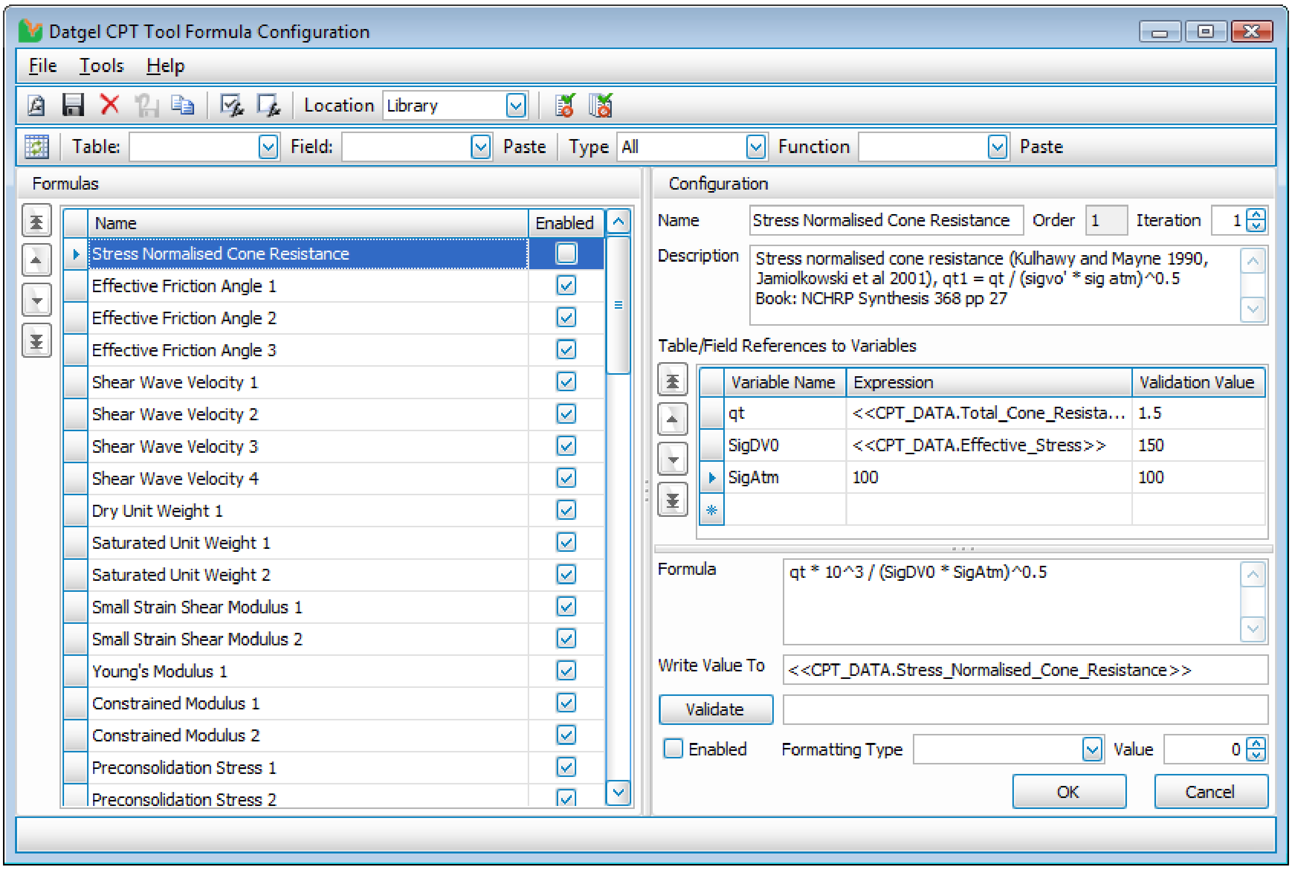
We will now copy this field into the CPT_POINT_PARAMETERS table. Select CPT_POINT_PARAMETERS from the yellow drop down list from the top.

Call the command **Tables > Merge Fields from Current File**. Select CPT_GLOBAL_PARAMETERS and click **OK**. Then select Undrained_Shear_Strength_Tutorial_5 and click **OK**. Clear the *Default Value*. Click **Save** to save the changes.

Go back to the **INPUT** tab and launch the Formula Tool Configuration Form, by calling the command **Add-Ins > Datgel CPT Tool > Formula Tool Configuration**.



The Formula Tool Configuration Form should appear.

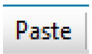


Change the Location drop down to **Project**. Click on the **new** Icon to create a new blank formula.

We will now use the Table Field Data Tool to insert a table field reference to the configuration.

In the Configuration Group, Click on the **Write Value To** text field so that the cursor is blinking in the text field. Click on the Table drop down list, and select CPT_DATA. Then click on the Field drop down list, and select Undrained_Shear_Strength_5.

The Table Field Drop Down list should look like the following:

Click on the Paste 

button. `<<CPT_DATA.Undrained_Shear_Strength_5>>` should have been pasted in the **Write Value To** field.

NOTE: You are free to type the table field references. However, using the Table Field Data Tool eliminates typographical errors which will cause errors and unexpected results further down the track. Hence, you are encouraged to use the Table Field Data Tool to insert table field references, as typographical errors can be difficult to find afterwards.

In the Configuration Group, fill in the following values.

Field Name	Value
Name	Undrained Shear Strength 5

Iteration	1
Description	Undrained shear strength from CSSM (method 5), Su = 0.5 * sin phi' * OCR^lambda * sig vo'; phi' is taken from the first of these fields with data: Effective_Friction_Angle_3 and Effective_Friction_Angle_1; OCR is taken from Overconsolidation_Ratio_1; Lambda stored on CPT_POINT_MATERIAL_PROPERTIES, CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables Book: NCHRP Synthesis 368 pp39
Write Value To	`<<CPT_DATA.Undrained_Shear_Strength_5>>`
Enabled	Check this option.
Formatting Type	Decimal Places
Value	1

We will now enter the variables in the Table/Field References to Variables Grid.

Click on the **Variable Name** column, first row. Type in `PhiD1` minding the case of each character.

Click on the **Expression** column, first row. Go to the Table Field Data Tool, and select the CPT_DATA table, Effective_Friction_Angle_1 field. Click on the Paste button, and this should insert `<<CPT_DATA.Effective_Friction_Angle_1>>` in the cell in the first row of the **Expression** column.

Click on the **Validation Value** column, first row. Enter `15` in the cell.

We have just finished entering one variable, `PhiD1` which represents ϕ' from the equation.

Repeat the last three steps to enter the rest of the variables listed below:

Variable Name	Expression	Validation Value	Represents Variable in the Equation
PhiD1	`<<CPT_DATA.Effective_Friction_Angle_1>>`	15	ϕ'
PhiD3	`<<CPT_DATA.Effective_Friction_Angle_3>>`	10	ϕ'
OCR	`<<CPT_DATA.Overconsolidation_Ratio_1>>`	3	OCR
SigDV0	`<<CPT_DATA.Effective_Stress>>`	100	σ_{vo}'
PjLambda	`<<CPT_GLOBAL_PARAMETERS.Undrained_Shear_Strength_5_Lambda>>`	0.7	Λ
PtLambda	`<<CPT_POINT_PARAMETERS.Undrained_Shear_Strength_5_Lambda>>`	0.8	Λ

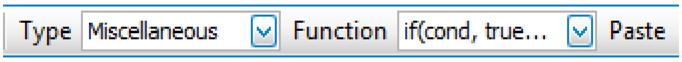
SoilType	<<CPT_DATA.Soil_Type_1>>	Fine

TIP: You can use the up down arrows adjacent to the Variable Grid on the left to change the order the variables appear in the Grid. The order does not affect the formula calculation in any way.

We are now ready to write the Formula.

Click on the **Formula** text field so that the cursor is blinking in the text field. Go to the Function Data Tool, select `Miscellaneous` as the Type, then select the `If()` function.

The Function Data Tool should look like the following:



Click on the **Paste** 

button. `if(cond, trueval, falseval)` should have been pasted in the **Formula** field.

NOTE: You are free to type the function names. However, using the Function Data Tool eliminates typographical errors which will cause errors and unexpected results further down the track. Additionally, it helps you to set up the proper function syntax for the formula. Hence you are encouraged to use the Function Data Tool to insert functions, as typographical errors can be difficult to find afterwards.

Parameters and Functions are case sensitive.

Enter the following text in the formula field, using the Function Data Tool when needed:

```
if(
  SoilType == "Fine" || SoilType == "Mixed" || SoilType == ""
,
  0.5 * sin(first(PhiD3,PhiD1)/180*pi) * OCR^ first(PtLambda,PjLambda) * SigDV0
,
  ""
)
```

An explanation of the formula is as below:

```
If(
  SoilType == "Fine" || SoilType == "Mixed" || SoilType == "" ...
```

Check to see if the Soil Type is either “Fine”, “Mixed” or empty. If it is, then evaluate the equation, otherwise, return empty. `||` denotes an OR logical operation, and == denotes an EQUAL TO text comparison.

```
first(PhiD3,PhiD1)
```

The first() function returns the first non-empty value (from left to right) in the list of parameters. If both `PhiD3` and `PhiD1` have values, then the first value, `PhiD3` is returned.

```
sin(first(PhiD3,PhiD1)/180*pi)
```

The parameter for the sine function in the Formula Tool must be in radians. `PhiD3` and `PhiD1` are in Degrees, so the value is converted to radians by dividing by `180`, then multiplying by `pi`.

TIP: You can use spaces and carriage returns (new line) to format, and space out your formula for better readability. The formatting method used in this tutorial separates the function name, parameters, parameter delimiters and closing bracket in a new line, and the parameters are indented by two spaces.

For example,

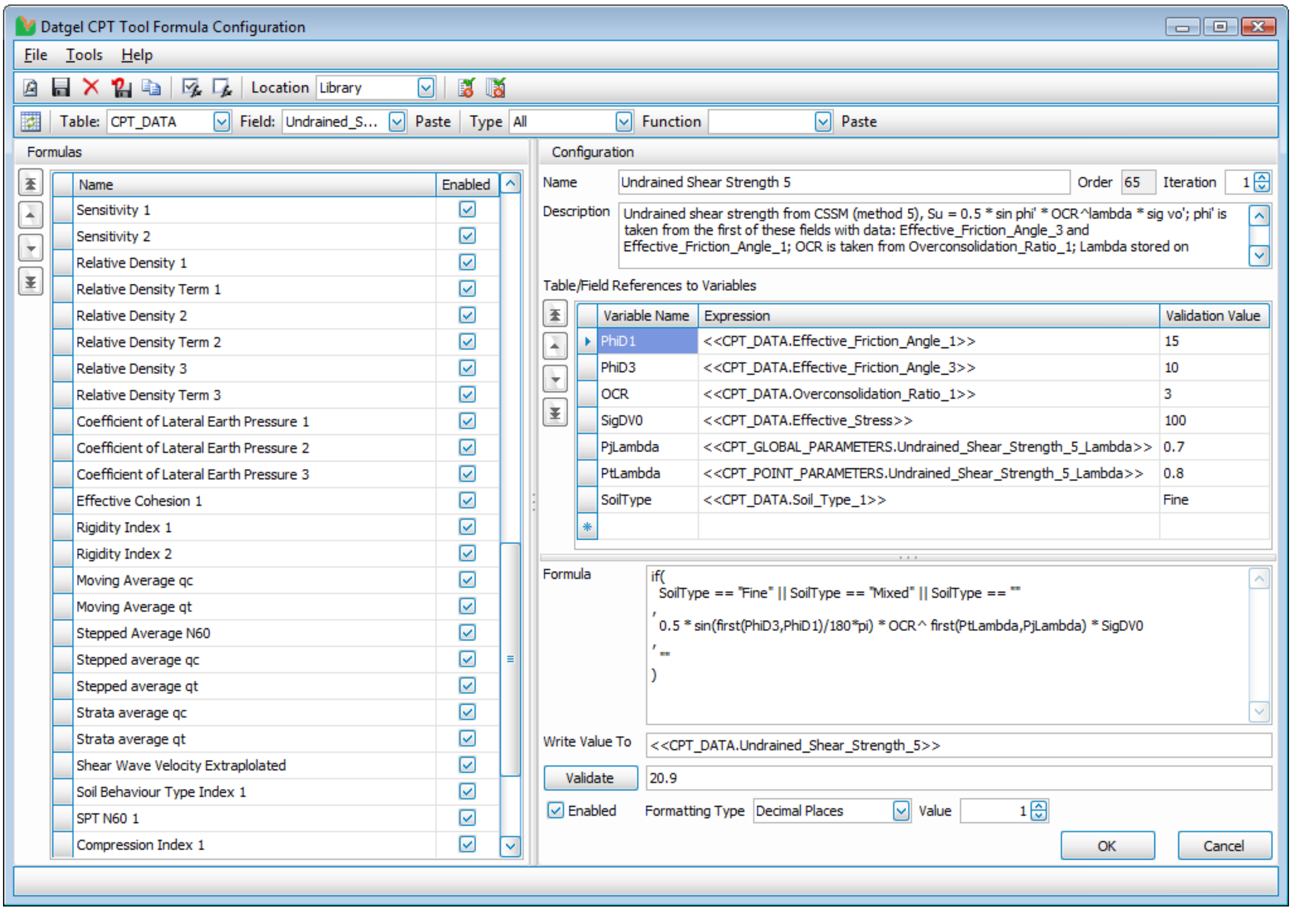
```
FunctionName(Parameter1,Parameter2,FunctionName2(Parameter1,Parameter2))
```

Becomes

```
FunctionName(
  Parameter1
,
  Parameter2
,
  FunctionName2(
  ,
    Parameter1
  ,
    Parameter2
  )
)
```

Using a consistent formatting standard throughout your collection of formulas will allow you to quickly read and understand a formula, and enables you to find errors easily.

Your screen should look similar to the following:



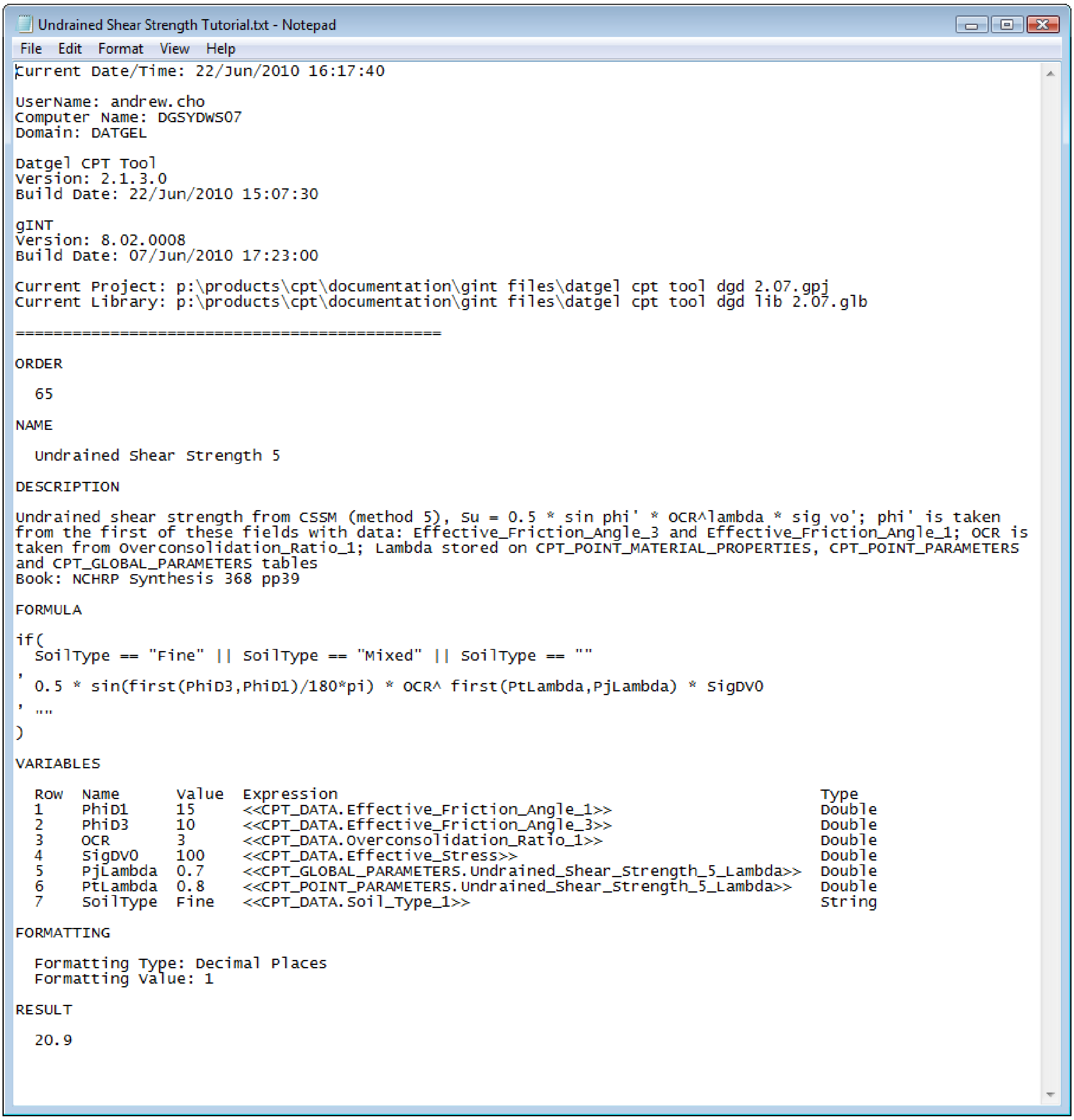
Click the **save** button to save the formula to your Project. After saving, the formula name should be visible in the Formulas Grid on the left side.

We are now ready to validate the formula. Click on the **Validate** Validate button. This will substitute variables in the Formula with the corresponding value in the **Validation Value** column in the Variables Grid, and then evaluate the equation.

If everything has been correctly entered, a value of `20.9` will appear in the text field adjacent to the **Validate** button. Otherwise, an error message will show, detailing why the validation failed. Read the error message carefully and fix your configuration accordingly. Then click the **Validate** button again to validate the configuration. Repeat until no errors are shown, and the correct value is returned.

The details of our formula can be saved to a text file, so that it may be archived, printed or distributed. Click on the **Generate Validation Report for Current Formula** button. Specify a file name and path for the new text file and click **Save**.

The text file will be created, and will be automatically opened in your default text editor.



Undrained Shear Strength Tutorial.txt - Notepad

File Edit Format View Help

```
Current Date/Time: 22/Jun/2010 16:17:40

UserName: andrew.cho
Computer Name: DGSYDWS07
Domain: DATGEL

Datgel CPT Tool
Version: 2.1.3.0
Build Date: 22/Jun/2010 15:07:30

gINT
Version: 8.02.0008
Build Date: 07/Jun/2010 17:23:00

Current Project: p:\products\cpt\documentation\gint files\datgel cpt tool dgd 2.07.gpj
Current Library: p:\products\cpt\documentation\gint files\datgel cpt tool dgd lib 2.07.glb

=============================================

ORDER

  65

NAME

  Undrained Shear Strength 5

DESCRIPTION

Undrained shear strength from CSSM (method 5), Su = 0.5 * sin phi' * OCR^lambda * sig vo'; phi' is taken
from the first of these fields with data: Effective_Friction_Angle_3 and Effective_Friction_Angle_1; OCR is
taken from Overconsolidation_Ratio_1; Lambda stored on CPT_POINT_MATERIAL_PROPERTIES, CPT_POINT_PARAMETERS
and CPT_GLOBAL_PARAMETERS tables
Book: NCHRP Synthesis 368 pp39

FORMULA

if(
  SoilType == "Fine" || SoilType == "Mixed" || SoilType == ""
,
  0.5 * sin(first(PhiD3,PhiD1)/180*pi) * OCR^ first(PtLambda,PjLambda) * SigDV0
,
  ""
)

VARIABLES

  Row  Name      Value  Expression                                             Type
  1    PhiD1     15     <<CPT_DATA.Effective_Friction_Angle_1>>                Double
  2    PhiD3     10     <<CPT_DATA.Effective_Friction_Angle_3>>                Double
  3    OCR       3      <<CPT_DATA.Overconsolidation_Ratio_1>>                 Double
  4    SigDV0    100    <<CPT_DATA.Effective_Stress>>                          Double
  5    PjLambda  0.7    <<CPT_GLOBAL_PARAMETERS.Undrained_Shear_Strength_5_Lambda>>  Double
  6    PtLambda  0.8    <<CPT_POINT_PARAMETERS.Undrained_Shear_Strength_5_Lambda>>   Double
  7    SoilType  Fine   <<CPT_DATA.Soil_Type_1>>                               String

FORMATTING

  Formatting Type: Decimal Places
  Formatting Value: 1

RESULT

  20.9
```

Return to the Formula Tool Configuration form, and click **OK** to close the form.

We are now ready to calculate the Undrained Shear Strength 5 correlation in the CPT_DATA table.

Go to **INPUT | CPT | CPT Global Parameters** tab, and enter `0.7` in the Undrained_Shear_Strength_Tutorial_5_Lambda field.

Go to **INPUT | CPT | CPT Data** tab, and select **GEF_01** as the PointID. Click on the bottom half of the screen and change a value to enable the **Save** button.

Click **Save**. Assuming that you have entered a value in all table fields referenced in the Variables Grid, and there is a value in the Effective_Stress field, and Soil_Type_1 is either "Fine", "Mixed" or empty, you should see a value in the newly created Undrained_Shear_Strength_5 field.

Over 50 working correlations in the Formula Tool have been provided to you with the CPT Tool standard gINT Files. A good way to learn how to use the Formula Tool is by learning from example. You may use these existing correlations as a basis to create new correlations that suit your requirements. The **Copy Formula** button on the Formula Configuration form is useful feature to quickly create multiple formulas that have only small differences.

You may also copy rows in the parameter grid to other correlations.

Now we will add the new correlation to the CPT Symbology tables.

Go to **DATA DESIGN | Library Data** tab and select DG_CPT_SYMBOLOGY from the yellow table drop down list.

Correctly assign the **Data Template** field, and then add a new row at the bottom with the following values, using the Data Tool when appropriate:

Column Name	Value
Parameter	Undrained Shear Strength 5
gINT Field Name	<<CPT_DATA.Undrained_Shear_Strength_5>>
SQL Field Name	[CPT_DATA].[Undrained_Shear_Strength_5]
Unit	kPa
Line Colour	Very Light Magenta
Line Type	Solid
Line Thickness	0.2
Data Marker	5
Data Marker Height Log	0
Data Marker Height Graph	
Minimum Scale	0
Maximum Scale	500
Automatic Scale	
Automatic Scale Round To	
Show on Report	True
Remark	
Name	Undrained Shear Strength
Abbreviation	S<<SUB>>u<<SUB>>
Reference	Wroth (1984)
Reference Short	

Go to **INPUT | CPT | CPT Project Symbology**. Scroll to the bottom, and select `Undrained Shear Strength 5` from the drop down list in the Parameter column. For `the Undrained Shear Strength 3` parameter, Set the **Show on Report** column value to **false**.

Values entered in this table will take precedence over the values in the DG_CPT_SYMBOLOGY library table. Therefore, The Undrained Shear Strength 3 parameter will not be shown on reports generated with this project file.

We will now output a dynamic report showing the calculated values in our newly created s_u field.

Go to **OUTPUT | Logs** tab, and select the CPT DYNAMIC A4P log report from the yellow drop down list. Select **GEF_01** in PointID field.

Click on the **Print** or **Preview** button, and the **User Report Variables** window will show. Fill in the following values and click **OK**.

Name	Value
Column 1	QT QC FT FS WITH MINOR
Column 2	RF SLOPE INDICATOR
Column 3	UNDRAINED SHEAR STRENGTH
Column 4	
Column 5	
Column 6	
Column 7	
Column 8	
Column 9	
Column 10	
Width 1 (mm)	
Width 2 (mm)	45
Width 3 (mm)	45
Width 4 (mm)	
Width 5 (mm)	
Width 6 (mm)	
Width 7 (mm)	
Width 8 (mm)	
Width 9 (mm)	
Width 10 (mm)	
Show qc qt Average Legend	Check this option.
Show Dissipation Legend	Check this option.
Show Design Line Legend	Check this option.
Legend 1	UNDRAINED SHEAR STRENGTH
Legend 2	

Below is an output of the report, exported as a png file.

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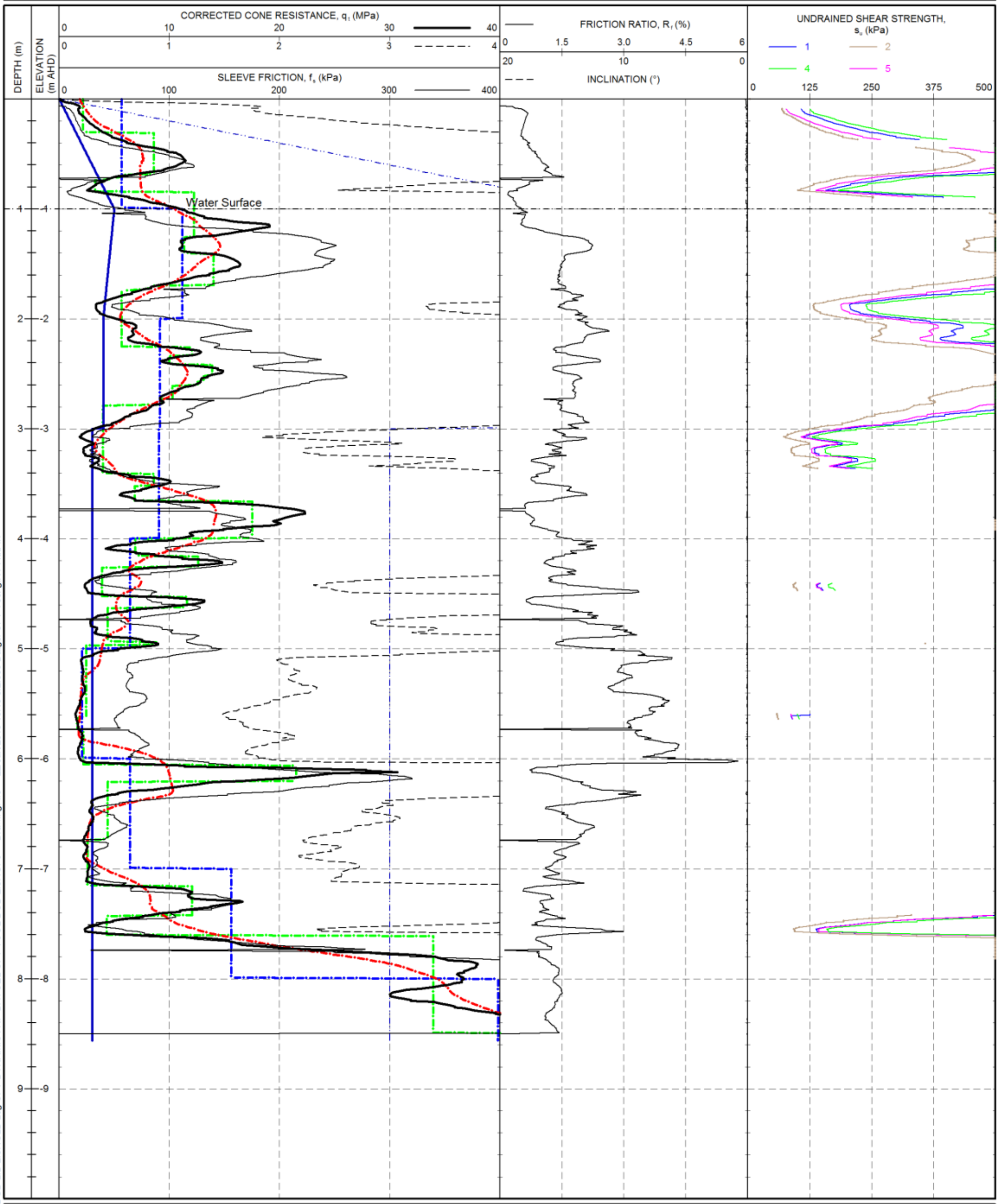
DATA SOLUTIONS
Geotechnics • Geoenvironment • Laboratory

CPT LOG

Hole ID **GEF_01a**

CLIENT	: CPT Client	AREA	: Place	SHEET	: 1 OF 1
ENGINEER	: ABC Engineering	EASTING	: 247950.9 m	STATUS	:
PROJECT	: CPT Tool Project	NORTHING	: 1267310.9 m	DATE	: 03/04/2009
LOCATION	: Somewhere	COORD. SYS.	: MGA94 56		
PROJECT No.	: 2.07	ELEVATION	: 0.00 m AHD		



q_t Moving Average Over 0.5 m
q_t Stepped Average Over 1 m
q_t Strata Average
Design Line
Dissipation Test

Undrained Shear Strength Method:
1. Su = ((qt · 10^3) - sigma vo) / Nkt; or ((qc · 10^3) - sigma vo) / Nk
2. Su = (qt · 10^3) / Nkt; or (qc · 10^3) / Nk
4. Trak et al. (1980), Terzaghi et al. (1996)
5. Wroth (1984)

DATGEL CPT TOOL DGD LIB 2.07.GLB Log CPT DYNAMIC A4P DATGEL CPT TOOL DGD 2.07.GPJ <<DrawingFile>> 22/Jun/2010 18:15 8.2.008 Datgel CPT Tool gINT Add-In

12 Correlations

The primary references for the correlation was Mayne (2007) and Lunne et al. (1997).

Many of the correlations listed in this section use constants within a formula. Users can set the constants in the following tables. The tables are listed in order of priority.

1. CPT_POINT_MATERIAL_PROPERTIES
2. CPT_POINT_PARAMETERS
3. CPT_GLOBAL_PARAMETERS

For example, if the Relative_Density_1_C0 field on CPT_POINT_PARAMETERS has a value it will be used in preference to the value, if any, on the CPT_GLOBAL_PARAMETERS table.

The fields in the CPT_POINT_MATERIAL_PROPERTIES table allow the constants to be defined for depth ranges for a particular PointID. A top and bottom depth must be specified when using the CPT_POINT_MATERIAL_PROPERTIES table, and the depth ranges must not overlap.

12.1 Soil Behaviour Type

The CPT Tool is supplied with five material type interpretation methods:

- Robertson 1990
- Robertson 1990 Extrapolated (axis extrapolated out)
- Robertson et al. 1986
- Robertson et al. 1986 q_c vs. R_f (Applicable when u_2 isn't measured)
- Schneider et al. 2008 (defined by formula in paper's table 6)

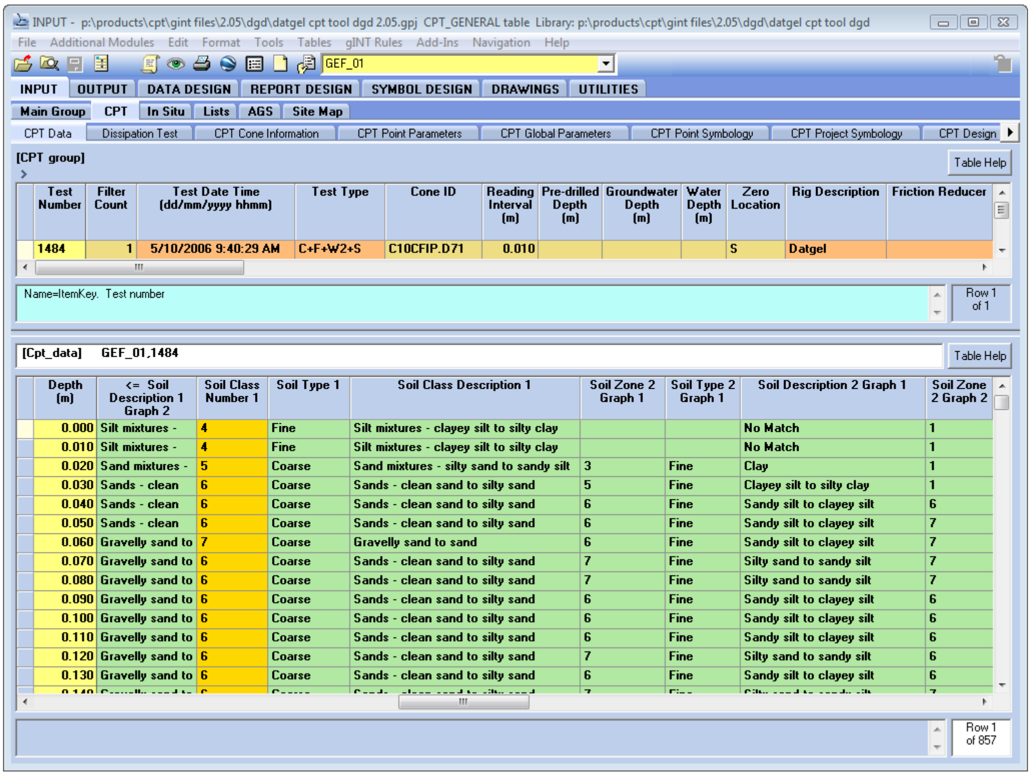
Additional methods may be defined by users in the DG_CPT* library tables. See section *13 Creating a New Soil Behaviour Type*.

The CPT_DATA table allows for two methods to be defined. The methods are set on the CPT_GLOBAL_PARAMETERS and the CPT_POINT_PARAMETERS tables.

The interpretation is done using 2 graphs, and then the first single result is used as the overall material classification. E.g. if Soil Zone 1 Graph 1 = 9,10,11,12 and Soil Zone 1 Graph 2 = 9, then Soil Class Number 1 will = 9.

If a point lies on the boarder of two zones, then the soil zone will be an appended string of both numbers, e.g. "9,10". The material type graph reports will print a black do for these duel points.

If the graph parameters are not within the range of the graph, then the Description field is set to "No Match".



12.2 Undrained Shear Strength and Consistency Term

12.2.1 Undrained Shear Strength 1

Undrained Shear Strength 1 (s_u) in Undrained_Shear_Strength_Term_1 is defined as:

When q_t has data,

$$s_u = \frac{(q_t \cdot 10^3 - \sigma_{vo})}{N_{kt}}$$

Otherwise,

$$s_u = \frac{(q_c \cdot 10^3 - \sigma_{vo})}{N_k}$$

N_k and N_{kt} are defined on the CPT_POINT_MATERIAL_PROPERTIES, CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables. Different values for N_k and N_{kt} can be defined for when q_c or q_t is either greater than or equal to, or less than a defined break point. Each of these tables have six fields from which the N_k and N_{kt} values, and the q_c and q_t break point values are stored and retrieved for the calculation of s_u.

Field Name	Description
Undrained_Shear_Strength_1_Nk_qc_BP	Break point used to determine which N_k to use in the s_u calculation
Undrained_Shear_Strength_1_Nk_qc_LT_BP	Used as the N_k in the s_u calculation, where q_t does not have data, and q_c is less than the break point.

Field Name	Description
Undrained_Shear_Strength_1_Nk_qc_GTE_BP	Used as the N_k in the s_u calculation, where q_t does not have data, and q_c is greater than or equal to the break point.
Undrained_Shear_Strength_1_Nkt_qt_BP	Break point used to determine which N_{kt} to use in the s_u calculation
Undrained_Shear_Strength_1_Nkt_qt_LT_BP	Used as the N_{kt} in the s_u calculation, where q_t has data, and q_t is less than the break point.
Undrained_Shear_Strength_1_Nkt_qt_GTE_BP	Used as the N_{kt} in the s_u calculation, where q_t has data, and q_t is greater than or equal to the break point.

The fields in the CPT_POINT_MATERIAL_PROPERTIES table allow the N_k and N_{kt} to be defined for depth ranges for a particular PointID. A top and bottom depth must be specified when using the CPT_POINT_MATERIAL_PROPERTIES table, and the depth ranges must not overlap.

If the CPT_POINT_MATERIAL_PROPERTIES table is populated for the calculated PointID, the N_k or N_{kt} that lies within the depth range of the current depth of the row in the CPT_DATA table is used to calculate s_u. If a matching depth range for the current depth is not found, or N_k or N_{kt} is missing, then the value is taken from the CPT_POINT_PARAMETERS or the CPT_GLOBAL_PARAMETERS tables.

12.2.2 Undrained Shear Strength 1 Term

The Undrained_Shear_Strength_Term_1 is defined based on the value of the Undrained_Shear_Strength_1 field and the values in the DG_CPT_SOIL_CONSISTENCY library table.

12.2.3 Undrained Shear Strength 2

Undrained Shear Strength 2 (s_u) in Undrained_Shear_Strength_Term_2 is defined as:

When q_t has data,

$$s_u = \frac{(q_t \cdot 10^3)}{N_{kt}}$$

Otherwise,

$$s_u = \frac{(q_c \cdot 10^3)}{N_k}$$

Where:

N_{kt} is stored in the Undrained_Shear_Strength_2_Nkt field.

N_k is stored in the Undrained_Shear_Strength_2_Nk field.

The variables are stored on CPT_POINT_MATERIAL_PROPERTIES, CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

The fields in the CPT_POINT_MATERIAL_PROPERTIES table allow the N_k and N_{kt} to be defined for depth ranges for a particular PointID. A top and bottom depth must be specified when using the CPT_POINT_MATERIAL_PROPERTIES table, and the depth ranges must not overlap.

If the CPT_POINT_MATERIAL_PROPERTIES table is populated for the calculated PointID, the N_k or N_{kt} that lies within the depth range of the current depth of the row in the CPT_DATA table is used to calculate s_u. If a matching depth range for the current depth is not found, or N_k or N_{kt} is missing, then the value is taken from the CPT_POINT_PARAMETERS or the CPT_GLOBAL_PARAMETERS tables.

12.2.4 Undrained Shear Strength 2 Term

The Undrained_Shear_Strength_Term_2 is defined based on the value of the Undrained_Shear_Strength_2 field and the values in the DG_CPT_SOIL_CONSISTENCY library table.

12.2.5 Undrained Shear Strength 3

Undrained Shear Strength 3 (s_u) based on CSSM in Undrained_Shear_Strength_3 is defined as:

When q_t has data,

$$s_u = 0.5 \cdot \sin\phi' \cdot OCR^{\Lambda} \cdot \sigma_{vo}'$$

Wroth (1984), NCHRP Synthesis 368 pp 39

Where:

ϕ' is taken from the first of these fields with data: Effective_Friction_Angle_3 and Effective_Friction_Angle_1

OCR is taken from Overconsolidation_Ratio_1

$\Lambda = 1 - C_s/C_c$, typically low to medium sensitivity clays are $0.7 \le \Lambda \le 0.8$, and sensitive and structured clays are $0.9 \le \Lambda \le 1.0$, and is stored in the Undrained_Shear_Strength_3_Lambda field.

Λ is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.2.6 Undrained Shear Strength 3 Term

The Undrained_Shear_Strength_Term_3 is defined based on the value of the Undrained_Shear_Strength_3 field and the values similar to that in DG_CPT_SOIL_CONSISTENCY library table.

12.2.7 Undrained Shear Strength 4

Undrained Shear Strength 4 (s_u) in Undrained_Shear_Strength_4 is defined as:

$$s_u = C_1 \cdot \sigma_p'$$

Trak et al. (1980), Terzaghi et al. (1996), NCHRP Synthesis 368 pp 40

Where:

σ_p' is taken from Preconsolidation_Stress_1

C_1 is 0.22 in the published formula, and is stored in the Undrained_Shear_Strength_4_C1 field.

C_1 is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.2.8 Undrained Shear Strength 4 Term

The Undrained_Shear_Strength_Term_4 is defined based on the value of the Undrained_Shear_Strength_4 field and the values similar to that in DG_CPT_SOIL_CONSISTENCY library table.

12.3 Relative Density and Relative Density Term

12.3.1 Relative Density 1

Relative density (D_r) in Relative_Density_1 is defined as:

$$D_r = \frac{1}{C_2} \cdot \ln\left(\frac{q_t \cdot 10^3 \cdot Wehr}{C_0 \cdot (\sigma'_{vo})^{C_1}}\right) \cdot 100$$

Baldi et al. (1986) and Al-Homoud and Wehr (2006), CPT in Geotechnical Practice pp 83

Where:

C_0 is stored in the Relative_Density_1_C0 field. Published value for normally consolidated 157, over consolidated 181

C_1 is stored in the Relative_Density_1_C1 field. Published value for normally consolidated 0.55, over consolidated 0.55

C_2 is stored in the Relative_Density_1_C2 field. Published value for normally consolidated 2.41, over consolidated 2.46

$Wehr$ is the Wehr Correction for Calcareous Soils, this constant is defined in the Relative_Density_1_Wehr_Correction field and was suggested in Al-Homoud and Wehr (2006). If the field is empty the default is 1.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.3.2 Relative Density Term 1

Relative density term in Relative_Density_Term_1 is defined based on Relative_Density_1 on the CPT_DATA table and the values in the DG_CPT_SOIL_CONSISTENCY library table.

12.3.3 Relative Density 2

Relative density (D_r) in Relative_Density_2 is defined as:

$$D_r = 100 \cdot \left[\mathrm{C_1} \cdot \ln\left(\frac{\mathrm{q_t}/\sigma_{\mathrm{atm}}}{\sqrt{\sigma_{\mathrm{v0}}'/\sigma_{\mathrm{atm}}}}\right) + \mathrm{C_2}\right]$$

Jamiolkowski et al. (2001), NCHRP Synthesis 368 pp 41-42

Where:

C_1 is stored in the Relative_Density_2_C1 field. Published value is 0.268 for all sands

C_2 is stored in the Relative_Density_2_C2 field. For average compressibility: C2 = -0.675, for high compressibility and sands of carbonate or calcareous composition: C2 <= 1.0, for low compressibility: C2 >= -2.0

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.3.4 Relative Density Term 2

Relative density term in Relative_Density_Term_2 is defined based on Relative_Density_2 on the CPT_DATA table and the values in the DG_CPT_SOIL_CONSISTENCY library table.

12.3.5 Relative Density 3

Relative density (D_r) in Relative_Density_3 is defined as:

$$D_r = \left[\frac{q_{t1}}{305 \cdot C_1 \cdot OCR^{0.18} \cdot (1.2 + 0.05 \cdot \log(t/100))}\right]^{0.5} \cdot 100$$

Kulhawy and Mayne (1990), CPT in Geotechnical Practice pp 84

Where:

> C_1 is stored in the Relative_Density_3_C1 field. Published values range from 0.91 for low compressibility, 1.0 for medium compressible sands, to 1.09 for highly compressible
>
> t is time in years and stored in the Relative_Density_3_t field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.3.6 Relative Density Term 3

Relative density term in Relative_Density_Term_3 is defined based on Relative_Density_3 on the CPT_DATA table and the values in the DG_CPT_SOIL_CONSISTENCY library table.

12.4 Soil Behaviour Type Index

12.4.1 Soil Behaviour Type Index 1

The soil behaviour type index (I_C) in Soil_Behaviour_Type_Index_1 is defined as:

$$I_C = ((C_1 - \log_{10} Q_t)^2 + (\log_{10} F_r + C_2)^2)^{0.5}$$

Robertson and Wride (1998)

Where:

> C_1 is 3.47 in the published formula, and is stored in the Soil_Behaviour_Type_Index_1_C1 field.
>
> C_2 is 1.22 in the published formula, and is stored in the Soil_Behaviour_Type_Index_1_C2 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.4.2 Soil Behaviour Type Index 2

The soil behaviour type index (I_C) in Soil_Behaviour_Type_Index_2 is defined as:

$$I_C = \sqrt{[C_1 - \log_{10} Q_t(1 - B_q)]^2 + [\, C_2 + C_3 \cdot \log_{10} F_r]^2}$$

Jefferies and Davies (1993)

Where:

C_1 is 3 in the published formula, and is stored in the Soil_Behaviour_Type_Index_2_C1 field.

C_2 is 1.5 in the published formula, and is stored in the Soil_Behaviour_Type_Index_2_C2 field.

C_3 is 1.3 in the published formula, and is stored in the Soil_Behaviour_Type_Index_2_C3 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.5 SPT N60 Value

12.5.1 SPT N60 Value 1

The SPT N_{60} in SPT_N60_1 is defined as:

$$N_{60} = \frac{q_c \cdot 10^3}{C_1 \cdot p_a \,(1 - \frac{I_c}{C_2})}$$

Robertson and Wride (1998), CPT in Geotechnical Practice pp 151

Where:

C_1 is 8.5 in the published formula, and is stored in the SPT_N60_1_C1 field.

C_2 is 4.6 in the published formula, and is stored in the SPT_N60_1_C2 field.

p_a is the Atmospheric pressure, 100 kPa, and cannot be changed in the CPT Tool.

I_c is stored in the Soil_Behaviour_Type_Index_1 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.5.2 SPT N60 Value 2

The SPT N_{60} in SPT_N60_2 is defined as:

$$N_{60} = \frac{q_c}{C_1 \cdot (1 - \frac{I_c}{C_2})}$$

Jefferies and Davies (1993)

Where:

C_1 is 0.85 in the published formula, and is stored in the SPT_N60_2_C1 field.

C_2 is 4.75 in the published formula, and is stored in the SPT_N60_2_C2 field.

I_c is stored in the Soil_Behaviour_Type_Index_2 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.6 SPT Average N60 Value

The SPT average N60 value is a stepped average of SPT N60 values in the SPT_N60_1 or SPT_N60_2 fields in the CPT_DATA table for each defined depth interval step.

The average of the N60 values is calculated for each depth interval step, and the result is recorded in the SPT_ Average_N60_1 or SPT_Average_N60_2 fields in the CPT_DATA table for each row in that interval step.

The depth interval distance is defined on the SPT_N60_Average_Interval field on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables, and is in metres.

12.7 Shear Wave Velocity

12.7.1 Shear Wave Velocity 1

Shear Wave velocity 1 (V_S) in Shear_Wave_Velocity_1 is defined as:

$$V_s = C_1 \cdot \log(f_s) + C_2$$

Mayne (2006), NCHRP Synthesis 368 pp 30

Where:

C_1 is 118.5 in the published formula, and is stored in the Shear_Wave_Velocity_1_C1 field.

C_2 is 18.5 in the published formula, and is stored in the Shear_Wave_Velocity_1_C2 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.7.2 Shear Wave Velocity 2

Shear Wave velocity 2 (V_S) in Shear_Wave_Velocity_2 is defined as:

$$V_s = (C_1 \cdot \log(q_t \cdot 10^3) - C_2)^{C_3} \cdot \left(\frac{f_s}{q_t \cdot 10^3} \cdot 100\right)^{C_4}$$

Hegazy and Mayne (1995), NCHRP Synthesis 368 pp 30

Where:

C_1 is 10.1 in the published formula, and is stored in the Shear_Wave_Velocity_2_C1 field.

C_2 is 11.4 in the published formula, and is stored in the Shear_Wave_Velocity_2_C2 field.

C_3 is 1.67 in the published formula, and is stored in the Shear_Wave_Velocity_2_C3 field.

C_4 is 0.3 in the published formula, and is stored in the Shear_Wave_Velocity_2_C4 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of V_s is calculated when the Soil_Type_1 field value on the CPT_DATA table has any value for that row.

12.7.3 Shear Wave Velocity 3

Shear Wave velocity 3 (V_S) in Shear_Wave_Velocity_3 is defined as:

$$V_s = C_1 \cdot (q_t \cdot 10^3)^{C_2}$$

Mayne and Rix (1995), NCHRP Synthesis 368 pp 30

Where:

C_1 is 1.75 in the published formula, and is stored in the Shear_Wave_Velocity_3_C1 field.

C_2 is 0.627 in the published formula, and is stored in the Shear_Wave_Velocity_3_C2 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of V_s is calculated only when the Soil_Type_1 field value on the CPT_DATA table is *Fine or Mixed* for that row.

12.7.4 Shear Wave Velocity 4

Shear Wave velocity 4 (V_S) in Shear_Wave_Velocity_4 is defined as:

$$V_s = C_1 \cdot {q_t}^{C_2} \cdot (\sigma'_{v0} \cdot 10^{-3})^{C_3}$$

Baldi et al. (1989), NCHRP Synthesis 368 pp 30

Where:

C_1 is 277 in the published formula, and is stored in the Shear_Wave_Velocity_4_C1 field.

C_2 is 0.13 in the published formula, and is stored in the Shear_Wave_Velocity_4_C2 field.

C_3 is 0.27 in the published formula, and is stored in the Shear_Wave_Velocity_4_C3 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of V_s is calculated only when the Soil_Type_1 field value on the CPT_DATA table is *Coarse or Mixed* for that row.

12.8 Unit Weight

12.8.1 Dry Unit Weight 1

Dry Unit Weight 1 (γ_{dry}) in Dry_Unit_Weight_1 is defined as:

$$\gamma_{dry} = C_1 \cdot \log(q_{t1}) + C_2$$

Mayne (2007), NCHRP Synthesis 368 pp 31

Where:

C_1 is 1.89 in the published formula, and is stored in the Dry_Unit_Weight_1_C1 field.

C_2 is 11.8 in the published formula, and is stored in the Dry_Unit_Weight_1_C2 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of V_s is calculated only when the Soil_Type_1 field value on the CPT_DATA table is *Coarse or Mixed* for that row.

12.8.2 Saturated Unit Weight 1

Saturated Unit Weight 1 (γ_{sat}) in Saturated_Unit_Weight_1 is defined as:

$$\gamma_{sat} = C_1 \cdot \log(V_s) - C_2 \cdot \log(z)$$

Mayne (2007), NCHRP Synthesis 368 pp 31

Where:

C_1 is 8.32 in the published formula, and is stored in the Saturated_Unit_Weight_1_C1 field

C_2 is 1.61 in the published formula, and is stored in the Saturated_Unit_Weight_1_C2 field

z is Depth

V_s is taken from the first of these fields with data: Shear_Wave_Velocity_Extrapolated or Shear_Wave_Velocity_1

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation is applicable to all soil types.

12.8.3 Saturated Unit Weight 2

Saturated Unit Weight 2 (γ_{sat}) in Saturated_Unit_Weight_2 is defined as:

$$\gamma_{sat} = C_1 \cdot \log(f_s) + C_2 \cdot G_s - C_3$$

Mayne (2007), NCHRP Synthesis 368 pp 32

Where:

C_1 is 2.6 in the published formula, and is stored in the Saturated_Unit_Weight_2_C1 field

C_2 is 15 in the published formula, and is stored in the Saturated_Unit_Weight_2_C2 field

C_3 is 26.5 in the published formula, and is stored in the Saturated_Unit_Weight_2_C3 field

G_s is Specific Gravity of Solids, typically 2.4 to 2.9, and is stored in the Specific_Gravity_of_Solids field on CPT_GLOBAL_PARAMETERS

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation is applicable to all soil types.

12.9 Small-Strain Shear Modulus

12.9.1 Small-Strain Shear Modulus 1

Small-Strain Shear Modulus 1 (G_0) of sand in Small_Strain_Shear_Modulus_1 is defined as:

$$G_0 = C_1 \cdot \left(\frac{q_c \cdot 10^3}{\sqrt{\sigma'_{v0}}}\right)^{C_2} \cdot q_t$$

Rix and Stokoe (1992), CPT in Geotechnical Practice pp 94

Where:

C_1 is 1634 in the published formula, and is stored in the Small_Strain_Shear_Modulus_1_C1 field

C_2 is -0.75 in the published formula, and is stored in the Small_Strain_Shear_Modulus_1_C2 field

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of G_0 is calculated only when the Soil_Type_1 field value on the CPT_DATA table is *Coarse or Mixed* for that row.

12.9.2 Small-Strain Shear Modulus 2

Small-Strain Shear Modulus 2 (G_0) in Small_Strain_Shear_Modulus_2 is defined as:

$$G_0 = \frac{\gamma_{bulk}}{g} \cdot V_s^2$$

Elastic theory, CPT in Geotechnical Practice pp 74 and 94, NCHRP Synthesis 368 pp 32

Where:

V_s is taken from the first of these fields with data: Shear_Wave_Velocity_Extrapolated or Shear_Wave_Velocity_1

γ_{bulk} is taken from Bulk_Unit_Weight

This correlation of G_0 is applicable to all soil types.

12.10 Young's Modulus

Young's Modulus 1 (E_0) in Youngs_Modulus_1 is defined as:

$$E_0 = 2 \cdot (1 + \nu) \cdot G_0$$

Elastic theory, CPT in Geotechnical Practice pp 74 and 94, NCHRP Synthesis 368 pp 32

Where:

υ = 0.2 is applied and can be varied in the Formula Tool. Published literature states: υ' = 0.2 applies for drained soils and υ_u = 0.5 applies for undrained soils

G_0 is taken from Small_Strain_Shear_Modulus_2

This correlation of E_0 is applicable to all soil types.

12.11 Constrained Modulus

12.11.1 Constrained Modulus 1

The constrained modulus 1 (M) in Constrained_Modulus_1 is defined as:

$$M = C_1 \cdot (q_t - \sigma_{vo} \cdot 10^{-3})$$

Kulhawy and Mayne (1990), NCHRP Synthesis 368 pp 33

Where:

> C_1 is 8.25 in the published formula, and is stored in the Constrained_Modulus_1_C1 field.

The constant is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.11.2 Constrained Modulus 2

The constrained modulus 2 (M) in Constrained_Modulus_2 is defined as:

$$M = C_1 \cdot G_0$$

Burns and Mayne (2002), NCHRP Synthesis 368 pp 33-34

Where:

> C_1 is 0.02 for organic plastic clays up to 2 for over consolidated quartz sands in the published literature, and is stored in the Constrained_Modulus_2_C1 field
>
> G_0 is taken from Small_Strain_Shear_Modulus_2

The constant is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of M is applicable to all soil types.

> This global approach to defining C_1 is potentially inaccurate, it would be better to define the constant based on soil type with depth.

12.12 Coefficient of Volume Change

The coefficient of volume change 1 (m_v) in Coefficent_Volume_Change_1 is defined as:

$$m_v = \frac{1}{M}$$

Where:

> M the constrained modulus, and is taken from the Constrained_Modulus_1 field.

12.13 Compression Index

The Compression Index 1 (C_c) in Compression_Index_1 is defined as:

$$C_c = \frac{C_1(1 + e) \cdot \sigma'_v \cdot 10^{-3}}{M}$$

Where:

C_1 is 2.3 in the published formula, and is stored in the Compression_Index_1_C1 field.

e is the Void Ratio, and is stored in the Void_Ratio field.

M is the constrained modulus, and is taken from the Constrained_Modulus_1 field.

The constant and e are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.14 Preconsolidation Stress and Overconsolidation Ratio

12.14.1 Preconsolidation Stress 1 and Overconsolidation Ratio 1

The Preconsolidation Stress 1 ($\sigma_p{}'$) of clay in Preconsolidation_Stress_1 is defined as:

$$\sigma_p{}' = C_1 \cdot (q_t \cdot 10^3 - \sigma_{vo})$$

Mayne (1995), Demers and Leroueil (2002), NCHRP Synthesis 368 pp 34

Where:

C_1 is 0.33 in the published formula, and is stored in the Preconsolidation_Stress_1_C1 field.

The constant is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

The overconsolidation ratio 1 in Overconsolidation_Ratio_1 is defined as:

$$OCR = \frac{\sigma_p{}'}{\sigma_{vo}{}'}$$

$\sigma_p{}'$ is taken from Preconsolidation_Stress_1 field

12.14.2 Preconsolidation Stress 2 and Overconsolidation Ratio 2

The Preconsolidation Stress 2 ($\sigma_p{}'$) of clay in Preconsolidation_Stress_2 is defined as:

$$\sigma_p' = C_1 \cdot \Delta u$$

Chen and Mayne (1996), NCHRP Synthesis 368 pp 34

Where:

C_1 is 0.53 in the published formula, and is stored in the Preconsolidation_Stress_2_C1 field.

The constant is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

The overconsolidation ratio 2 in Overconsolidation_Ratio_2 is defined as:

$$OCR = \frac{\sigma_p{}'}{\sigma_{vo}{}'}$$

$\sigma_p{}'$ is taken from Preconsolidation_Stress_2 field

12.14.3 Preconsolidation Stress 3 and Overconsolidation Ratio 3

The Preconsolidation Stress 3 ($\sigma_p{}'$) of clay in Preconsolidation_Stress_3 is defined as:

$$\sigma_p{}' = C_1 \cdot (q_t \cdot 10^3 - u_2)$$

Mayne (2005), NCHRP Synthesis 368 pp 35

Where:

C_1 is 0.6 in the published formula, and is stored in the Preconsolidation_Stress_3_C1 field.

The constant is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

The overconsolidation ratio 3 in Overconsolidation_Ratio_3 is defined as:

$$OCR = \frac{\sigma_p{}'}{\sigma_{vo}{}'}$$

$\sigma_p{}'$ is taken from Preconsolidation_Stress_3 field

12.14.4 Preconsolidation Stress 4 and Overconsolidation Ratio 4

The Preconsolidation Stress 4 ($\sigma_p{}'$) of clay in Preconsolidation_Stress_4 is defined as:

$$\sigma_p' = C_1 \cdot Q_t^{C_2} \cdot \sigma_{vo}{}'$$

Robertson (2009), Guide to CPT pp 31

Where:

C_1 is 0.25 in the published formula, and is stored in the Preconsolidation_Stress_4_C1 field

C_2 is 1.25 in the published formula, and is stored in the Preconsolidation_Stress_4_C2 field

The constant is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

The overconsolidation ratio 4 in Overconsolidation_Ratio_4 is defined as:

$$OCR = \frac{\sigma_p{}'}{\sigma_{vo}{}'}$$

$\sigma_p{}'$ is taken from Preconsolidation_Stress_4 field

12.14.5 Preconsolidation Stress 5 and Overconsolidation Ratio 5

The Preconsolidation Stress 5 ($\sigma_p{}'$) of sand in Preconsolidation_Stress_5 is defined as:

$$\sigma_p' = \left[\frac{C_1 \cdot (q_t \cdot 10^3/\sigma_{atm})^{C_2}}{(1 - \sin\phi') \cdot (\sigma_{v0}{}'/\sigma_{atm})^{C_3}}\right]^{\left(\frac{1}{\sin\phi' - C_4}\right)} \cdot \sigma_{vo}{}'$$

Mayne (2005), NCHRP Synthesis 368 pp 35

Where:

C_1 is 0.192 in the published formula, and is stored in the Preconsolidation_Stress_5_C1 field

C_2 is 0.22 in the published formula, and is stored in the Preconsolidation_Stress_5_C2 field

C_3 is 0.31 in the published formula, and is stored in the Preconsolidation_Stress_5_C3 field

C_4 is 0.27 in the published formula, and is stored in the Preconsolidation_Stress_5_C4 field

ϕ' is taken from Effective_Friction_Angle_3

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

The overconsolidation ratio 5 in Overconsolidation_Ratio_5 is defined as:

$$OCR = \frac{\sigma_p{}'}{\sigma_{vo}{}'}$$

$\sigma_p{}'$ is taken from Preconsolidation_Stress_5 field

12.14.6 Preconsolidation Stress 6 and Overconsolidation Ratio 6

The Preconsolidation Stress 6 ($\sigma_p{}'$) of all soil types in Preconsolidation_Stress_6 is defined as:

$$\sigma_p' = C_1 \cdot \sigma_{atm}{}^{C_2} \cdot (G_0 \cdot 10^3)^{C_3} \cdot \sigma_{vo}{}'^{C_4}$$

Mayne (2007), NCHRP Synthesis 368 pp 35

Where:

C_1 is 0.101 in the published formula, and is stored in the Preconsolidation_Stress_6_C1 field

C_2 is 0.102 in the published formula, and is stored in the Preconsolidation_Stress_6_C2 field

C_3 is 0.478 in the published formula, and is stored in the Preconsolidation_Stress_6_C3 field

C_4 is 0.420 in the published formula, and is stored in the Preconsolidation_Stress_6_C4 field

G_0 is taken from Small_Strain_Shear_Modulus_2

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

The overconsolidation ratio 6 in Overconsolidation_Ratio_6 is defined as:

$$OCR = \frac{\sigma_p{}'}{\sigma_{vo}{}'}$$

$\sigma_p{}'$ is taken from Preconsolidation_Stress_6 field

12.15 Effective Angle of Friction

12.15.1 Effective Angle of Friction 1

The effective angle of internal friction of mixed soils (ϕ') in Effective_Friction_Angle_1 is defined as:

$$\phi' = C_1{}^{\circ} \cdot B_q{}^{C_2} \cdot \left[C_3 + C_4 \cdot B_q + \log Q_t\right]$$

Mayne and Campanella (2005), NCHRP Synthesis 368 pp 38-39

Where:

C_1 is 29.5 in the published formula, and is stored in the Effective_Friction_Angle_1_C1 field.

C_2 is 0.121 in the published formula, and is stored in the Effective_Friction_Angle_1_C2 field.

C_3 is 0.256 in the published formula, and is stored in the Effective_Friction_Angle_1_C3 field.

C_4 is 0.336 in the published formula, and is stored in the Effective_Friction_Angle_1_C4 field.

This correlation of ϕ' is only applicable for $0.1 < B_q < 1.0$ and hence will only be calculated if B_q in the Pore_Pressure_Ratio field on the same row lies within this range.

12.15.2 Effective Angle of Friction 2

The effective angle of internal friction of sand (ϕ') in Effective_Friction_Angle_2 is defined as:

$$\phi' = \tan^{-1}\left(C_1 + C_2 \cdot \log\left(\frac{q_t \cdot 10^3}{\sigma_{v0}'}\right)\right)$$

Robertson and Campanella (1983), NCHRP Synthesis 368 pp 38

Where:

C_1 is 0.1 in the published formula, and is stored in the Effective_Friction_Angle_2_C1 field.

C_2 is 0.38 in the published formula, and is stored in the Effective_Friction_Angle_2_C2 field.

This correlation of ϕ' is only applicable for Sands and hence will only be calculated if the Soil_Type_1 field value is *coarse* or *mixed*.

12.15.3 Effective Angle of Friction 3

The effective angle of internal friction of sand (ϕ') in Effective_Friction_Angle_3 is defined as:

$$\phi' = C_1 + C_2 \cdot \log(q_{t1})$$

Kulhawy and Mayne (1990), NCHRP Synthesis 368 pp 38

Where:

C_1 is 17.6° in the published formula, and is stored in the Effective_Friction_Angle_3_C1 field.

C_2 is 11.0° in the published formula, and is stored in the Effective_Friction_Angle_3_C2 field.

This correlation of ϕ' is only applicable for Sands and hence will only be calculated if the Soil_Type_1 field value is *coarse* or *mixed*.

12.1 Effective Cohesion

12.1.1 Effective Cohesion 1

The cohesion (c') in Effective_Cohesion_1 is defined as:

$$c' = C_1 \cdot \sigma_p'$$

Mayne and Stewart (1988), Mesri and Abdel-Ghaffar (1993), NCHRP Synthesis 368 pp 44

Where:

C_1 is 0.02 in the published formula, and is stored in the Effective_Cohesion_1_C1_C1 field.

$\sigma_p{}'$ is taken from Preconsolidation_Stress_1field.

12.2 Sensitivity

12.2.1 Sensitivity 1

The Sensitivity (S_t) in Sensitivity_1 is defined as:

$$S_t = \frac{N_s}{R_f}$$

Schmertmann (1978b), Rad and Lunne (1986), CPT in Geotechnical Practice pp 68

Where:

N_s is a value between 5 and 10 in the published formula, and is stored in the Sensitivity_1_Ns field.

The constant is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.2.2 Sensitivity 2

The Sensitivity S_t in Sensitivity_2 is defined as:

$$S_t = \frac{C_1 \cdot (q_t \cdot 10^3 - \sigma_{vo})}{f_s}$$

Mayne (2007), NCHRP Synthesis 368 pp 41

Where:

C_1 is 0.073 in the published formula, and is stored in the Sensitivity_2_C1 field.

The constant is stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of S_t is based on the assumption of OCR < 2, $s_u = 0.22\,\sigma'_p$ and $\sigma'_p = 0.33\,(q_t - \sigma_{vo})$. The value of S_t is recorded in the Sensitivity_2 field on the CPT_DATA table.

12.3 Coefficient of Lateral Earth Pressure

12.3.1 Coefficient of Lateral Earth Pressure 1

Coefficient of Lateral Earth Pressure 1 (K_0) is recorded in the Coefficient_Lateral_Earth_Pressure_1 is defined as:

$$K_0 = (1 - \sin\phi') \cdot OCR^{\sin\phi'}$$

$$Maximum\ K_0 = K_P = \frac{(1 + \sin\phi')}{(1 - \sin\phi')}$$

Mayne (2007), NCHRP Synthesis 368 pp 42

Where:

OCR is taken from the Overconsolidation_Ratio_1 field on the CPT_DATA table.

ϕ' is taken from the Effective_Friction_Angle_3 and Effective_Friction_Angle_1 field on the CPT_DATA table.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.3.2 Coefficient of Lateral Earth Pressure 2

Coefficient of Lateral Earth Pressure 2 (K_0) is recorded in the Coefficient_Lateral_Earth_Pressure_2 is defined as:

$$K_0 = C_1 \cdot \left(\frac{q_t \cdot 10^3}{\sigma_{atm}}\right)^{C_2} \cdot \left(\frac{\sigma_{atm}}{\sigma_{v0}{}'}\right)^{C_3} \cdot OCR^{C_4}$$

Mayne (2007), NCHRP Synthesis 368 pp 43

Where:

OCR is taken from the Overconsolidation_Ratio_5 field on the CPT_DATA table.

C_1 is 0.192 in the published formula, and is stored in the Coefficient_Lateral_Earth_Pressure_2_C1 field.

C_2 is 0.22 in the published formula, and is stored in the Coefficient_Lateral_Earth_Pressure_2_C2 field.

C_3 is 0.31 in the published formula, and is stored in the Coefficient_Lateral_Earth_Pressure_2_C3 field.

C_4 is 0.27 in the published formula, and is stored in the Coefficient_Lateral_Earth_Pressure_2_C3 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.3.3 Coefficient of Lateral Earth Pressure 3

Coefficient of Lateral Earth Pressure 3 (K_0) is recorded in the Coefficient_Lateral_Earth_Pressure_3 is defined as:

$$K_0 = C_1 \cdot \left(\frac{q_t \cdot 10^3 - \sigma_{vo}}{\sigma_{vo}{}'}\right)$$

Kulhawy and Mayne (1990), CPT Guide pp 32

Where:

C_1 is 0.1 in the published formula, and is stored in the Coefficient_Lateral_Earth_Pressure_3_C1 field.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

12.4 Rigidity Index

12.4.1 Rigidity Index 1

Rigidity index 1 (I_r) is recorded in the Rigidity_Index_1 is defined as:

$$I_r = exp\left[\left(\frac{C_1}{M} + C_2\right) \cdot \left(\frac{q_t \cdot 10^3 - \sigma_{vo}}{q_t \cdot 10^3 - u_2}\right) - C_3\right]$$

Mayne (2001), NCHRP Synthesis 368 pp 46

Where:

C_1 is 1.5 in the published formula, and is stored in the Rigidity_Index_1_C1 field.

C_2 is 2.925 in the published formula, and is stored in the Rigidity_Index_1_C2 field.

C_3 is 2.925 in the published formula, and is stored in the Rigidity_Index_1_C3 field.

M is the Cam clay constant, slope of the critical state line and is defined as:

$$M = \frac{6 \cdot \sin \phi'}{3 - \sin \phi'}$$

ϕ' for the calculation of the Cam clay constant M is taken from the Effective_Friction_Angle_1 field on the CPT_DATA table.

The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of I_r is calculated only when the Soil_Type_1 field value on the CPT_DATA table has a value of *Fine* for that row.

12.4.2 Rigidity Index 2

Rigidity index 2 (I_r) is recorded in the Rigidity_Index_2 is defined as:

$$I_r = \frac{exp[C_1 \cdot (C_2 - PI)]}{[1 + \ln\{1 + C_3 \cdot (OCR - 1)^{C_4}\}]^{C_5}}$$

Keaveny and Mitchel (1986), NCHRP Synthesis 368 pp 46

Where:

C_1 is 0.0435 in the published formula, and is stored in the Rigidity_Index_2_C1 field.

C_2 is 137 in the published formula, and is stored in the Rigidity_Index_2_C2 field.

C_3 is 0.385 in the published formula, and is stored in the Rigidity_Index_2_C3 field.

C_4 is 3.2 in the published formula, and is stored in the Rigidity_Index_2_C4 field.

C_5 is 0.8 in the published formula, and is stored in the Rigidity_Index_2_C5 field.

PI is the Plasticity Index, and is stored in the Plasticity_Index field.

OCR is taken from the Overconsolidation_Ratio_4 field on the CPT_DATA table.

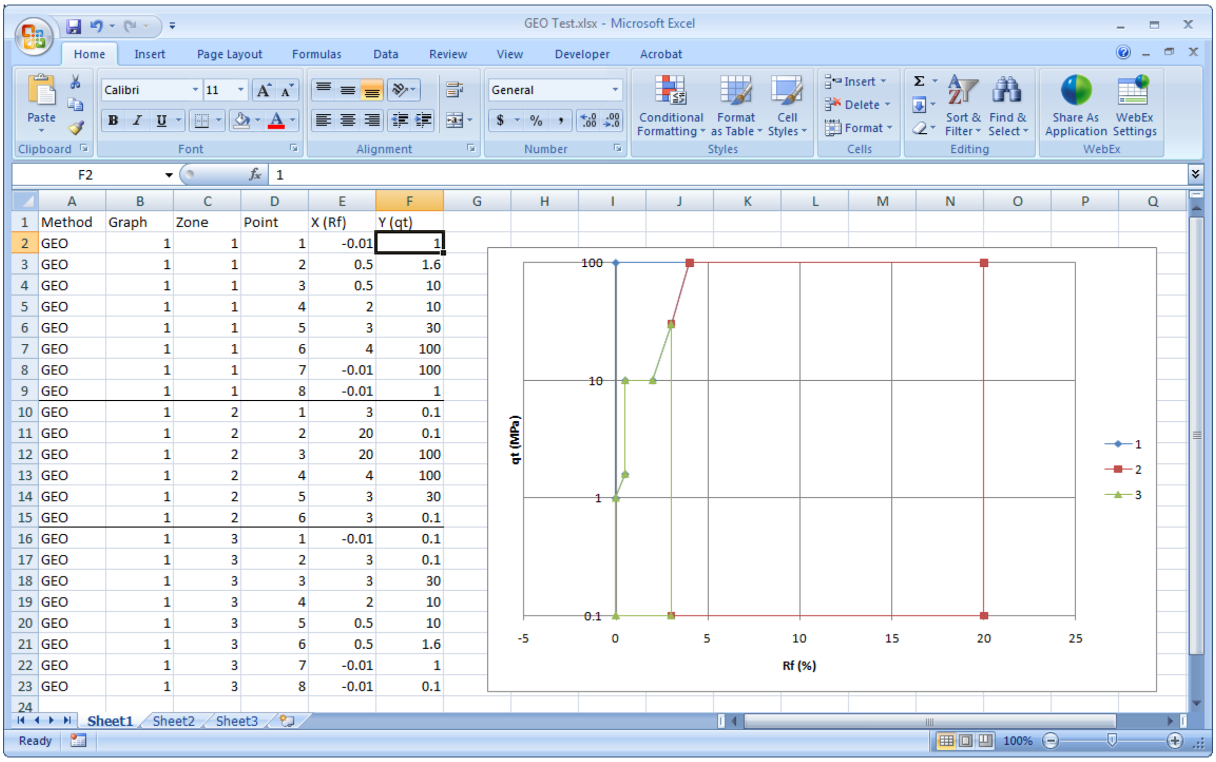
The constants are stored on CPT_POINT_PARAMETERS and CPT_GLOBAL_PARAMETERS tables.

This correlation of I_r is calculated only when the Soil_Type_1 field value on the CPT_DATA table has a value of *Fine* for that row.

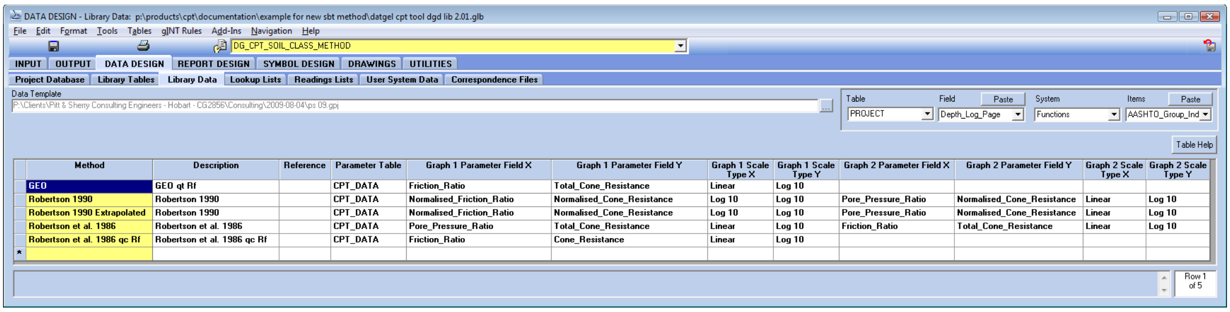
13 Creating a New Soil Behaviour Type

Creating a new soil behaviour type involves adding data to library tables, and optionally creating *Fixed Curve on Graph* and *Graph* report. As an example we will add a new SBT method titled GEO.

1. Create the points and a graph for the new method in Excel. Ensure there are no gaps and points of neighbouring zones coincide.

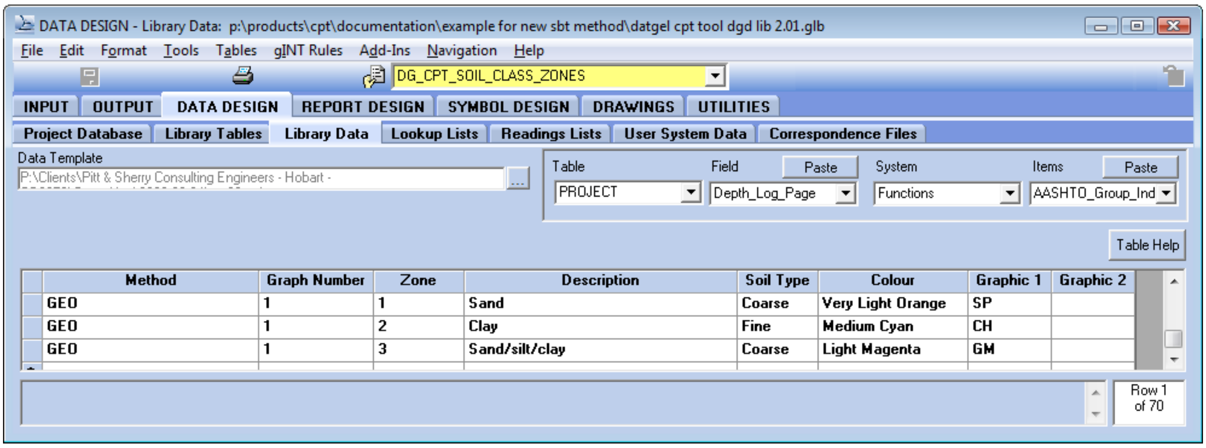


4. DG_CPT_SOIL_CLASS_METHOD



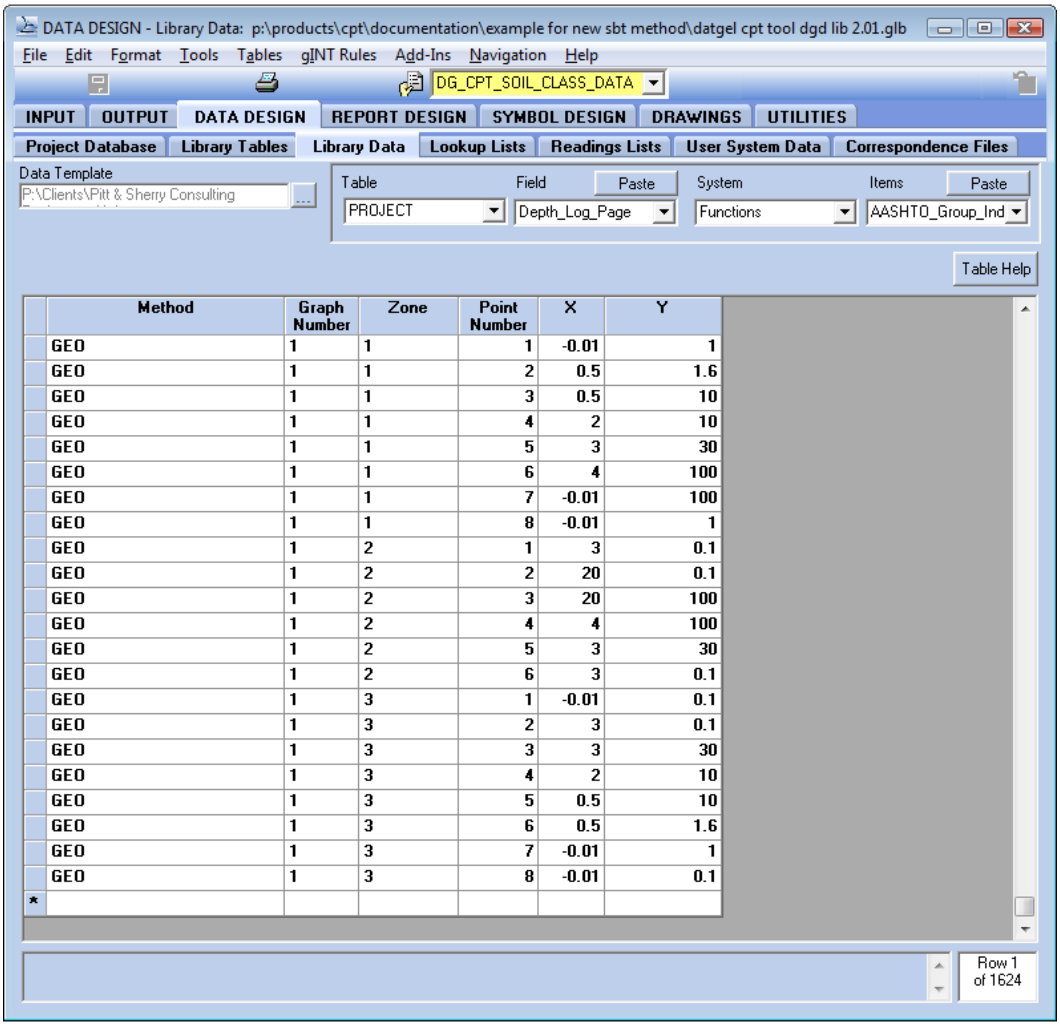
Graph 2 is optional

5. DG_CPT_SOIL_CLASS_ZONES



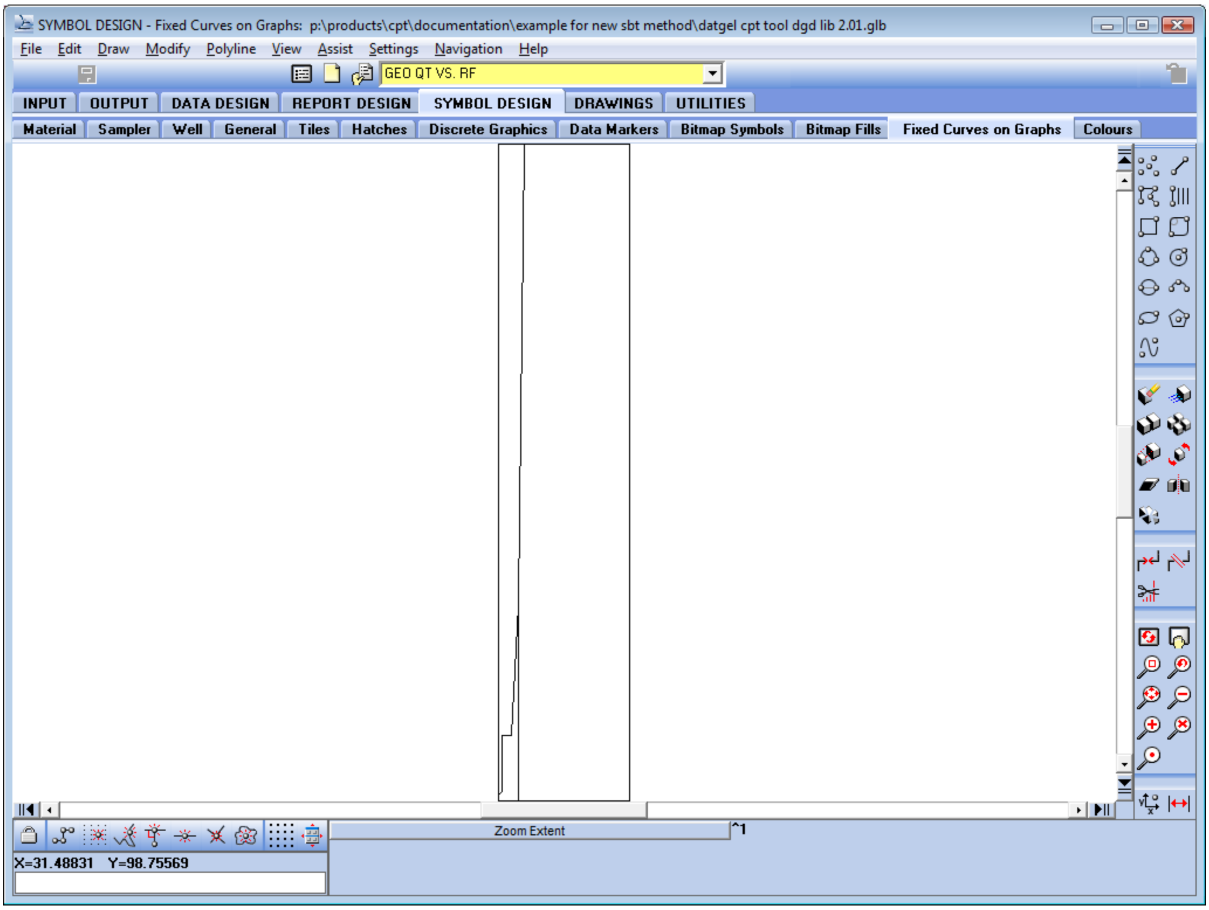
Method	Graph Number	Zone	Description	Soil Type	Colour	Graphic 1	Graphic 2
GEO	1	1	Sand	Coarse	Very Light Orange	SP	
GEO	1	2	Clay	Fine	Medium Cyan	CH	
GEO	1	3	Sand/silt/clay	Coarse	Light Magenta	GM	

6. DG_CPT_SOIL_CLASS_DATA



Method	Graph Number	Zone	Point Number	X	Y
GEO	1	1	1	-0.01	1
GEO	1	1	2	0.5	1.6
GEO	1	1	3	0.5	10
GEO	1	1	4	2	10
GEO	1	1	5	3	30
GEO	1	1	6	4	100
GEO	1	1	7	-0.01	100
GEO	1	1	8	-0.01	1
GEO	1	2	1	3	0.1
GEO	1	2	2	20	0.1
GEO	1	2	3	20	100
GEO	1	2	4	4	100
GEO	1	2	5	3	30
GEO	1	2	6	3	0.1
GEO	1	3	1	-0.01	0.1
GEO	1	3	2	3	0.1
GEO	1	3	3	3	30
GEO	1	3	4	2	10
GEO	1	3	5	0.5	10
GEO	1	3	6	0.5	1.6
GEO	1	3	7	-0.01	1
GEO	1	3	8	-0.01	0.1

7. You may now return to INPUT, set the new SBT method on the Global or Point Parameters tables, and calculate a CPT. The results will now print on log reports.
8. Optionally you can now create a **SYMBOL DESIGN | Fixed Curve on Graph**



9. Optionally now create a new graph report. This can be most efficiently done by copying the pre-existing Graph report titled *CPT ROBERTSON ET AL. 1986 QT VS. RF*. Use the command **File > Copy page...** and name the new report *CPT GEO QT VS. RF*.
10. Now open the report properties and make the following changes

Property	New Value
General Tab	
Description	Soil behaviour type classification graph - GEO, total cone resistance (qt) versus friction ratio (Rf)
Report Variable – Soil Class Method	`<<Let(A="GEO")>><<Get(A)>>`
Report Variable – Default Title	`GEO qt vs. Rf - [[PointID]]`
Data Representation Tab	
Fixed Curves	Change Named Fixed Curve to: `GEO QT VS. RF`
Override Line/DM Expression Tab	
Data marker Colour Expression 1	Replace all `Robertson et al. 1986` with `GEO`

11. You may now move to OUTPUT and preview the report

14 Transfer Description and Consistency for Current PointID

This command transfers a summary of the material type classification 1 to a Stratigraphy/Lithology table, and the calculated Relative_Density_Term_1 and Undrained_Shear_Strength_Term_1 to Consistency/Density table.

The command is located in **INPUT | Add-Ins > Datgel CPT Tool > Transfer Description and Consistency for current PointID**, and can be called from child tables of POINT.

The results of the first Soil Behaviour Type method are used.

The order of operation is:

1. Minimum Layer Thickness
2. Consolidation of like layers
3. Soil Group Thickness

14.1 Minimum Layer Thickness

This option can be used to exclude geotechnically insignificant layers, e.g. say the purpose of your CPT is for pile design, then you may wish to ignore a 30 mm clay lens within a much larger sand layer.

If a layer thickness is less than the value in CPT_GLOBAL_PARAMETERS table Minimum_Thickness_Soil_Layer field, then the layer will be removed and:

1. If the layer above is the same coarse or fine type, then the Bottom will be set to the Bottom of the removed layer.
2. If the layer below is the same coarse or fine type, then the Depth will be set to the Depth of the removed layer.
3. Otherwise the Bottom field for the layer above will be updated.

The Consistency and Density transfer is not affected by the Minimum_Thickness_Soil_Layer field.

This filter will not apply if Minimum_Thickness_Soil_Layer is blank.

14.2 Soil Group Thickness

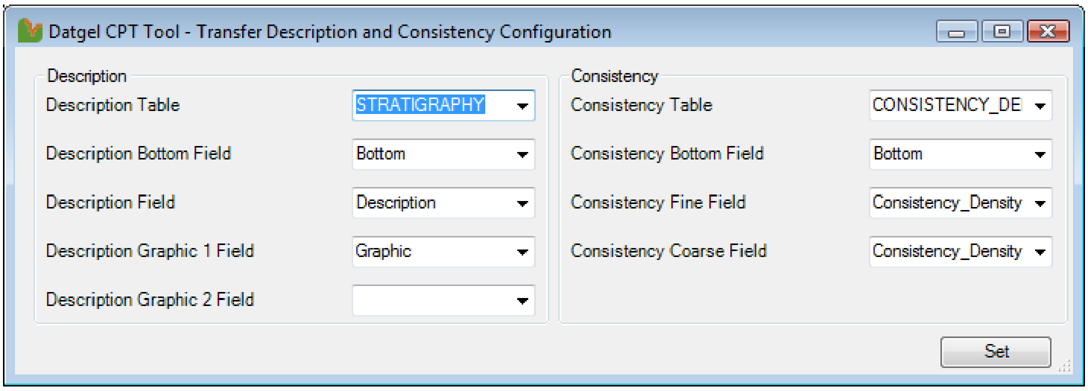
If a layer is less than the value in CPT_GLOBAL_PARAMETERS table Soil_Class_Group_Thickness field, then it will be appended to the layer above if they are both the same coarse or fine type.

The Consistency and Density transfer is not affected by the Soil_Class_Group_Thickness field.

This filter will not apply if Soil_Class_Group_Thickness is blank.

14.3 Configuration of description and consistency summary transfer

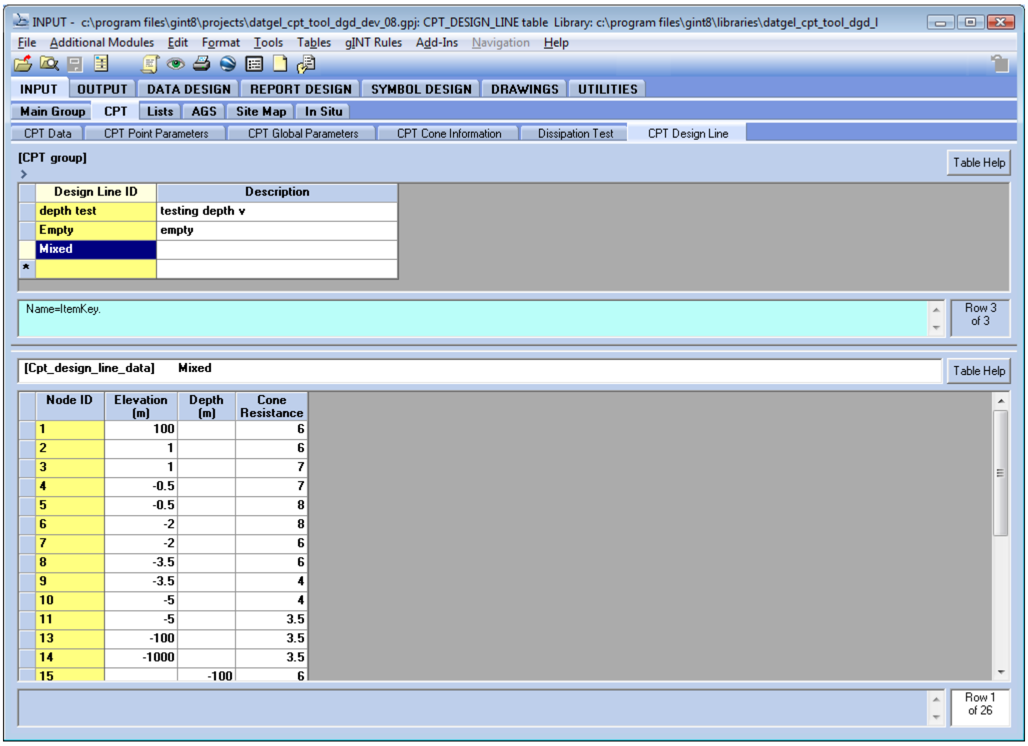
Before using the transfer command, first configure the custom fields and tables using the command in **INPUT | Add-Ins > Datgel CPT Tool > Transfer Description and Consistency Configuration**.



1. Set field and table names using the pick lists. *Description Graphic 2 Field* is not required.
2. Click **Set**
3. Close the form by clicking X button

15 Configuring the Design Line

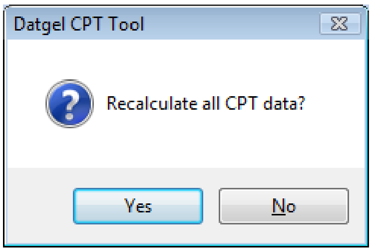
To be able to print a design line on the q_c and q_t columns on the log reports, the Design line must first be defined in the CPT_DESIGN_LINE and CPT_DESIGN_LINE_DATA tables.



To enter data in the CPT_DESIGN_LINE_DATA table (lower screen); enter a Design Line ID in the CPT_DESIGN_LINE table (upper screen). Enter a description if desired.

Then click on the CPT_DESIGN_LINE_DATA table. Each row represents a node (point or corner) in the Design Line, where the Elevation or Depth represents the vertical axis and the Cone_Resistance represents the horizontal axis. The Node ID determines the order in which the nodes are drawn, as the Design Line is constructed by drawing a line from one node to the next.

When the values in either the CPT_DESIGN_LINE or CPT_DESIGN_LINE_DATA tables are modified, you will be prompted with the following:



Every row in the CPT_DATA table has a Cone_Resistance_Design_Line value, which is calculated based on which Design Line is assigned and the depth of the current row. Therefore, it is necessary to recalculate the CPT_DATA table to reflect any changes made in these tables if an existing Design Line is modified. However, if entering a new Design Line, it is unlikely the new Design Line is assigned to any PointIDs, so it is unnecessary to recalculate the CPT_DATA table.

The Elevation value will always take precedence over Depth when calculating the Design Line. If there are both Elevation and Depth values in this table, then only the Elevation values are used, and the Depth values are ignored. Only if the entire Elevation column is left blank, the Depth values are used.

Once the Design Lines have been defined, they can be assigned to PointIDs in the CPT_POINT_PARAMETERS table or on the CPT_GLOBAL_PARAMETERS. The two fields in this table related to the Design Line are Design_Line and Show_Design_Line. The Design_Line field is a pick list of the design Lines defined in the CPT_DESIGN_LINE Table, and the Show_Design_Line field is a check box which determines whether the Design Line is shown on the CPT log reports or not. The Design Line is represented on the CPT log reports as a thick black line.

16 Moving Average

The Cone_Resistance_Moving_Average field in the CPT_DATA field is an average of q_c values above and below the given depth. The distance above and below can be configured in the CPT_GLOBAL_PARAMETERS table, in the field Moving_Average_Thickness. The thickness defines the depth range of the q_c values taken, where the given depth is in the middle of the range.

For example, specifying a Moving_Average_Thickness of 1 m, the q_c values are taken from ±0.5m from the given depth.

17 Exclude Fines Layers

A fines layer is defined by consecutive rows that have been classified as “fine” in the Soil_Type_1 Field. If the fines layer is thicker than a predetermined length, then the Exclude field is checked and records within a buffer distance are also have Exclude checked. The Exclude field can be used to control what records print on the CPT reports.

The minimum thickness to exclude the Fines layer can be defined in the Exclude_Fines_Layer_Thickness field in the CPT_GLOBAL_PARAMETERS table or the CPT_POINT_PARAMETERS table. The value in the CPT_POINT_PARAMETERS table takes precedence. Likewise, the buffer thickness of the records above and below the fines layer to exclude can be defined in the field in the Exclude_Fines_Layer_Buffer field in the CPT_GLOBAL_PARAMETERS or the CPT_POINT_PARAMETERS table.

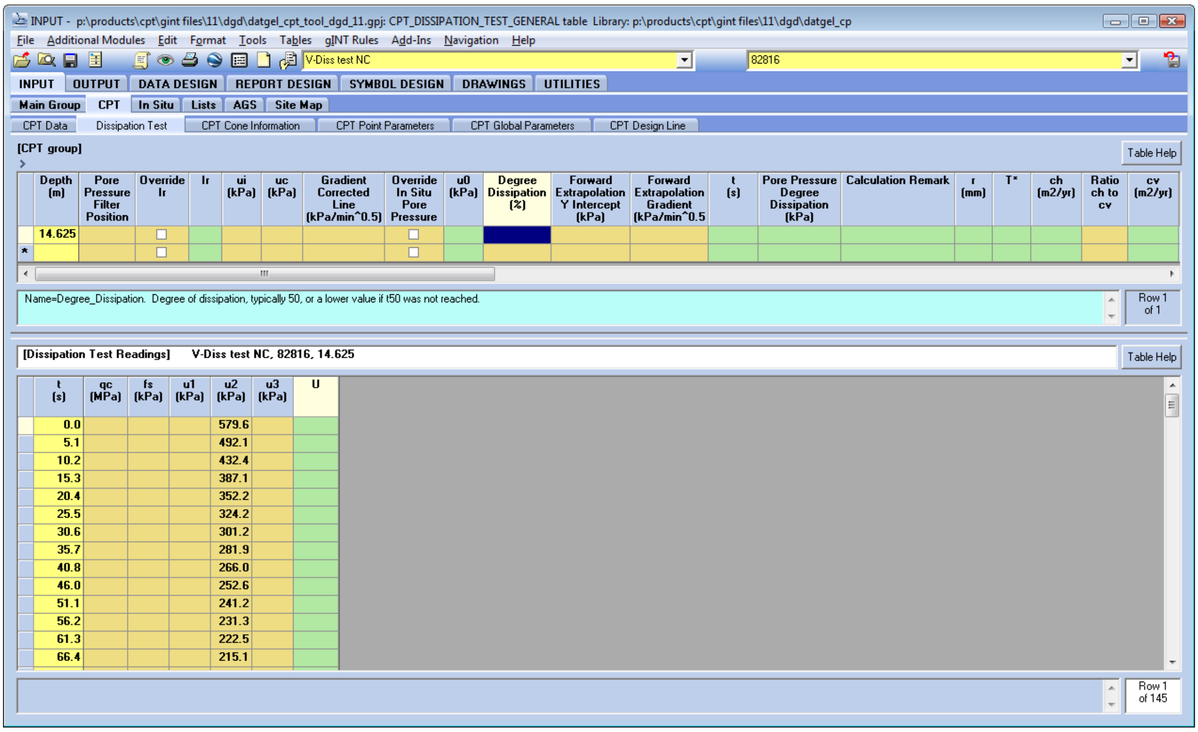
NOTE: These fields are not in the standard CPT Tool gINT files

18 Dissipation Test Analysis

Dissipation tests may be analysed using the strain path method (SPM) proposed by Houlsby and Teh 1988. Further, dissipation tests carried out in over consolidated soils maybe corrected using the square root time method as proposed in Sully et al. 1999, and short tests may be extrapolated forward to estimate tx.

18.1 Procedure to analyse a dissipation test in normally consolidated soil

1. Import the data as described in section *5* Data Import.
2. Navigate to **INPUT | CPT | Dissipation Test**, and open the required PointID and Test Number. This example will use PointID ‘V-Diss test NC’, which is the same as the test at 14.625 m in data file `Probedrill_01.dis`. After import the screen will look similar to the following screen shot.



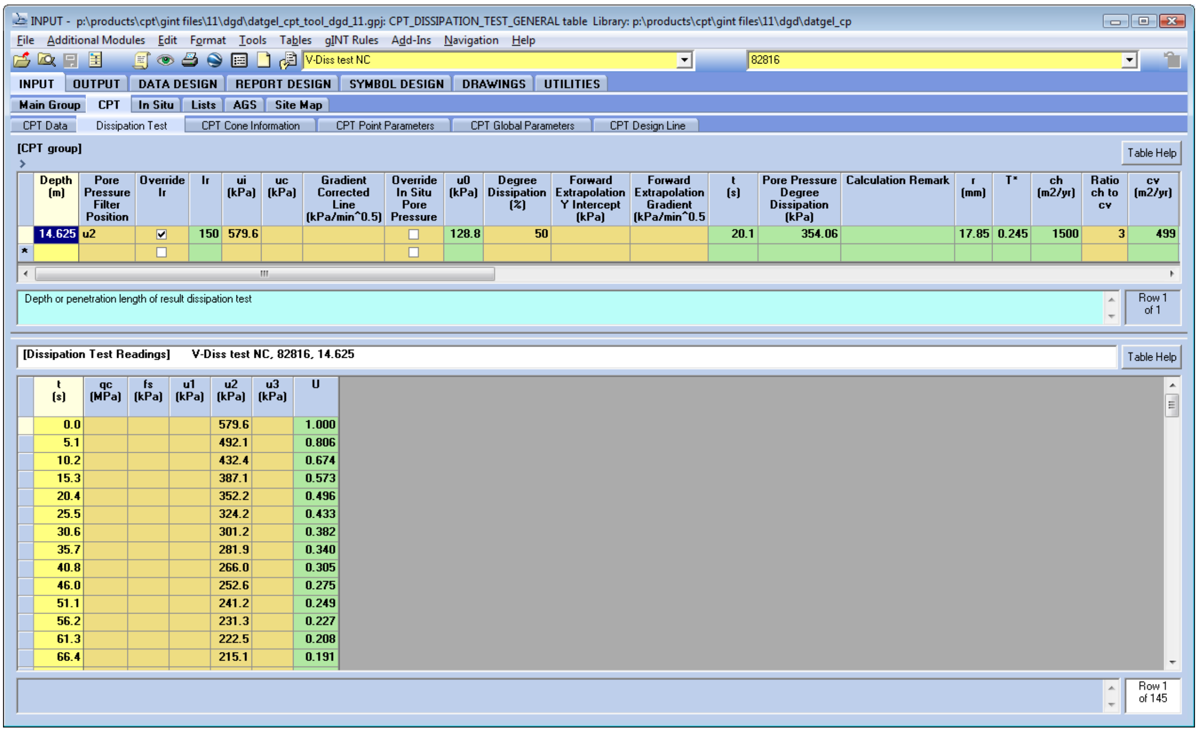
3. Ensure the ground water depth is defined, see section *7* Groundwater. Set CPT_GENERAL.Groundwater_Depth to *1.50*.
4. In this example the Pore_Pressure_Filter_Position must be set to *u2*.
5. Rigidity_Index, **Ir**, maybe automatically looked up from CPT_DATA.Rigidity_Index_1 from the record with the same depth or next smaller depth, or may be manually defined by first checking the field Override_Rigidity_Index, **Override Ir**, and then entering a value. In this example we will manually define *150*.
6. Initial_Pore_Pressure, **ui**, must be manually set, and is typically the first pore pressure reading of the test. In this example we will manually define *579.6*.
7. Corrected_Initial_Pore_Pressure from back-extrapolation, **uc**, and Gradient_Corrected_Line, are not typically required for normally consolidated soils. In this example these two fields are left blank.
8. In_Situ_Pore_Pressure is automatically calculated based on the groundwater depth (described in section *7* Groundwater). By checking Override_In_Situ_Pore_Pressure, the user can manually set **u0**. In this example we will allow **u0** to automatically calculate.

9. Degree_Dissipation defines the degree of dissipation, typically 50, or a lower value if t_{50} was not reached. In this example we will use *50*.

10. Forward_Extraplolation_Y_Intercept and Forward_Extrapolation_Gradient can be used to define a best fit line to forward extrapolate to a t beyond the recorded data when the test doesn't reach the required **Degree Dissipation**. In this example these two fields are left blank.

11. Ratio_ch_to_cv is the ratio of horizontal coefficient of consolidation to vertical coefficient of consolidation. In this example we will use *3*.

12. Now click the **Save** button, and the recalculated screen should be similar to the following screen shot.

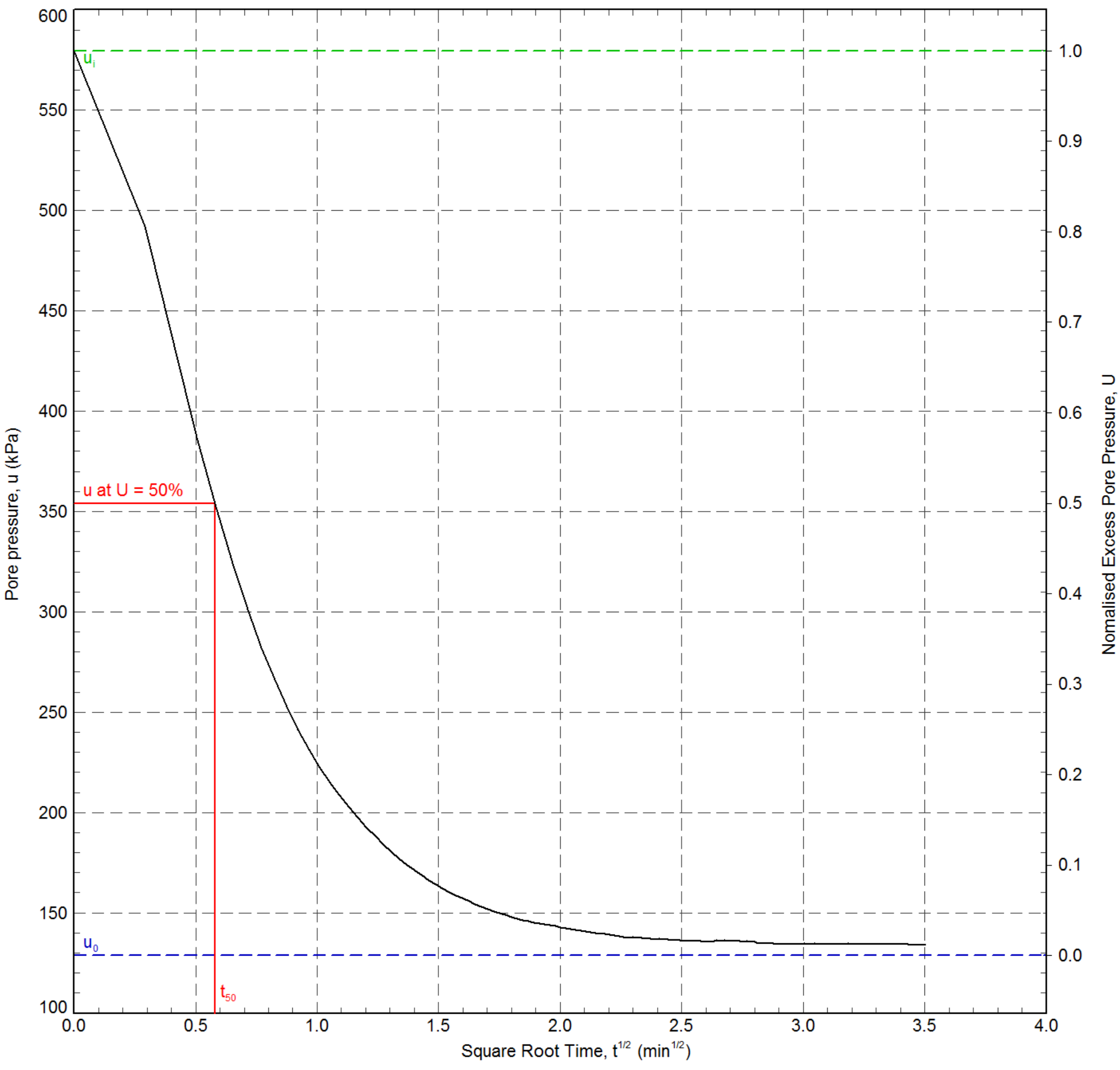


13. To preview the graph report, click on the bottom half of the screen and the click the Preview icon. *Graph!cpt diss. pore pressure vs. sqr t* should already be set as the default report for this table. The preview should be similar to the following figure.

DISSIPATION TEST

Test ID
V-Diss test NC - 14.63 m

CLIENT : CPT Client	AREA : Sydney 19-05-08	SHEET : 1 OF 1
ENGINEER : CPT Engineer	EASTING : 240335.9 m	STATUS :
PROJECT : CPT Tool Project	NORTHING : 390000.0 m	DATE :
LOCATION : Somewhere World	COORD. SYS.: MGA94 56	
PROJECT No. : 123456	ELEVATION : 3.10 m AHD	



In Situ Pore Pressure, u_0:	128.76 kPa	Horizontal Coefficent of Consolidation, c_h:	$1.50x10^3$ m^2/yr
Initial Pore Pressure, u_i:	579.6 kPa	Ratio c_h/c_v:	3
Finial Pore Pressure:	579.640255 kPa	Vertical Coefficent of Consolidation, c_v:	$4.99x10^2$ m^2/yr
Degree of Dissipation:	50 %		
Dissipation Pressure:	354.06 kPa		
Time for 50% Dissipation, t_{50}:	0.34 min		

RIG : TRACK RIG	ANALYSED BY :	DATE:	REMARK
CONE TYPE :	CHECKED BY :	DATE:	
CONE ID : EC17	APPROVED BY :	DATE:	
OPERATOR :			

DATGEL_CPT_TOOL_DGD_LIB_11.GLB Graph CPT DISS. PORE PRESSURE VS. SQR T DATGEL_CPT_TOOL_DGD_11.GPJ <<DrawingFile>> Datgel CPT Tool gINT Add-In 15/05/2009 16:31

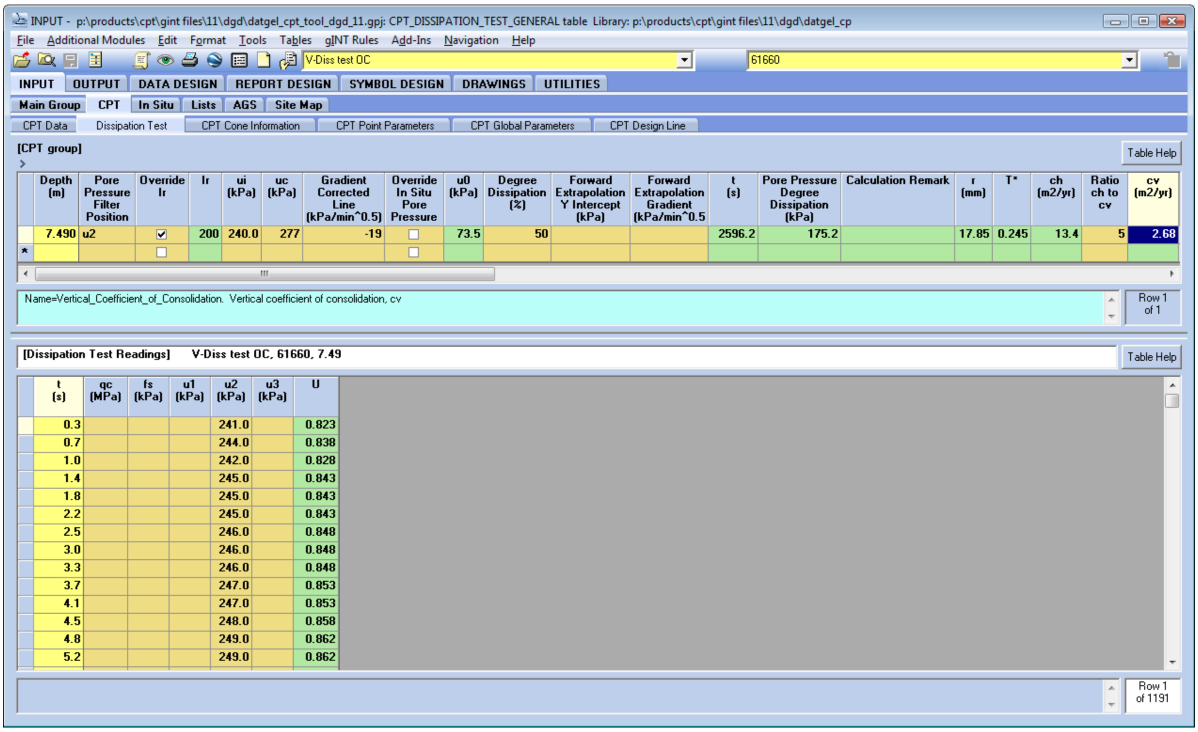
18.2 Procedure to analyse a dissipation test in overconsolidated soil

This example uses PointID *V-Diss test OC*, which corresponds with the data in file `Geotech_AB_04.cpt` and `Geotech_AB_04.dpt`.

1. Follow steps 1 to 6 and 8 to 12 described above, however in this example set **Ir** to *200*, **ui** to *240.0*, and **Ratio ch to cv** to *5*.

2. You may also like to use the minimum and maximum scale fields to control the graph report scale extents.

3. As you can see in the following graph, the pore pressure first increases before decreasing. This is a typical Type III over consolidated response described in Sully et al 1999. The **uc** and **Gradient Corrected Line** must be correctly defined (see figure 7 in Sully et al 1999). The simplest procedure is to preview the Graph report *cpt diss. pore pressure vs. sqr t* by clicking on the INPUT preview button, estimate uc and the gradient, close the preview and enter the estimated numbers in the fields. Repeat the procedure until you are happy with the magenta coloured line.



Datgel DATA SOLUTIONS
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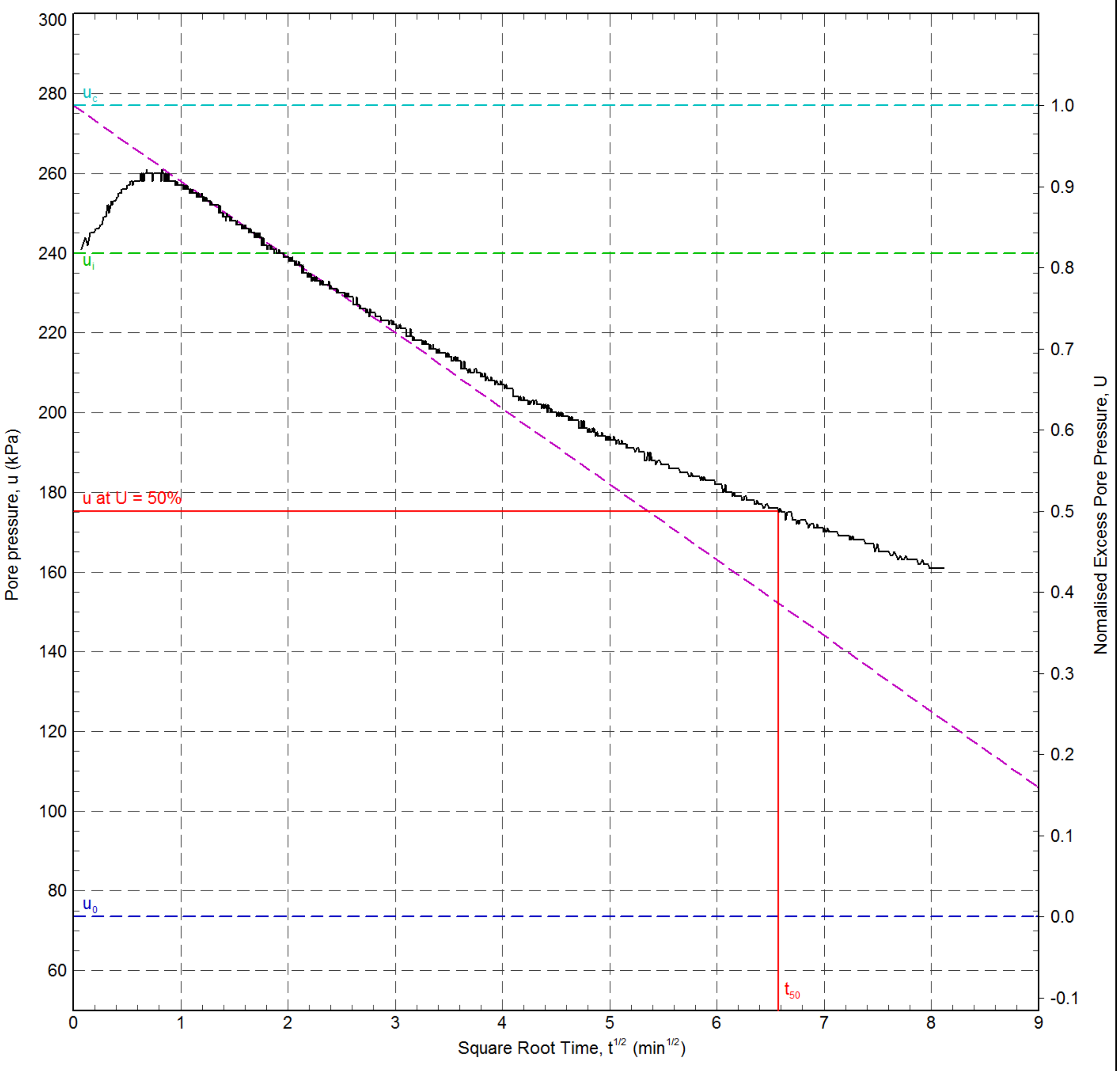
DISSIPATION TEST

Test ID
V-Diss test OC - 7.49 m

CLIENT : CPT Client	AREA :	SHEET : 1 OF 1
ENGINEER : CPT Engineer	EASTING :	STATUS : 3
PROJECT : CPT Tool Project	NORTHING :	DATE : 01/01/09
LOCATION : Somewhere World	COORD. SYS.: MGA94 56	
PROJECT No. : 123456	ELEVATION :	



In Situ Pore Pressure, u_0:	73.48 kPa	Horizontal Coefficent of Consolidation, c_h:	1.34×10^1 m^2/yr
Initial Pore Pressure, u_i:	240 kPa	Ratio c_h/c_v:	5
Finial Pore Pressure:	261 kPa	Vertical Coefficent of Consolidation, c_v:	2.68×10^0 m^2/yr
Back Extrapolated Pore Pressure, u_c:	277 kPa		
Degree of Dissipation:	50 %		
Dissipation Pressure:	175.2 kPa		
Time for 50% Dissipation, t_{50}:	43.27 min		

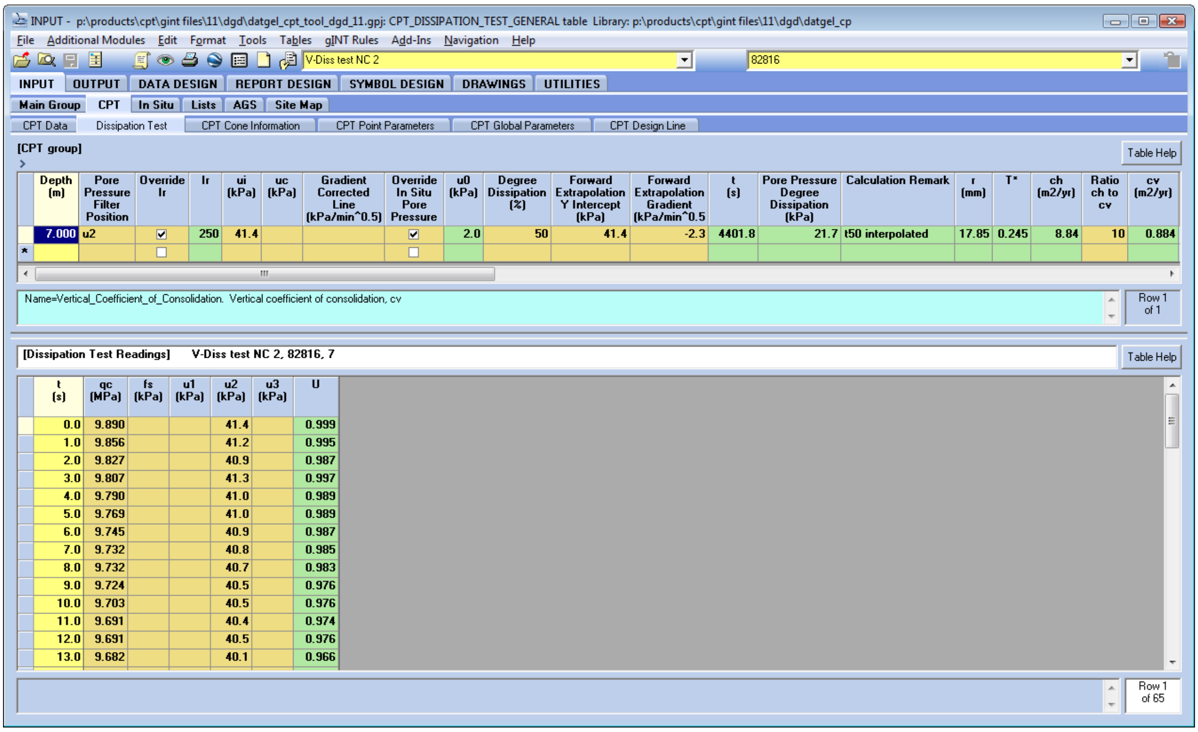
RIG :	ANALYSED BY : ABC	DATE: 02/01/2009	REMARK
CONE TYPE :	CHECKED BY : DEF	DATE: 03/01/2009	adsf; var
CONE ID : 3167	APPROVED BY : GHI	DATE: 04/01/2009	
OPERATOR : PMW			

18.3 Procedure to use forward extrapolation

The forward extrapolation option allow the user to define a straight line in measure pore pressure – square root minute space that will be used to estimate tx beyond the recorded data range. An example of it use is illustrated below.

In this example, PointID = V-Diss test NC 2, the data was recorded for only 64 seconds which corresponds with 5.5% degree of dissipation. Using the forward extrapolation line we can estimate t_{50}.

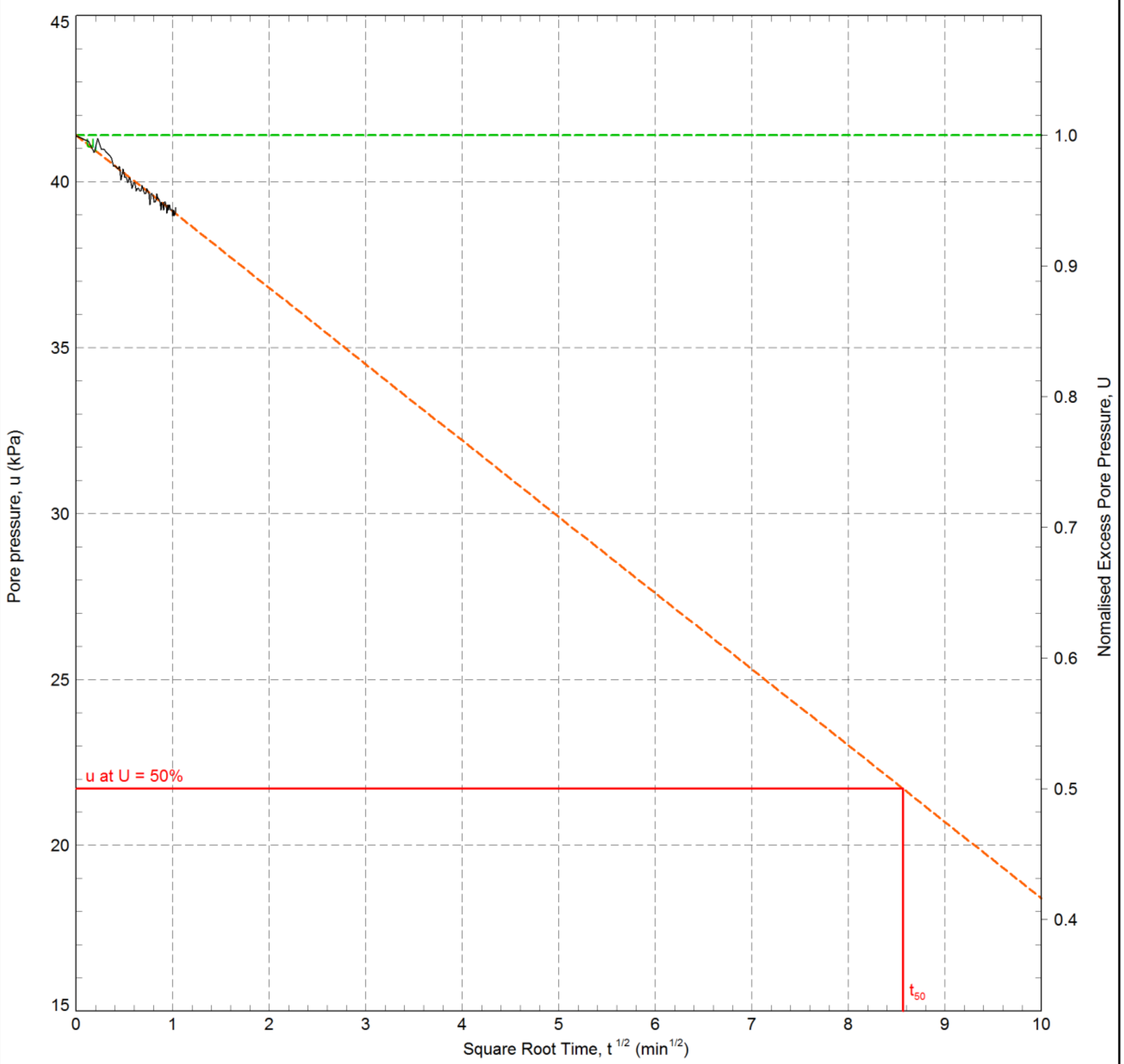
1. Enter data in CPT_DISSIPATION_TEST_GENERAL as described in previous examples.
2. The simplest procedure to define the Forward_Extraplolation_Y_Intercept and Forward_Extrapolation_Gradient fields is to preview the Graph report *cpt diss. pore pressure vs. sqr t* by clicking on the INPUT preview button, estimate y intercept and gradient, close the preview and enter the estimated numbers in the fields. Repeat the procedure until you are happy with the orange coloured line. An alternative is to print the same report in output and manually define the line on paper and then enter the values in the fields.



DISSIPATION TEST

Test ID
V-Diss test NC 2 - 7.00 m

CLIENT : CPT Client	AREA : Sydney 19-05-08	SHEET : 1 OF 1
ENGINEER : CPT Engineer	EASTING : 240335.9 m	STATUS :
PROJECT : CPT Tool Project	NORTHING : 390000.0 m	DATE :
LOCATION : Somewhere World	COORD. SYS. : MGA94 56	
PROJECT No. : 123456	ELEVATION : 3.10 m AHD	



In Situ Pore Pressure, u_0:	2 kPa
Initial Pore Pressure, u_i:	41.4 kPa
Finial Pore Pressure:	41.38 kPa
Degree of Dissipation:	50 %
Dissipation Pressure:	21.7 kPa
Time for 50% Dissipation, t_{50}:	73.36 min
Calculation Remark:	t50 interpolated from best fit line

Horizontal Coefficent of Consolidation, c_h:	8.84×10^{0} m^2/yr
Ratio c_h/c_v:	10
Vertical Coefficent of Consolidation, c_v:	8.84×10^{-1} m^2/yr

RIG : TRACK RIG	ANALYSED BY :	DATE:	REMARK
CONE TYPE :	CHECKED BY :	DATE:	
CONE ID : EC17	APPROVED BY :	DATE:	
OPERATOR :			

DATGEL_CPT_TOOL_DGD_LIB_11.GLB Graph CPT DISS. PORE PRESSURE VS. SQR T DATGEL_CPT_TOOL_DGD_11.GPJ <<DrawingFile>> Datgel CPT Tool gINT Add-In 19/05/2009 11:23

19 Reports

19.1 Log Reports

Table 3 - Log Reports

Name	Description
CPT A4P	CPT / Friction cone report with qc, fs and Rf
CPT DYNAMIC 11X17L	Dynamic CPT report
CPT DYNAMIC A3L	Dynamic CPT report
CPT DYNAMIC A4P	Dynamic CPT report
CPT DYNAMIC LETP	Dynamic CPT report
CPT LETP	CPT / Friction cone report with qc, fs and Rf
CPT MATERIAL A4P	CPT / Friction cone report with qc, fs, Rf and soil description
CPT MATERIAL LETP	CPT / Friction cone report with qc, fs, Rf and soil description
CPT QC ONLY A4P	CPT qc only
CPT QC ONLY LETP	CPT qc only
CPT SOIL BEHAVIOUR TYPE INDEX A4P	CPT report with qt, Fr, Bq Ic 1 and Ic 2
CPT SOIL BEHAVIOUR TYPE INDEX LETP	CPT report with qt, Fr, Bq Ic 1 and Ic 2
CPTU A4P	CPTU / Piezocone report with qt, fs or ft, u, u0, Rf and Bq
CPTU COMPARISON A4	CPT/CPTU Comparison log using POINT.Associated_PointID
CPTU COMPARISON LETP	CPT/CPTU Comparison log using POINT.Associated_PointID
CPTU DERIVED MATERIAL A4P	CPTU / Piezocone derived report with qt, Rf, Bq and material description
CPTU DERIVED MATERIAL LETP	CPTU / Piezocone derived report with qt, Rf, Bq and material description
CPTU LETP	CPTU / Piezocone report with qt, fs or ft, u, u0, Rf and Bq
CPTU MATERIAL A4P	CPTU / Piezocone report with qt, fs or ft, u, u0, Rf, Bq and material description
CPTU MATERIAL LETP	CPTU / Piezocone report with qt, fs or ft, u, u0, Rf, Bq and material description
CPTU MEASURED MATERIAL A4P	CPTU / Piezocone measured report with qc, fs, u, u0 and material description
CPTU MEASURED MATERIAL LETP	CPTU / Piezocone measured report with qc, fs, u, u0 and material description
CPTU NORMALISED N60 11X17L	CPTU normalised parameters (qc, qt, Rf, Bq, Pennetration Rate, Qt, Fr), interpreted soil type, N60 and material description
CPTU NORMALISED N60 A3L	CPTU normalised parameters (qc, qt, Rf, Bq, Pennetration Rate, Qt, Fr), interpreted soil type, N60 and material description
CPTU PHI 11X17L	CPTU / Piezocone report with qt, fs or ft, uo, u2, Rf, Bq, interpreted soil type, Phi', material description and consistency
CPTU PHI A3L	CPTU / Piezocone report with qt, fs or ft, uo, u2, Rf, Bq, interpreted soil type, Phi', material description and consistency
CPTU SU 11X17L	CPTU / Piezocone report with qt, fs or ft, uo, u2, Rf, Bq, interpreted soil type, su, material description and consistency
CPTU SU A3L	CPTU / Piezocone report with qt, fs or ft, uo, u2, Rf, Bq, interpreted soil type, su, material description and consistency
CPTU SU A4P	CPTU / Piezocone report with qt, fs or ft, u, u0, Rf and Su.

CPTU SU DR 11X17L	CPTU / Piezocone report with qc, qt, fs or ft, uo, u2, Rf, Bq, interpreted soil type, Dr, su, material description and consistency
CPTU SU DR A3L	CPTU / Piezocone report with qc, qt, fs or ft, uo, u2, Rf, Bq, interpreted soil type, Dr, su, material description and consistency
CPTU SU DR CC 11X17L	CPTU / Piezocone report with qc, qt, fs or ft, uo, u2, Rf, Bq, Dr, su, Cc, material description and consistency
CPTU SU DR CC A3L	CPTU / Piezocone report with qc, qt, fs or ft, uo, u2, Rf, Bq, Dr, su, Cc, material description and consistency
CPTU SU LETP	CPTU / Piezocone report with qt, fs or ft, u, u0, Rf and Su
SCPTU ALL A4P	SCPTU / Piezocone report with qt, fs, ub, t50 and Vs (Measured & Extrapolated)
SCPTU ALL LETP	SCPTU / Piezocone report with qt, fs, ub, t50 and Vs (Measured & Extrapolated)
SCPTU CORRELATED A4P	SCPTU / Piezocone report with qt, fs, ub, t50 and Vs (Correlated)
SCPTU CORRELATED LETP	SCPTU / Piezocone report with qt, fs, ub, t50 and Vs (Correlated)
SCPTU MEASURED EXTRAP A4P	SCPTU / Piezocone report with qt, fs, ub, t50 and Vs (Measured, Extrapolated & Correlated)
SCPTU MEASURED EXTRAP LETP	SCPTU / Piezocone report with qt, fs, ub, t50 and Vs (Measured, Extrapolated & Correlated)

19.2 Fences Reports

Table 4 - Fence Reports

Name	Description
CPT FENCE 11X17L	A3 landscape fence report with 6 plot column options and CPT classification colour column
CPT FENCE A3L	A3 landscape fence report with 6 plot column options and CPT classification colour column
CPT FENCE A4L	A4 landscape fence report with 6 plot column options and CPT classification colour column
CPT FENCE A4P	A4 portrait fence report with 6 plot column options and CPT classification colour column
CPT FENCE LETL	Letter landscape fence report with 6 plot column options and CPT classification colour column
CPT FENCE LETP	Letter portrait fence report with 6 plot column options and CPT classification colour column

Table 5 - Fence Report Variables

Name	Default Value	Notes
Title	Inferred Subsurface Section	Enter fence report title
Drawn		Person's initials/name
Drawn Date		Enter date
Checked		Person's initials/name
Checked Date		Enter date
Figure Number		Enter text. If left blank, it will default to “Figure 1”.
Revision		Enter Revision
Sheet		Enter Sheet
Override Sitemap		Enter a value to override the default sitemap scale

Scale		
Stick CPT	C	C = Soil classification method colour (default) L = Legend/material graphic L C = Legend/ Soil classification method colour S = Stick/line
Default Title		Enter default fence report title. Shown if Title is empty.
Column R3		Enter a parameter to display on the right side of the fence post, furthest from the centre of the PointID
Width R3 (mm)		Enter the column width of the parameter. If left blank, it will use the default column width defined for that parameter. Typical values are 10 mm for line and bar plots, 4 mm for text
Column R2		Enter a parameter to display on the right side of the fence post
Width R2 (mm)		Enter the column width of the parameter. If left blank, it will use the default column width defined for that parameter. Typical values are 10 mm for line and bar plots, 4 mm for text
Column R1		Enter a parameter to display on the right side of the fence post, closest to the centre of the PointID
Width R1 (mm)		Enter the column width of the parameter. If left blank, it will use the default column width defined for that parameter. Typical values are 10 mm for line and bar plots, 4 mm for text
Column L1		Enter a parameter to display on the left side of the fence post, closest to the centre of the PointID
Width L1 (mm)		Enter the column width of the parameter. If left blank, it will use the default column width defined for that parameter. Typical values are 10 mm for line and bar plots, 4 mm for text
Column L2		Enter a parameter to display on the left side of the fence post
Width L2 (mm)		Enter the column width of the parameter. If left blank, it will use the default column width defined for that parameter. Typical values are 10 mm for line and bar plots, 4 mm for text
Column L3		Enter a parameter to display on the left side of the fence post, furthest from the centre of the PointID
Width L3 (mm)		Enter the column width of the parameter. If left blank, it will use the default column width defined for that parameter. Typical values are 10 mm for line and bar plots, 4 mm for text
Legend 1		Enter a parameter to display a legend for the line, colour, data marker and reference text for each correlation of that parameter
Legend 2		Enter a parameter to display a legend for the line, colour, data marker and reference text for each correlation of that parameter
Legend 3		Enter a parameter to display a legend for the line, colour, data marker and reference text for each correlation of that parameter
Legend 4		Enter a parameter to display a legend for the line, colour, data marker and reference text for each correlation of that parameter

19.3 Graph Reports

Table 6 - Graph Reports

Name	Description
BPT QB VS DEPTH A4P	Ball Bearing Pressure (qb) vs. depth
BPT QB VS DEPTH LETP	Ball Bearing Pressure (qb) vs. depth
CPT COEFF LATERAL EARTH PRESS DEPTH A4P	Coefficient Lateral Earth Pressure (K0) correlations versus Depth
CPT COEFF LATERAL EARTH PRESS DEPTH LETP	Coefficient Lateral Earth Pressure (K0) correlations versus Depth
CPT COEFF LATERAL EARTH PRESSURE RL A4P	Coefficient Lateral Earth Pressure (K0) correlations versus Elevation
CPT COEFF LATERAL EARTH PRESSURE RL LETP	Coefficient Lateral Earth Pressure (K0) correlations versus Elevation
CPT CONSTRAINED MODULUS DEPTH A4P	Constrained Modulus (M) correlations versus Depth
CPT CONSTRAINED MODULUS DEPTH LETP	Constrained Modulus (M) correlations versus Depth
CPT CONSTRAINED MODULUS RL A4P	Constrained Modulus (M) correlations versus Elevation
CPT CONSTRAINED MODULUS RL LETP	Constrained Modulus (M) correlations versus Elevation
CPT DISS. NORMALISED EX U VS. LIN T A4L	Dissipation test graph of normalised excess pore pressure versus linear time, grouped by PointID
CPT DISS. NORMALISED EX U VS. LIN T A4P	Dissipation test graph of normalised excess pore pressure versus linear time
CPT DISS. NORMALISED EX U VS. LIN T LETL	Dissipation test graph of normalised excess pore pressure versus linear time, grouped by PointID
CPT DISS. NORMALISED EX U VS. LIN T LETP	Dissipation test graph of normalised excess pore pressure versus linear time
CPT DISS. NORMALISED EX U VS. LOG T A4L	Dissipation test graph of normalised excess pore pressure versus log time, grouped by PointID
CPT DISS. NORMALISED EX U VS. LOG T A4P	Dissipation test graph of normalised excess pore pressure versus log time
CPT DISS. NORMALISED EX U VS. LOG T LETL	Dissipation test graph of normalised excess pore pressure versus log time, grouped by PointID
CPT DISS. NORMALISED EX U VS. LOG T LETP	Dissipation test graph of normalised excess pore pressure versus log time
CPT DISS. NORMALISED EX U VS. SQR T A4L	Dissipation test graph of normalised excess pore pressure versus square root time, grouped by PointID
CPT DISS. NORMALISED EX U VS. SQR T A4P	Dissipation test graph of normalised excess pore pressure versus square root time
CPT DISS. NORMALISED EX U VS. SQR T LETL	Dissipation test graph of normalised excess pore pressure versus square root time, grouped by PointID
CPT DISS. NORMALISED EX U VS. SQR T LETP	Dissipation test graph of normalised excess pore pressure versus square root time
CPT DISS. PORE PRESSURE VS. LIN T A4L	Dissipation test graph of normalised excess pore pressure versus linear time, grouped by PointID
CPT DISS. PORE PRESSURE VS. LIN T A4P	Dissipation test graph of pore pressure versus linear time
CPT DISS. PORE PRESSURE VS.	Dissipation test graph of normalised excess pore pressure versus linear time,

LIN T LETL	grouped by PointID
CPT DISS. PORE PRESSURE VS. LIN T LETP	Dissipation test graph of pore pressure versus linear time
CPT DISS. PORE PRESSURE VS. LOG T A4L	Dissipation test graph of normalised excess pore pressure versus log time, grouped by PointID
CPT DISS. PORE PRESSURE VS. LOG T A4P	Dissipation test graph of pore pressure versus log time
CPT DISS. PORE PRESSURE VS. LOG T LETL	Dissipation test graph of normalised excess pore pressure versus log time, grouped by PointID
CPT DISS. PORE PRESSURE VS. LOG T LETP	Dissipation test graph of pore pressure versus log time
CPT DISS. PORE PRESSURE VS. SQR T A4L	Dissipation test graph of normalised excess pore pressure versus square root time, grouped by PointID
CPT DISS. PORE PRESSURE VS. SQR T A4P	Dissipation test graph of pore pressure versus square root time
CPT DISS. PORE PRESSURE VS. SQR T LETL	Dissipation test graph of normalised excess pore pressure versus square root time, grouped by PointID
CPT DISS. PORE PRESSURE VS. SQR T LETP	Dissipation test graph of pore pressure versus square root time
CPT EFFECTIVE COHESION DEPTH A4P	Effective Cohesion (c') correlations versus Depth
CPT EFFECTIVE COHESION DEPTH LETP	Effective Cohesion (c') correlations versus Depth
CPT EFFECTIVE COHESION RL A4P	Effective Cohesion (c') correlations versus Elevation
CPT EFFECTIVE COHESION RL LETP	Effective Cohesion (c') correlations versus Elevation
CPT EFFECTIVE FRICTION ANGLE DEPTH A4P	Effective Friction Angle (Phi') correlations versus Depth
CPT EFFECTIVE FRICTION ANGLE DEPTH LETP	Effective Friction Angle (Phi') correlations versus Depth
CPT EFFECTIVE FRICTION ANGLE RL A4P	Effective Friction Angle (Phi') correlations versus Elevation
CPT EFFECTIVE FRICTION ANGLE RL LETP	Effective Friction Angle (Phi') correlations versus Elevation
CPT IC 1 DEPTH A4P	Soil Behaviour Type Index (Ic) 1 versus Depth
CPT IC 1 DEPTH LETP	Soil Behaviour Type Index (Ic) 1 versus Depth
CPT IC 1 RL A4P	Soil Behaviour Type Index (Ic) 1 versus Elevation
CPT IC 1 RL COLOUR A4P	Soil Behaviour Type Index (Ic) 1 versus Elevation with differing colours for each PointID
CPT IC 1 RL COLOUR LETP	Soil Behaviour Type Index (Ic) 1 versus Elevation with differing colours for each PointID
CPT IC 1 RL LETP	Soil Behaviour Type Index (Ic) 1 versus Elevation
CPT IC 2 DEPTH A4P	Soil Behaviour Type Index (Ic) 2 versus Depth
CPT IC 2 DEPTH LETP	Soil Behaviour Type Index (Ic) 2 versus Depth
CPT IC 2 RL A4P	Soil Behaviour Type Index (Ic) 2 versus Elevation
CPT IC 2 RL COLOUR A4P	Soil Behaviour Type Index (Ic) 2 versus Elevation with differing colours for each PointID
CPT IC 2 RL COLOUR LETP	Soil Behaviour Type Index (Ic) 2 versus Elevation with differing colours for each PointID

CPT IC 2 RL LETP	Soil Behaviour Type Index (Ic) 2 versus Elevation
CPT OCR DEPTH A4P	Overconsolidation Ratio (OCR) correlations versus Depth
CPT OCR DEPTH LETP	Overconsolidation Ratio (OCR) correlations versus Depth
CPT OCR RL A4P	Overconsolidation Ratio (OCR) correlations versus Elevation
CPT OCR RL LETP	Overconsolidation Ratio (OCR) correlations versus Elevation
CPT PRECONSOLIDATION STRESS DEPTH A4P	Preconsolidation Stress (Sig p') correlations versus Depth
CPT PRECONSOLIDATION STRESS DEPTH LETP	Preconsolidation Stress (Sig p') correlations versus Depth
CPT PRECONSOLIDATION STRESS RL A4P	Preconsolidation Stress (Sig p') correlations versus Elevation
CPT PRECONSOLIDATION STRESS RL LETP	Preconsolidation Stress (Sig p') correlations versus Elevation
CPT QC QT VS DEPTH A4P	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Depth. If qt is found, the graph will plot qt. Otherwise, qc is plotted
CPT QC QT VS DEPTH COLOUR A4P	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Depth with differing colours for each PointID. If qt is found, the graph will plot qt. Otherwise, qc is plotted
CPT QC QT VS DEPTH COLOUR LETP	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Depth with differing colours for each PointID. If qt is found, the graph will plot qt. Otherwise, qc is plotted
CPT QC QT VS DEPTH FT PSI A4P	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Depth. If qt is found, the graph will plot qt. Otherwise, qc is plotted. Two scales on each axis, m and ft, and MPa and psi
CPT QC QT VS DEPTH FT PSI LETP	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Depth. If qt is found, the graph will plot qt. Otherwise, qc is plotted. Two scales on each axis, m and ft, and MPa and psi
CPT QC QT VS DEPTH LETP	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Depth. If qt is found, the graph will plot qt. Otherwise, qc is plotted
CPT QC QT VS ELEVATION A4P	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Elevation. If qt is found, the graph will plot qt. Otherwise, qc is plotted
CPT QC QT VS ELEVATION COLOUR A4P	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Elevation with differing colours for each pointID. If qt is found, the graph will plot qt. Otherwise, qc is plotted
CPT QC QT VS ELEVATION COLOUR LETP	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Elevation with differing colours for each pointID. If qt is found, the graph will plot qt. Otherwise, qc is plotted
CPT QC QT VS ELEVATION LETP	Cone Resistance (qc) or Corrected Total Cone Resistance (qt) versus Elevation. If qt is found, the graph will plot qt. Otherwise, qc is plotted
CPT RELATIVE DENSITY DEPTH A4P	Relative Density (Dr) correlations versus Depth
CPT RELATIVE DENSITY DEPTH LETP	Relative Density (Dr) correlations versus Depth
CPT RELATIVE DENSITY RL A4P	Relative Density (Dr) correlations versus Elevation
CPT RELATIVE DENSITY RL LETP	Relative Density (Dr) correlations versus Elevation
CPT RF VS DEPTH A4P	Friction ratio (Rf) vs depth
CPT RF VS DEPTH LETP	Friction ratio (Rf) vs depth
CPT RF VS ELEVATION A4P	Friction Ratio (Rf) versus Elevation
CPT RF VS ELEVATION COLOUR A4P	Friction ratio (Rf) vs elevation with differing colours for each PointID

CPT RF VS ELEVATION COLOUR LETP	Friction ratio (Rf) vs elevation with differing colours for each PointID
CPT RF VS ELEVATION LETP	Friction Ratio (Rf) versus Elevation
CPT RIGIDITY INDEX DEPTH A4P	Rigidity Index (Ir) correlations versus Depth
CPT RIGIDITY INDEX DEPTH LETP	Rigidity Index (Ir) correlations versus Depth
CPT RIGIDITY INDEX RL A4P	Rigidity Index (Ir) correlations versus Elevation
CPT RIGIDITY INDEX RL LETP	Rigidity Index (Ir) correlations versus Elevation
CPT ROBERTSON 90 QT VS. BQ A4P	Soil behaviour type classification graph - Robertson 1990, normalised cone resistance (Qt) versus pore pressure parameter (Bq)
CPT ROBERTSON 90 QT VS. BQ EXTRAP A4P	Soil behaviour type classification graph - Robertson 1990 (extrapolated graph), normalised cone resistance (Qt) versus pore pressure parameter (Bq)
CPT ROBERTSON 90 QT VS. BQ EXTRAP LETP	Soil behaviour type classification graph - Robertson 1990 (extrapolated graph), normalised cone resistance (Qt) versus pore pressure parameter (Bq)
CPT ROBERTSON 90 QT VS. BQ EXTRAP M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson 1990 (extrapolated graph), normalised cone resistance (Qt) versus pore pressure parameter (Bq)
CPT ROBERTSON 90 QT VS. BQ EXTRAP M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson 1990 (extrapolated graph), normalised cone resistance (Qt) versus pore pressure parameter (Bq)
CPT ROBERTSON 90 QT VS. BQ LETP	Soil behaviour type classification graph - Robertson 1990, normalised cone resistance (Qt) versus pore pressure parameter (Bq)
CPT ROBERTSON 90 QT VS. BQ M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson 1990, normalised cone resistance (Qt) versus pore pressure parameter (Bq)
CPT ROBERTSON 90 QT VS. BQ M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson 1990, normalised cone resistance (Qt) versus pore pressure parameter (Bq)
CPT ROBERTSON 90 QT VS. FR A4P	Soil behaviour type classification graph - Robertson 1990, normalised cone resistance (Qt) versus normalised friction ration (Fr)
CPT ROBERTSON 90 QT VS. FR EXTRAP A4P	Soil behaviour type classification graph - Robertson 1990 (extrapolated graph), normalised cone resistance (Qt) versus normalised friction ration (Fr)
CPT ROBERTSON 90 QT VS. FR EXTRAP LETP	Soil behaviour type classification graph - Robertson 1990 (extrapolated graph), normalised cone resistance (Qt) versus normalised friction ration (Fr)
CPT ROBERTSON 90 QT VS. FR EXTRAP M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson 1990 (extrapolated graph), normalised cone resistance (Qt) versus normalised friction ration (Fr)
CPT ROBERTSON 90 QT VS. FR EXTRAP M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson 1990 (extrapolated graph), normalised cone resistance (Qt) versus normalised friction ration (Fr)
CPT ROBERTSON 90 QT VS. FR LETP	Soil behaviour type classification graph - Robertson 1990, normalised cone resistance (Qt) versus normalised friction ration (Fr)
CPT ROBERTSON 90 QT VS. FR M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson 1990, normalised cone resistance (Qt) versus normalised friction ration (Fr)
CPT ROBERTSON 90 QT VS. FR M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson 1990, normalised cone resistance (Qt) versus normalised friction ration (Fr)
CPT ROBERTSON ET AL. 86 QC VS. RF A4P	Soil behaviour type classification graph - Robertson et. al. 1986, cone resistance (qc) versus friction ratio (Rf)
CPT ROBERTSON ET AL. 86 QC VS. RF LETP	Soil behaviour type classification graph - Robertson et. al. 1986, cone resistance (qc) versus friction ratio (Rf)
CPT ROBERTSON ET AL. 86 QC VS. RF M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson et. al. 1986, cone resistance (qc) versus friction ratio (Rf)
CPT ROBERTSON ET AL. 86 QC VS. RF M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson et. al. 1986, cone resistance (qc) versus friction ratio (Rf)

CPT ROBERTSON ET AL. 86 QT VS. BQ A4P	Soil behaviour type classification graph - Robertson et. al. 1986, total corrected cone resistance (qt) versus pore pressure parameter (Bq)
CPT ROBERTSON ET AL. 86 QT VS. BQ LETP	Soil behaviour type classification graph - Robertson et. al. 1986, total corrected cone resistance (qt) versus pore pressure parameter (Bq)
CPT ROBERTSON ET AL. 86 QT VS. BQ M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson et. al. 1986, total corrected cone resistance (qt) versus pore pressure parameter (Bq)
CPT ROBERTSON ET AL. 86 QT VS. BQ M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson et. al. 1986, total corrected cone resistance (qt) versus pore pressure parameter (Bq)
CPT ROBERTSON ET AL. 86 QT VS. RF A4P	Soil behaviour type classification graph - Robertson et. al. 1986, total corrected cone resistance (qt) versus friction ratio (Rf)
CPT ROBERTSON ET AL. 86 QT VS. RF LETP	Soil behaviour type classification graph - Robertson et. al. 1986, total corrected cone resistance (qt) versus friction ratio (Rf)
CPT ROBERTSON ET AL. 86 QT VS. RF M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson et. al. 1986, total corrected cone resistance (qt) versus friction ratio (Rf)
CPT ROBERTSON ET AL. 86 QT VS. RF M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Robertson et. al. 1986, total corrected cone resistance (qt) versus friction ratio (Rf)
CPT SCHNEIDER ET AL. 08 LOG-LOG A4P	Soil behaviour type classification graph - Schneider et al 2008, normalised cone resistance (Qt) versus normalised pore pressure parameter (Delta u2 / Sigma'v0). Log-Log plot for use with clays, clayey silts, silts, sandy silts and sands with no negative penetration pore pressures
CPT SCHNEIDER ET AL. 08 LOG-LOG LETP	Soil behaviour type classification graph - Schneider et al 2008, normalised cone resistance (Qt) versus normalised pore pressure parameter (Delta u2 / Sigma'v0). Log-Log plot for use with clays, clayey silts, silts, sandy silts and sands with no negative penetration pore pressures
CPT SCHNEIDER ET AL. 08 LOG-LOG M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Schneider et al 2008, normalised cone resistance (Qt) versus normalised pore pressure parameter (Delta u2 / Sigma'v0). Log-Log plot for use with clays, clayey silts, silts, sandy silts and sands with no negative penetration pore pressures
CPT SCHNEIDER ET AL. 08 LOG-LOG M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Schneider et al 2008, normalised cone resistance (Qt) versus normalised pore pressure parameter (Delta u2 / Sigma'v0). Log-Log plot for use with clays, clayey silts, silts, sandy silts and sands with no negative penetration pore pressures
CPT SCHNEIDER ET AL. 08 QT VS. BQ A4P	Soil behaviour type classification graph - Schneider et al 2008, normalised cone resistance (Qt) versus pore pressure parameter (Bq). Semilog plot for use with clay soils with large negative excess penetration pore pressures
CPT SCHNEIDER ET AL. 08 QT VS. BQ LETP	Soil behaviour type classification graph - Schneider et al 2008, normalised cone resistance (Qt) versus pore pressure parameter (Bq). Semilog plot for use with clay soils with large negative excess penetration pore pressures
CPT SCHNEIDER ET AL. 08 QT VS. BQ M A4P	Soil behaviour type classification graph - Multiple PointIDs per page - Schneider et al 2008, normalised cone resistance (Qt) versus pore pressure parameter (Bq). Semilog plot for use with clay soils with large negative excess penetration pore pressures
CPT SCHNEIDER ET AL. 08 QT VS. BQ M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Schneider et al 2008, normalised cone resistance (Qt) versus pore pressure parameter (Bq). Semilog plot for use with clay soils with large negative excess penetration pore pressures
CPT SCHNEIDER ET AL. 08 SEMI-LOG A4P	Soil behaviour type classification graph - Schneider et al 2008, normalised cone resistance (Qt) versus normalised pore pressure parameter (Delta u2 / Sigma'v0). Semilog plot for use with sands and transitional soils with small negative excess penetration pore pressures
CPT SCHNEIDER ET AL. 08 SEMI-LOG LETP	Soil behaviour type classification graph - Schneider et al 2008, normalised cone resistance (Qt) versus normalised pore pressure parameter (Delta u2 / Sigma'v0). Semilog plot for use with sands and transitional soils with small negative excess penetration pore pressures
CPT SCHNEIDER ET AL. 08	Soil behaviour type classification graph - Multiple PointIDs per page - Schneider

SEMI-LOG M A4P	et al 2008, normalised cone resistance (Qt) versus normalised pore pressure parameter (Delta u2 / Sigma'v0). Semilog plot for use with sands and transitional soils with small negative excess penetration pore pressures
CPT SCHNEIDER ET AL. 08 SEMI-LOG M LETP	Soil behaviour type classification graph - Multiple PointIDs per page - Schneider et al 2008, normalised cone resistance (Qt) versus normalised pore pressure parameter (Delta u2 / Sigma'v0). Semilog plot for use with sands and transitional soils with small negative excess penetration pore pressures
CPT SENSITIVITY DEPTH A4P	Sensitivity (St) correlations versus Depth
CPT SENSITIVITY DEPTH LETP	Sensitivity (St) correlations versus Depth
CPT SENSITIVITY RL A4P	Sensitivity (St) correlations versus Elevation
CPT SENSITIVITY RL LETP	Sensitivity (St) correlations versus Elevation
CPT SHEAR WAVE VELOCITY DEPTH A4P	Shear Wave Velocity (Vs) correlations and measured versus Depth
CPT SHEAR WAVE VELOCITY DEPTH LETP	Shear Wave Velocity (Vs) correlations and measured versus Depth
CPT SHEAR WAVE VELOCITY RL A4P	Shear Wave Velocity (Vs) correlations versus Elevation
CPT SHEAR WAVE VELOCITY RL LETP	Shear Wave Velocity (Vs) correlations versus Elevation
CPT SMALL STRAIN SHEAR MOD DEPTH A4P	Small Strain Shear Modulus (G0 or Gmax) correlations versus Depth
CPT SMALL STRAIN SHEAR MOD DEPTH LETP	Small Strain Shear Modulus (G0 or Gmax) correlations versus Depth
CPT SMALL STRAIN SHEAR MODULUS RL A4P	Small Strain Shear Modulus (Go or Gmax) correlations versus Elevation
CPT SMALL STRAIN SHEAR MODULUS RL LETP	Small Strain Shear Modulus (Go or Gmax) correlations versus Elevation
CPT SPT N60 DEPTH A4P	SPT N60 correlations versus Depth
CPT SPT N60 DEPTH LETP	SPT N60 correlations versus Depth
CPT SPT N60 RL A4P	SPT N60 correlations versus Elevation
CPT SPT N60 RL LETP	SPT N60 correlations versus Elevation
CPT SU VS DEPTH VANE TV PP A4P	Undrained shear strength vs depth. Plots Su from CPT, in situ vane, in situ torvane, in situ pocket penetrometer. Each test type to have different data marker and CPT to have a line (no data marker)
CPT SU VS DEPTH VANE TV PP LETP	Undrained shear strength vs depth. Plots Su from CPT, in situ vane, in situ torvane, in situ pocket penetrometer. Each test type to have different data marker and CPT to have a line (no data marker)
CPT UNDRAINED SHEAR STRENGTH DEPTH A4P	Undrained Shear Strength (Su) correlations versus Depth
CPT UNDRAINED SHEAR STRENGTH DEPTH LETP	Undrained Shear Strength (Su) correlations versus Depth
CPT UNDRAINED SHEAR STRENGTH RL A4P	Undrained Shear Strength (Su) correlations versus Elevation
CPT UNDRAINED SHEAR STRENGTH RL LETP	Undrained Shear Strength (Su) correlations versus Elevation
CPT YOUNGS MODULUS DEPTH A4P	Youngs Modulus (E) correlations versus Depth
CPT YOUNGS MODULUS DEPTH LETP	Youngs Modulus (E) correlations versus Depth
CPT YOUNGS MODULUS RL A4P	Youngs Modulus (E) correlations versus Elevation
CPT YOUNGS MODULUS RL	Youngs Modulus (E) correlations versus Elevation

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