User Guide

LAB

Lab Test Results

Version 8.09

Lab – Lab Test Results – Version 8.09
User Guide

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LAB - TABLE OF CONTENTS

LIST OF FIGURES v

Chapter 1. LAB - GENERALITIES 1-1

1. Introduction 1-1
2. Launching the Lab module 1-1
3. File, Edit, Insert and View menus 1-2
4. Tools menu 1-2
   - 4.1. Definition of the graphs 1-2
   - 4.2. SECOND_AXIS graph 1-3
   - 4.3. Definition of the curves 1-4
   - 4.4. Options 1-4
   - 4.5. Options: General 1-5
     - 4.5.1. Display during navigation 1-5
     - 4.5.2. Printing parameters 1-6
     - 4.5.3. Restriction on the samples to include in the tables 1-6
     - 4.5.4. Global smoothing 1-7
     - 4.5.5. Saturation curves 1-7
   - 4.6. Options: Classification 1-7
   - 4.7. Options: Sieves 1-7
   - 4.8. Options: Materials 1-8
   - 4.9. Options: Tables 1, 2 and 3 1-9
     - 4.9.1. Selection of the significant values 1-9
     - 4.9.2. Width of the columns 1-12
     - 4.9.3. Symbols column and characteristics of the tables 1-13
     - 4.9.4. Drawing attributes of the tables of significant values 1-13
     - 4.9.5. Insertion and deletion of rows 1-13
   - 4.10. Options: Symbol 1-13
     - 4.10.1. Choice of curves 1-14
     - 4.10.2. Sample curves 1-14
     - 4.10.3. Envelope curves 1-15
     - 4.10.4. Curves calculated according to a percentage 1-15
     - 4.10.5. Curves calculated according to a standard deviation 1-15
     - 4.10.6. Number of defined rows and symbols 1-15
     - 4.10.7. Characteristics of the curves 1-15
     - 4.10.8. “Manual” management of the presentation of the samples retrieved 1-17
     - 4.10.9. Automatic management of the presentation of the samples retrieved 1-18
5. Data menu 1-19
6. Window and Help menus 1-19
7. Smoothing 1-19
8. Interactive Editing 1-20

Chapter 2. LAB - GRAIN SIZE ANALYSES 2-1

1. Generalities 2-1

2. GRAIN_SIZE_POINT and GRAIN_SIZE graphs 2-1
   - 2.1. Definition of the graph of grain size curves 2-1
   - 2.2. Predefined curves of the graph of grain size curves 2-2
     - 2.2.1. Spec curve 2-2
     - 2.2.2. Sieves curve 2-2
     - 2.2.3. Sample_+ curve 2-3
   - 2.3. Legend of the graph of grain size curves 2-3
   - 2.4. Definition and representation of the sieves 2-4
     - 2.4.1. Definition of the specification envelope 2-4
     - 2.4.2. Definition of the smoothing for statistic curves 2-5
     - 2.4.3. Definition of the reference sieves 2-5
     - 2.4.4. Drawing attributes of the reference sieves 2-5
     - 2.4.5. Definition of the sieves for the calculation of the statistic curves and combinations of grain size curves 2-5
     - 2.4.6. Selection, insertion and deletion of sieves 2-6
   - 2.5. Correction of grain size curves 2-6
     - 2.5.1. Including the percentages of cobbles and boulders 2-6
     - 2.5.2. Cutting at a sieve diameter 2-7
     - 2.5.3. Extrapolation of the grain size curves 2-7
   - 2.6. Combinations of grain size curves 2-7
     - 2.6.1. Display of the curves before combination and the results of combinations 2-7
     - 2.6.2. Combination 2-8
     - 2.6.3. Deleting combinations 2-11
   - 2.7. Curves to display: choice, representation and presence in the tables 2-11
     - 2.7.1. Sample curves 2-11
     - 2.7.2. Curves calculated according to a percentage 2-12
     - 2.7.3. Curves calculated according to a standard deviation 2-13
     - 2.7.4. Envelope curves 2-13

3. CLASSIFICATION graph 2-14
   - 3.1. Definition of the graph of materials classification 2-14
   - 3.2. Predefined curves of the graph of materials classification 2-14
     - 3.2.1. Main curve 2-14
     - 3.2.2. Secondary curve 2-14
   - 3.3. Configuration of the graph of materials classification 2-15
     - 3.3.1. Definition of the divisions 2-15
     - 3.3.2. Selection, insertion and deletion of divisions 2-16
     - 3.3.3. Drawing attributes of the divisions 2-16

4. TABLE_MAT graph 2-16
   - 4.1. Definition of the table of materials 2-16
   - 4.2. Columns of the table of materials 2-18
     - 4.2.1. Symbol column 2-18
     - 4.2.2. Materials column 2-19
   - 4.3. Configuration of the table of materials 2-19
     - 4.3.1. Definition of the zones of materials 2-20
     - 4.3.2. Values displayed in the table of materials 2-20
     - 4.3.3. Management of the display of the table of materials 2-20
     - 4.3.4. Selection, insertion and deletion of materials 2-21

5. TABLE_*n* graphs of significant values 2-21

6. Keywords specific to the grain size analysis 2-21

7. Example of a report for grain size analyses 2-23

Chapter 3. LAB - CONSOLIDATION TESTS 3-1

1. Generalities 3-1
2. calculation method of the consolidation parameters 3-1
3. CONSOLIDATION_POINT graph 3-2
   - 3.1. Definition of the graph of consolidation tests 3-2
   - 3.2. Predefined curves of the graph of consolidation tests 3-2
     - 3.2.1. Casagrande curve 3-3
     - 3.2.2. PcMinMax curve 3-3
     - 3.2.3. Pc curve 3-4
     - 3.2.4. P0 curve 3-4
     - 3.2.5. e0 curve 3-4
     - 3.2.6. Sample_+ curve 3-4
   - 3.3. Legend of the graph of consolidation tests 3-4
   - 3.4. Curves to display: choice, representation and presence in the tables 3-5
     - 3.4.1. Sample curves 3-5
4. Presentation of significant values of consolidation tests 3-6
5. TABLE_*n* graphs of significant values 3-6
6. Keywords specific to the consolidation 3-7
7. Example of a report for consolidation tests 3-8

Chapter 4. LAB - PROCTOR COMPACTION TESTS 4-1

1. Generalities 4-1
2. PROCTOR_POINT graph 4-1
   - 2.1. Definition of the graph of compaction tests 4-1
   - 2.2. Predefined curves of the graph of compaction tests 4-1
     - 2.2.1. *x*% curve(s) 4-1
     - 2.2.2. Opt_Avg curve 4-2
     - 2.2.3. Opt_Pnt curve 4-3
     - 2.2.4. Sample_+ curve 4-3
   - 2.3. Legend of the graph of compaction tests 4-3
   - 2.4. Definition of the saturation curves 4-4
     - 2.4.1. Water unit weight and relative density 4-4
     - 2.4.2. Definition of the saturation curves 4-4
     - 2.4.3. Selection, insertion, deletion of saturation curves 4-5
     - 2.4.4. Drawing attributes of the saturation curves 4-5
   - 2.5. Curves to display: choice, representation and presence in the tables 4-5
     - 2.5.1. Sample curves 4-6
3. TABLE_n graphs of significant values 4-6
4. Keywords specific to the compaction 4-6
5. Example of a report for compaction tests 4-8

Chapter 5. LAB - CONSISTENCY LIMITS 5-1

1. Generalities 5-1
2. LIMITS graph 5-1
   - 2.1. Definition of the graph of consistency limits 5-1
   - 2.2. Predefined curve of the graph of consistency limits 5-1
     - 2.2.1. Pnt_Avg curve 5-1
   - 2.3. Legend of the graph of consistency limits 5-2
   - 2.4. Points to display: choice, representation and presence in the tables 5-2

2.4.1. Sample curves 5-3
2.5. Plasticity chart 5-3
3. TABLE_n graphs of significant values 5-3
4. Keywords specific to the consistency limits 5-4
5. Example of a report for consistency limits 5-5

Chapter 6. LAB - TABLES OF VALUES 6-1

1. Generalities 6-1
2. TABLE_*n* tables 6-1
2.1. Definition of the TABLE_*n* tables 6-1
2.2. Columns of the TABLE_*n* tables 6-2
2.3. Presentation of a TABLE_*n* table 6-3
2.3.1. Drawing attributes 6-3
2.3.2. Widths of the table and its columns 6-4

Chapter 7. LAB - CUR_LI CHART 7-1

1. Generalities 7-1
2. CUR_LI graph 7-1
2.1. Definition of the CUR_LI graph 7-1
2.2. Predefined curve of the CUR_LI graph 7-1
2.2.1. H&M curve 7-1
2.3. Legend of the CUR_LI graph 7-1
2.4. Points to display: choice, representation and presence in the tables 7-2
2.4.1. Sample curves 7-2
3. TABLE_*n* graphs of significant values 7-2
4. Keywords specific to the CUR_LI chart 7-3
5. Example of a CUR_LI chart 7-4

LIST OF FIGURES

Figure 1-1 - Graph editing window 1-2
Figure 1-2 - Scrolling list of graphs 1-3
Figure 1-3 - Options: General panel 1-6
Figure 1-4 - Options: Classification panel 1-7
Figure 1-5 - Options: Sieves panel 1-8
Figure 1-6 - Options: Materials panel 1-9
Figure 1-7 - Options: Table of significant values (sieves and diameters) 1-11
Figure 1-8 - Options: Table of significant values (fields from a table) 1-12
Figure 1-9 - Options: Symbol panel 1-13
Figure 1-10 - List of the types of curves 1-14
Figure 1-11 - Interactive menu 1-20
Figure 1-12 - Adding a fit point 1-20
Figure 1-13 - Moving a fit point 1-21
Figure 1-14 - Deleting a fit point 1-21
Figure 2-1 - Curves of the graph of grain size curves 2-3
Figure 2-2 - Sieves definition panel 2-4
Figure 2-3 - Correction of the grain size curves 2-6
Figure 2-4 - Grain size combinations and display of results 2-8
Figure 2-5 - Combination form of the grain size curves 2-9
Figure 2-6 - Combination form after the calculation 2-10
Figure 2-7 - Symbols definition panel 2-12
Figure 2-8 - Selection of the standard deviation 2-13
Figure 2-9 - Curves of the classification graph 2-15
Figure 2-10 - Materials classification panel 2-16
Figure 2-11 - Definition panel of the materials constituting the samples 2-17
Figure 2-12 - Columns of the table of materials 2-19
Figure 2-13 - Example of a report for grain size analyses 2-23
Figure 3-1 - Details of the consolidation calculations 3-2
Figure 3-2 - Curves of the graph of consolidation tests 3-3
Figure 3-3 - Symbols definition panel 3-5
Figure 3-4 - Example of a report for consolidation tests 3-8
Figure 4-1 - Curves of the graph of compaction tests 4-2
Figure 4-2 - Definition of the saturation curves 4-4
Figure 4-3 - Symbols definition panel 4-5
Figure 4-4 - Example of a report for compaction tests 4-8
Figure 5-1 - Curve of the graph of consistency limits 5-2
Figure 5-2 - Symbols definition panel 5-3
Figure 5-3 - Example of a report for consistency limits 5-5
Figure 6-1 - Definition of the TABLE_*n* tables 6-1
Figure 6-2 - Columns of the TABLE_1 table 6-2

Figure 6-3 - Table *n* panel of the options window 6-3
Figure 7-1 - Curve of the CUR_LI graph 7-2
Figure 7-2 - Symbols definition panel 7-3
Figure 7-3 - Example of a CUR_LI chart 7-4

CHAPTER 1. LAB - GENERALITIES

1. INTRODUCTION

The **Lab** module displays the results, as curves and tables, of four different tests done on samples in laboratory:

- Grain size analyses;
- Oedometric consolidation tests;
- Proctor compaction analyses;
- Measurements of Atterberg consistency limits;

Lab uses a Graphical User Interface (i.e. with windowing) that is compatible with Microsoft Windows 7, 8 and 10.

Lab uses the Geo, X3D and SM2 libraries created by Sobek Technologies Inc. for data editing, the definition of the presentation style, and viewing and editing graphic results. Please refer to the Geo, X3D and SM2 guides for all details.

This chapter describes the general environment of Lab. Detailed descriptions of each test are provided in the following chapters.

2. LAUNCHING THE LAB MODULE

To open **Lab**, double-click on the icon shown here.

The connection to the database can be done directly when calling Lab by entering the following string as target. The string will be:

C:\Geotec80\Bin\Lab.exe username/password@odbc:connection_alias

See paragraph 2 of chapter 2 of the X3D guide for all the details about the connection to a database. Once the connection to a database is done, the user can execute a data query to produce graphic outputs.

When **Lab** is first launched, the following files are loaded from ***C:\Geotec80\Style****:*

- the markers file **geotec8.mrk**;
- the patterns file **geotec8.ptn**;
- the style file **lab_4tests.sty** which displays outputs for the four tests supported by Lab.

The user can begin working with this initial presentation, or open another style file included with the software. He can modify the style file and save it in a new presentation. In subsequent loadings, Lab opens the style, markers and patterns files that were in use when it was last closed.

3. FILE, EDIT, INSERT AND VIEW MENUS

None of the options of the **File**, **Edit**, **Insert** and **View** menus is specific to Lab. The detailed description of each option of these menus is done in chapters 2, 3, 4, and 5 of the X3D guide.

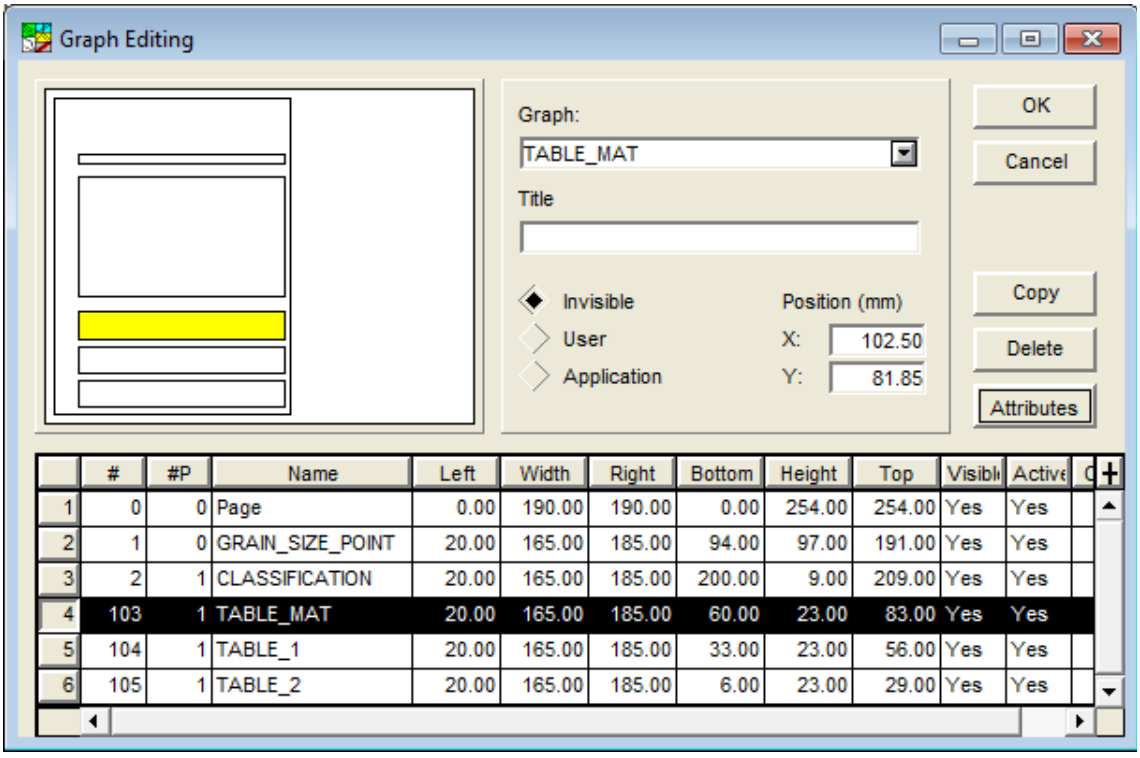
4. TOOLS MENU

The options of the **Tools** menu are used to define the utilisation parameters of Lab and to edit the graphic components produced by Lab: the characteristics of the graphic page, of the graphs, legends, axes, markers and patterns used. All these options are described in details in chapter 6 of the X3D library guide.

Options is specific to Lab. It is presented in paragraphs 4.4 to 4.10. The definitions of the graphs and curves are presented succinctly in the following paragraphs.

4.1. Definition of the graphs

The list of graphs is established and updated in the graph editing window opened by selecting the **Graphs**… option of the **Tools** menu or by clicking the button shown on the left. More details about the graph editing are available in paragraph 4 of chapter 6 of the X3D guide. Figure 1-1 shows an example of the graph editing window in Lab.



	#	#P	Name	Left	Width	Right	Bottom	Height	Top	Visibl	Active
1	0	0	Page	0.00	190.00	190.00	0.00	254.00	254.00	Yes	Yes
2	1	0	GRAIN_SIZE_POINT	20.00	165.00	185.00	94.00	97.00	191.00	Yes	Yes
3	2	1	CLASSIFICATION	20.00	165.00	185.00	200.00	9.00	209.00	Yes	Yes
4	103	1	TABLE_MAT	20.00	165.00	185.00	60.00	23.00	83.00	Yes	Yes
5	104	1	TABLE_1	20.00	165.00	185.00	33.00	23.00	56.00	Yes	Yes
6	105	1	TABLE_2	20.00	165.00	185.00	6.00	23.00	29.00	Yes	Yes

Figure 1-1 - Graph editing window

The table in this window contains all the graphs defined in the style file used. Each graph is identified by a unique number in the # column. The first graph is always **Page** with # **0**. This graph represents the graphic page and cannot be deleted.

Among the graphs, there are the **primary graphs** whose #P cell is **0**, a **secondary graph** whose #P cell is a **positive** value, and a **table** whose # is **100 or greater**.

The **Left**, **Width**, **Right**, **Bottom**, **Height** and **Top** fields define the position and dimension of the graphs. The user can modify these values.

The user can add a graph or replace a graph with another. **Lab** automatically manages the numbering of the graphs; however the user decides if the new graph is a primary or secondary graph (and the number of its parent graph) or a table (# greater or equal to 100). The user selects the graph name in the scrolling list displayed by clicking on the button to the right of the **Name** cell.

The scrolling list of graphs presented in figure 1-2 shows the list of tables that contain lab tests results presentable by Lab, preceded by CLASSIFICATION, TABLE_MAT, TABLE_1, TABLE_2, TABLE_3 and SECOND_AXIS (refer to chapters 2 to 7 for the details).

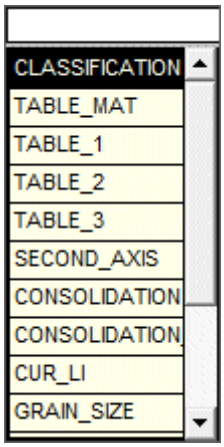


Figure 1-2 - Scrolling list of graphs

The user can also define a graph whose name is not in the scrolling list, such as INF or GEN. Curves cannot be defined for this graph, but the user can create objects in the space occupied by the graph. These objects are usually general information such as the graph title, site number, etc., and an image like the company logo. Chapter 4 of the **X3D** library guide describes object editing.

Except for the tables where the user can define columns, the other graphs only have predefined curves.

After creating a new graph or replacing a graph with another, the user must execute a new query for the data associated to the new graph to be read in the database and the graph filled with information.

4.2. SECOND_AXIS graph

The **SECOND_AXIS** graph is a dummy graph that is not associated with any table in the database. It does not have any curve, but can have axes defined by the user. It is then possible to display a graph associated to a single set of curves but showing different axes.

For example, a grain size graph often shows on the left vertical axis the passing percentages and on the right vertical axis the retained percentages. For this display, select a grain size graph, either **GRAIN_SIZE** or **GRAIN_SIZE_POINT**, and insert a new graph with the same dimensions. Then, change the name of the new graph to **SECOND_AXIS** in the scrolling list. In the axes editing window, remove the display of the X axis for the **SECOND_AXIS** graph, place the Y axis on the right, inverse it and change its title.

No automatism controls this graph in **Lab**; the user can therefore use the **SECOND_AXIS** graph as he wishes.

4.3. Definition of the curves

The list of curves of a graph or of columns of a table is established and updated in the legend and curves editing window or the table editing window opened by selecting the **Legend** option of the **Tools** menu or by clicking on the button shown here.

This window is described in chapters 2 to 7 depending on the selected graph or table. Please refer to those chapters for all details about the definition of curves or columns.

More details about the legend and curves editing and the table editing are also available in paragraph 5 of chapter 6 of the X3D guide.

4.4. Options

The **Options** item of the **Tools** menu or the button shown here opens the window of options for display and calculation of tables and curves. This window has eight definition panels for the presentation parameters. These panels are:

General	Panel where the user defines: • the display mode during navigation • the batch printing parameters • the selection of samples to include in the tables • the saturation curves for the Proctor compaction graph • the global smoothing values for the grain size, compaction and consolidation curves This panel is described in paragraph 4.5.
Classification	Panel where the user defines: • the classification table of materials by grain size This table is usually located above the grain size graph. This panel is described in paragraph 4.6.
Sieves	Panel where the user defines: • the references sieves in the grain size graph • the references sieves for the calculation of statistic curves and combinations of grain size curves • the display of the grain size envelope • the smoothing of the statistic curves This panel is described in paragraph 4.7.
Materials	Panel where the user defines: • the table presenting the percentages of the various materials constituting the samples represented

	• the correction of grain size curves • the combination of grain size curves This panel is described in paragraph 4.8.
Table 1, 2, 3	Panels where the user defines tables to present significant values like: • specific values from the curves such as the percentages passing the main sieves • values of D10, D30, D60, D*n* • percentages of various materials • calculated results of common tests • information from the tables read This panel is described in paragraph 4.9.
Symbol	Panel where the user defines: • the specific curves to plot among the calculated curves (percentages, averages, etc.) • the envelope curves for the envelope selected in the **Sieves** panel • the drawing attributes of each curve (sample) and their representation in tables 1, 2 or 3 This panel is described in paragraph 4.10.

The parameters defined in these panels will be saved in the style file.

The following boxes explain how to make selections in the tables of the options window and the role of the Insert and Delete buttons present in all the panels.

Selection of one or multiple rows
- To select a row, click on the grey cell at the left of the row.
- To select several consecutive rows, select the first row of the series, hold down the [Shift] key and select the last row of the series.
- To select several non-consecutive rows, select the right row, then select each other row while holding down the [Ctrl] key.

Insert and Delete buttons
- Clicking on the Insert button adds a copy of the select row, or of the first row selected if several were selected.
- Clicking on the Delete button deletes the selected row(s).

4.5. Options: General

The **General** panel is shown in figure 1-3. This panel is used to:
- define the display mode during navigation;
- define the distribution parameters of the samples retrieved for batch printing;
- restrict the samples to be included in the tables;
- define the saturation curves for the Proctor compaction graph;
- define the global smoothing values for the grain size, compaction and consolidation curves.

4.5.1. Display during navigation

In the zone "**Upon navigating, display**", the user can decide to display **all selected curves (records)** returned by the query, or only **the current curves (records)** according to their grouping.

In the zone “**Grouping them by**”, the user can decide to display the curves resulting from the query by showing the samples individually, or showing those belonging to each boring separately, or by showing those belonging to each site separately. If the user selected “all selected curves” in the previous zone, during navigation, the curves will be displayed in red according to the selected grouping.

4.5.2. Printing parameters

The user can define a **number of samples per page** in each graphic output for **batch printing**.

This option, combined with the two display options, is used to define the graphic printings. For batch printing, in other words to print all the records retrieved by the query, the option “Upon navigating, display all selected curves” must be selected. Otherwise, the printing will be done on the current records.

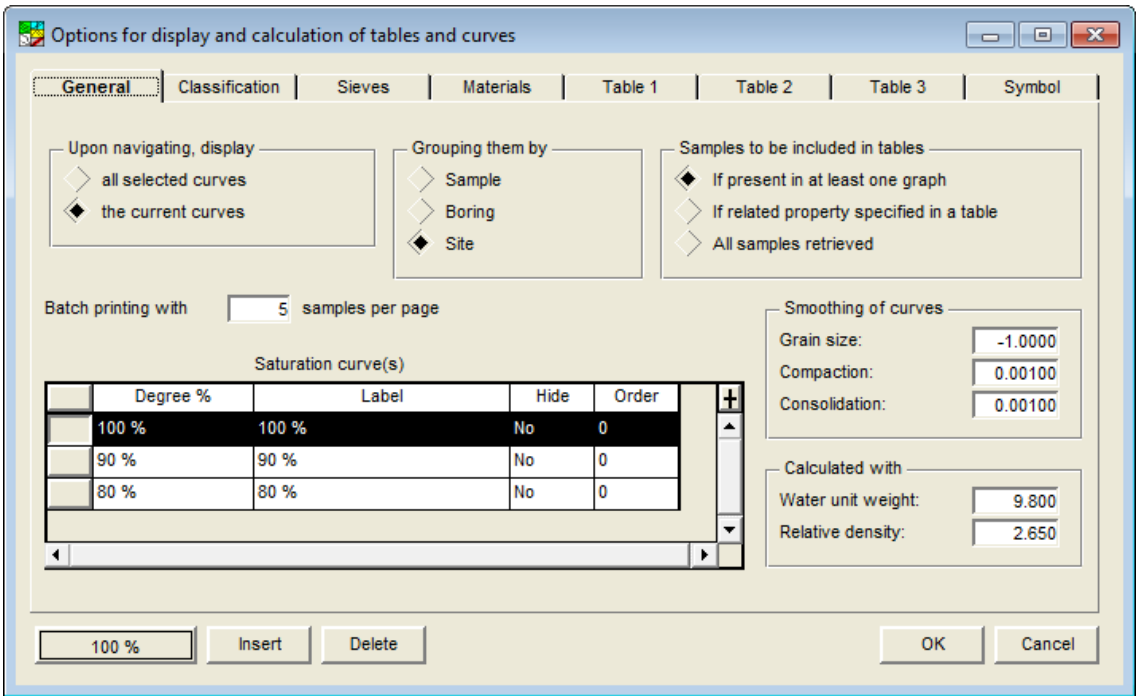


Figure 1-3 - Options: General panel

4.5.3. Restriction on the samples to include in the tables

For the display in the tables, the user can define which samples will be shown, with the options in the zone “**Samples to be included in tables**”.

- If the box **If present in at least one graph** is checked, the samples retrieved that have values presentable in at least one of the graphs of the style file will be displayed in the tables.
- If the box **If related property specified in a table** is checked, the samples presented in the graphs will be displayed in the table. In addition, if a field of a table of the database is defined as a column in a table, all the samples defined in this database table will be displayed in the table. This does not apply to the fields SITE_NO, BORING_NO, SAMPLE_NO and DEPTH_xx of any table.

- If the box **All samples retrieved** is checked, all the samples retrieved from the query will be displayed in the tables.

4.5.4. Global smoothing

In the zone "**Smoothing of curves**", the **Grain size**, **Compaction** and **Consolidation** fields are used to enter the global smoothing values for the grain size, compaction and consolidation curves.

It is not possible to enter a negative value in the **Compaction** and **Consolidation** fields. Indeed, it is not possible to have a broken line as a compaction curve because it would not be possible to obtain an optimum, nor as a consolidation curve because it would not be possible to apply the Casagrande construction. More details about smoothing are found in paragraph 7.

4.5.5. Saturation curves

Paragraph 2.4 of chapter 4 explains how to define the saturation curves and describes both fields of the rectangle "**Calculated with**".

4.6. Options: Classification

The **Classification** panel is shown in figure 1-4. It is used to define the classification table of the materials constituting the samples by size of the particles. Paragraph 3.3 of chapter 2 presents this panel.

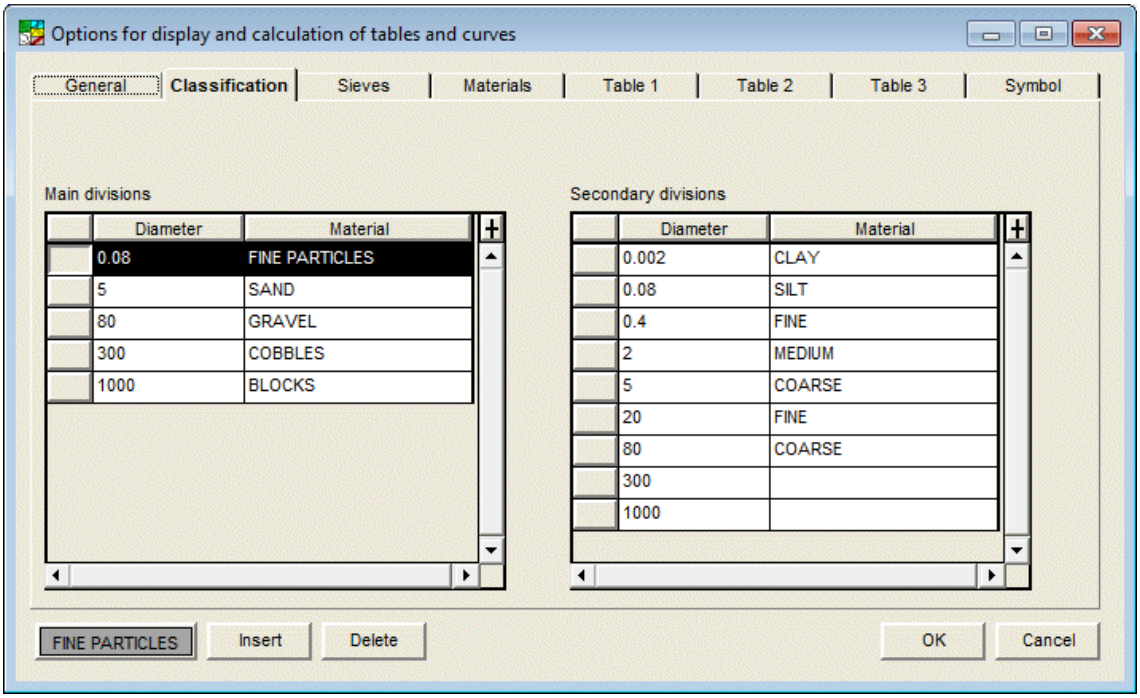


Figure 1-4 - Options: Classification panel

4.7. Options: Sieves

The **Sieves** panel is shown in figure 1-5 and is mainly used to define the reference sieves.

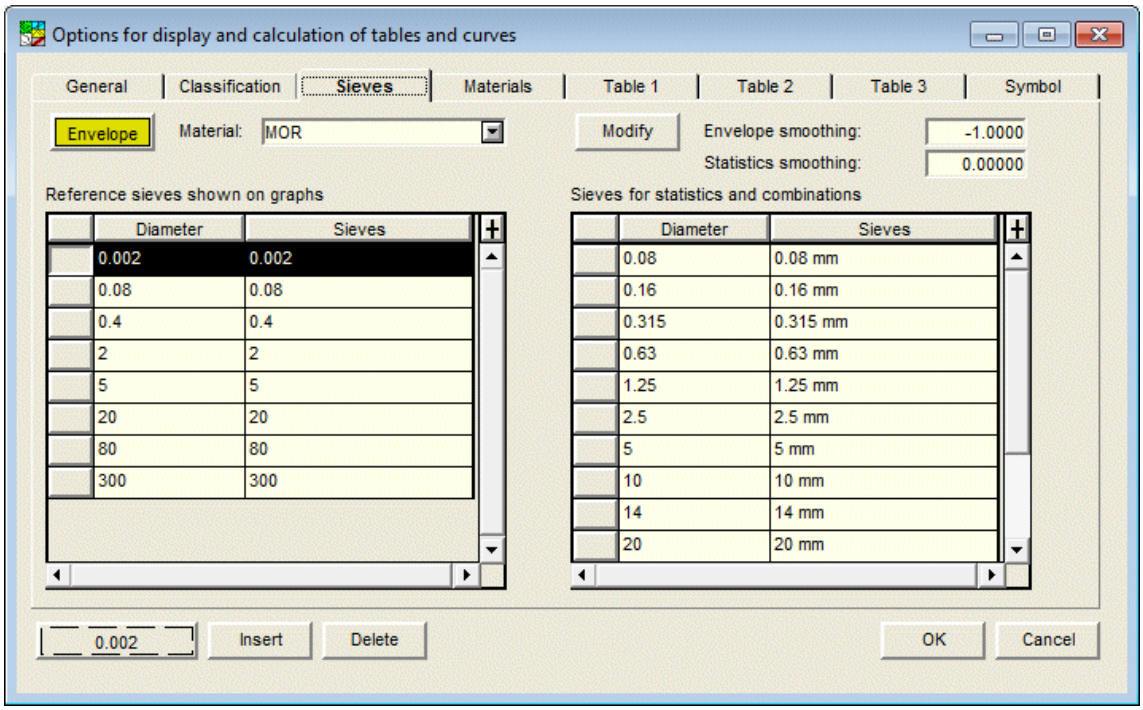


Figure 1-5 - Options: Sieves panel

The left section of the panel is used to define the values where vertical lines will represent the reference sieves in the graph of grain size curves.

The right section is used to define which reference sieves will be implied in the calculation of statistic curves and combinations of grain size curves.

The top section is used to define which grain size envelope will be displayed, its drawing attributes and its smoothing. The smoothing of the statistic curves is also defined.

The use of this panel is described in paragraph 2.4 of chapter 2 of this guide.

4.8. Options: Materials

The **Materials** panel is shown in figure 1-6. The panel is used to:

- define the **TABLE_MAT** table for the percentages of the materials constituting the samples in terms of their particle size (see paragraph 4.3 of chapter 2);
- correct the grain size curves by taking into account the percentages of cobbles and boulders entered in the **COBBLE** or **STRATIGRAPHY** table (see paragraph 2.5.1 of chapter 2);
- correct the grain size curves by cutting the curves at a specified diameter (see paragraph 2.5.2 of chapter 2);
- extrapolate the grain size curves (see paragraph 2.5.3 of chapter 2);
- display the combinations (see paragraph 2.6 of chapter 2).

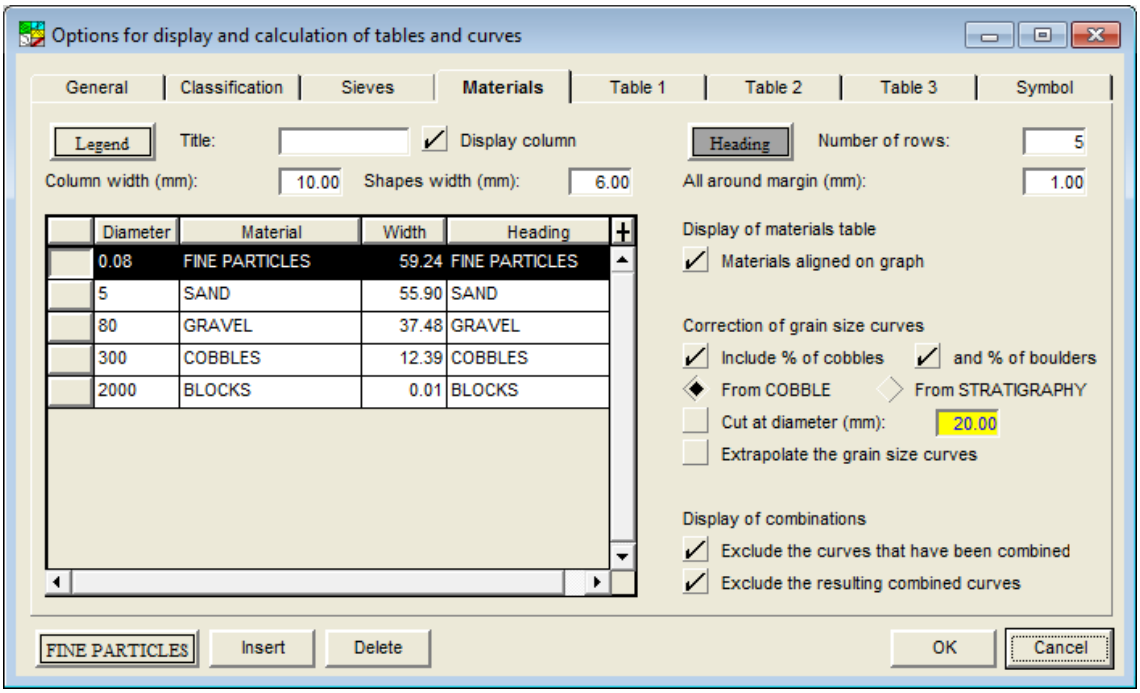


Figure 1-6 - Options: Materials panel

4.9. Options: Tables 1, 2 and 3

The **Table *n*** panel is used to associate significant values to a table defined as the **TABLE_*n*** graph. The modifications done in the **Table *n*** panel have an effect only if the **TABLE_*n*** graph exists in the style file. Each row defined in a **Table *n*** panel defines a column of the **TABLE_*n*** table.

4.9.1. Selection of the significant values

In each row of a **Table *n*** panel, the cells of the **Table** and **Field** columns define the significant value. The cells of the **Heading** and **Width** columns are used to define the heading and width of the resulting column. Each cell of the **Table** and **Field** columns contains a scrolling list which is displayed by clicking on the right end of the cell.

The possible values for the **Table** and **Field** columns of a **Table *n*** panel are listed below. The choices of **Sieve**, **Material** and **Diameter** are only available is a GRAIN_SIZE or GRAIN_SIZE_POINT graph is present in the style file.

In the columns of the Table *n* panel		**Result in the TABLE_*n* graph**
Table	**Field**	
Sieve	Diameter of the sieve: A list of the main sieve diameters is available; however, another diameter can be entered directly	Percentage passing the specified sieve
Material	List of the materials defined in the **Materials** panel (see paragraph 4.3 of chapter 2)	Percentage of the sample made of the selected material

In the columns of the Table *n* panel		Result in the TABLE_*n* graph
Table	**Field**	
Diameter	Particles percentage of the sample: A list of the main percentages is available; however, another percentage can be entered directly	Diameter corresponding to the specified percentage; usually, the D10, D30 and D60
Result	Geotechnical property: The list of the main properties is available: for example, the coefficients of uniformity and concavity (Cu and Cc), the compression and recompression indexes (Cci and Ccr), the optimum water content (W_opt), the maximum density (D_max), the unified classification (USCS), etc.	Value of the selected property
Name of a table from the Geotec database	Field of the selected table: The tables in the list are those that contain a field for the sample number. The list of fields from the selected table is available.	Value of the table's field (see note 1)

The selection of a value in the **Field** column displays a default heading that the user can change.

Note 1:

- If the table is **SAMPLE** and the field is **BORING_NO**:
  - Each row associated to a **Sample_x** element of the **Symbol** panel (see paragraph 4.10.2) displays the number of the boring where the sample was taken.
  - Each row associated to a **SPEC_*ENVELOPE*_MAX** or **SPEC_*ENVELOPE*_MIN** element of the **Symbol** panel (see paragraph 4.10.3) displays the "***ENVELOPE***" expression.
  - Each row associated to a **STAT_MIN_*n*%**, **STAT_AVG_*n*%** or **STAT_MAX_*n*%** element of the **Symbol** panel (see paragraph 4.10.4) displays the "**MIN**", "**AVG**" or "**MAX**" expression.
  - Each row associated to a **STAT_AVG_+*n.n*S** or **STAT_AVG_-*n.n*S** element of the **Symbol** panel (see paragraph 4.10.5) displays the "**AVG**" expression.
  - The row associated to the **STAT_STD_DEV** element of the **Symbol** panel (see paragraph 4.10.5) displays the expression "**STD**".
- If the table is **SAMPLE** and the field is **SAMPLE_NO**:
  - Each row associated to a **Sample_x** element of the **Symbol** panel (see paragraph 4.10.2) displays the number of the represented sample.
  - Each row associated to a **SPEC_ *ENVELOPE* _MAX** or **SPEC_ *ENVELOPE* _MIN** element of the **Symbol** panel (see paragraph 4.10.3) displays the "**MAX**" or "**MIN**" expression.
  - Each row associated to a **STAT_MIN_*n*%**, **STAT_AVG_*n*%** or **STAT_MAX_*n*%** of the **Symbol** panel (see paragraph 4.10.4) displays the "***n%***" expression.

- Each row associated to a **STAT_AVG_+*n.n*S** or **STAT_AVG_-*n.n*S** element of the **Symbol** panel (see paragraph 4.10.5) displays the "+***n.n*S**" or "-***n.n*S**" expression.
- The row associated to the **STAT_STD_DEV** element of the **Symbol** panel (see paragraph 4.10.5) displays the "**DEV**" expression.

- If the table is **SAMPLE** and the field is **DESCRIPTION**:
  - Each row associated to a **Sample_x** element of the **Symbol** panel (see paragraph 4.10.2) displays the description of the represented sample as defined in the **SAMPLE** table.
  - Each row associated to an element of the grain size envelope. or associated to a curve calculated according to a given percentage or standard deviation shows as description the title entered in the **Symbol** table (see paragraphs 4.10.3, 4.10.4 and 4.10.5).

Figure 1-7 shows a **Table 1** where is defined a table presenting the percentages passing some sieves and the diameters corresponding to some percentages.

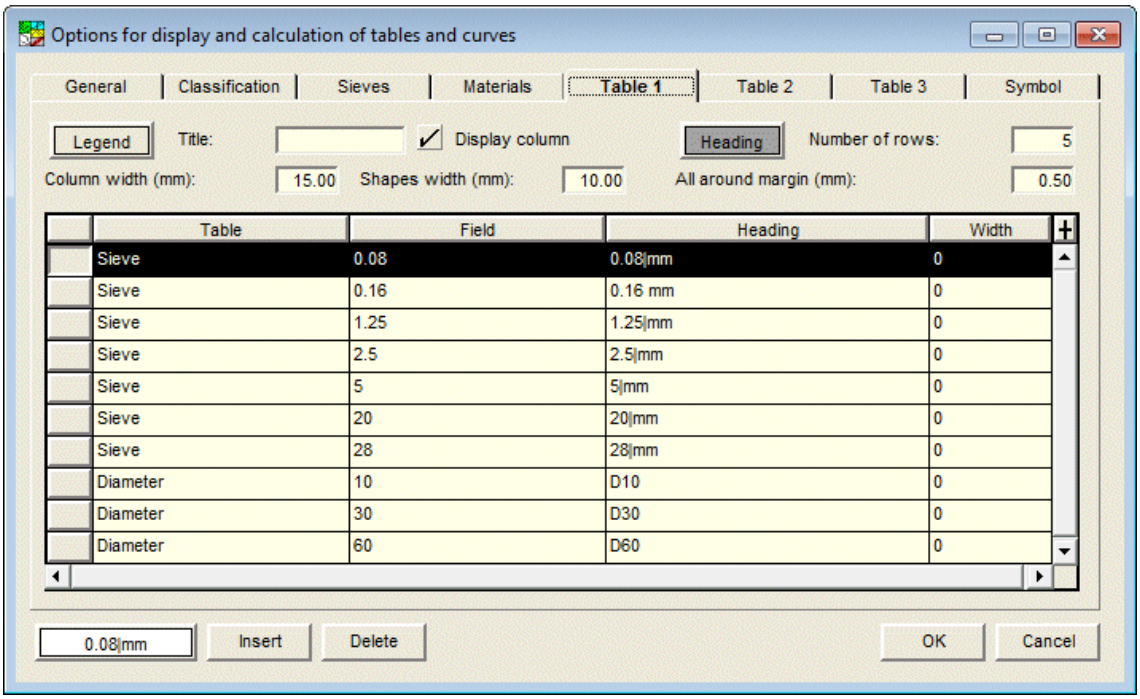


Figure 1-7 - Options: Table of significant values (sieves and diameters)

Figure 1-8 shows **Table 2** where is defined a table presenting values of fields from various tables of the database. In addition, a result is defined in the table.

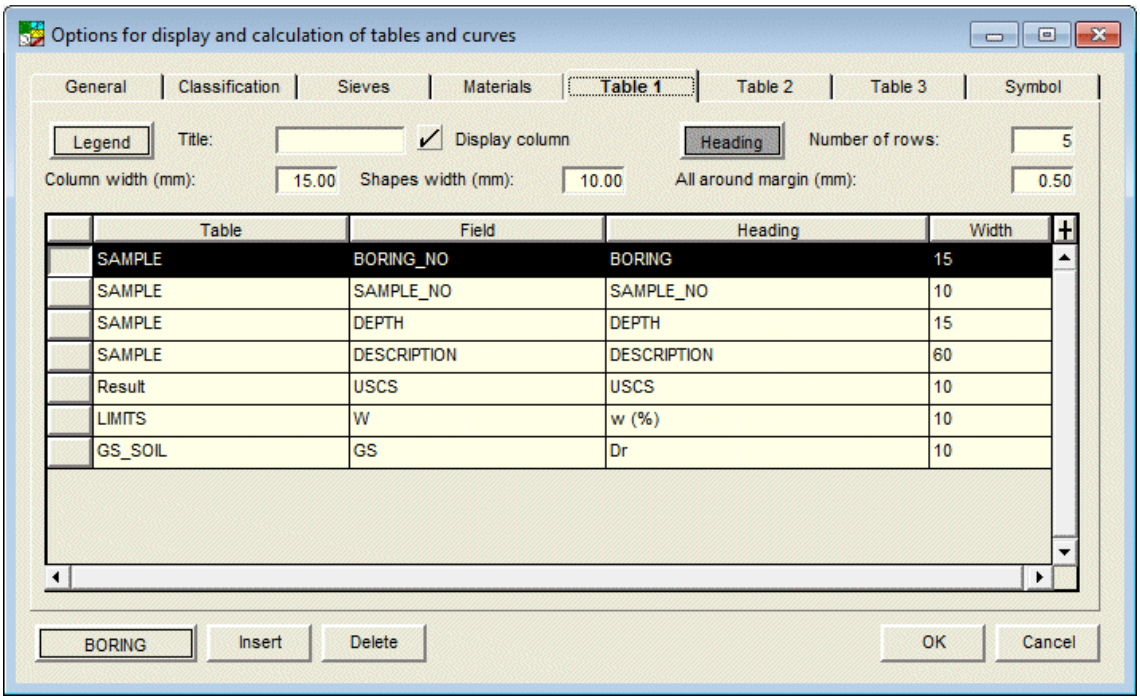


Figure 1-8 - Options: Table of significant values (fields from a table)

Most of the results shown in the tables of significant values that are not associated to table fields are interpolated from the graphs displayed.

If a result cannot be calculated, or if a field value does not exist for a record, the cell will contain the expression defined in the **Missing value** field of the **Default** panel of the preference editing window.

4.9.2. Width of the columns

The widths of the columns of the tables of significant values depend on the widths specified in the **Table *n*** panels and on the definition of an alignment for the table in the table editing window. See paragraphs 5.3.1 and 5.3.6 of chapter 6 of the X3D guide for all details on the dimensions of a table and its columns.

- The effective width of the columns with a defined **width** greater than **0** depends on this width. In a table without alignment (displayed with the dimensions of the graph's rectangle), the proportion between the defined widths is used (except for shapes column). In a table with alignment, the defined widths are used for the display.
- The effective width of the columns with a **width** of **0** depends on the length of the values contained, including the heading. The display of a column of width **0** is adjusted, **as much as possible**, to fit the longest value on one line. The heading can be displayed on several lines if it is made of several words with a total length exceeding the length of the longest value of the column or if it contains the character "**|**".

In a table without alignment, it is possible that no column can display the totality of its content. In a table with alignment, the columns with a defined width of 0 will show their entire content, while the columns with a defined width greater than 0 will have the defined width.

4.9.3. Symbols column and characteristics of the tables

The **Display column** checkbox and the fields for the shapes width, for the all-around margin and for the number of rows in the **Table *n*** panels are the same as in the **Materials** panel (see paragraph 4.2.1 of chapter 2).

4.9.4. Drawing attributes of the tables of significant values

The buttons labelled **Legend** and **Heading** and the button at the bottom left of the panel have the same roles and particularities as the equivalent buttons in the **Materials** panel (see paragraph 4 of chapter 2).

Among the drawing attributes, the format defined for a column of a table of significant values is valid for all the cells of this column, except for the heading.

4.9.5. Insertion and deletion of rows

The tables of the **Table *n*** panels always have at least one selected row. In the **Table *n*** panels, the **Insert** and **Delete** buttons are used the same way as in the other panels of the **Options** window (see paragraph 4.4).

4.10. Options: Symbol

The **Symbol** panel is shown in figure 1-9. It is used to select the curves that will be displayed in the graphs, to define their presence in the tables and their drawing attributes.

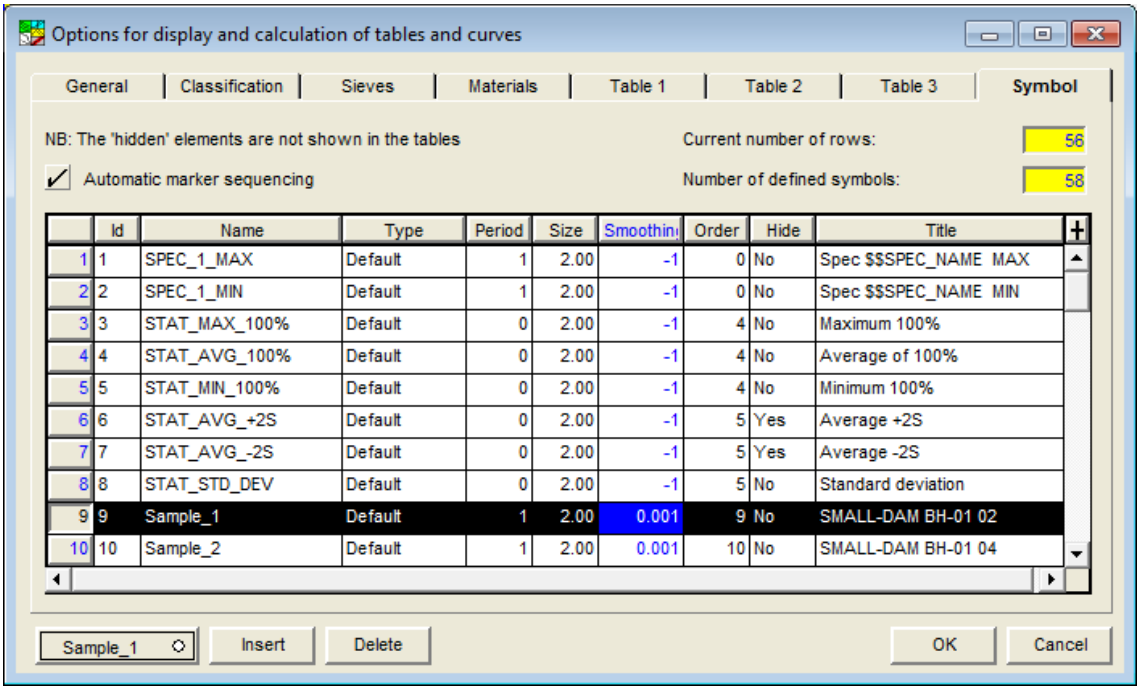


Figure 1-9 - Options: Symbol panel

In the **Symbol** panel, the **Insert** and **Delete** buttons are used the same way as in the other panels of the **Options** window (see paragraph 4.4).

4.10.1. Choice of curves

The **Name** column contains the identification of the entities to display as curves and/or as rows in the tables of significant values. A list of the types of curves, shown in figure 1-10, is displayed by clicking on the button at the right end of the **Name** cell.

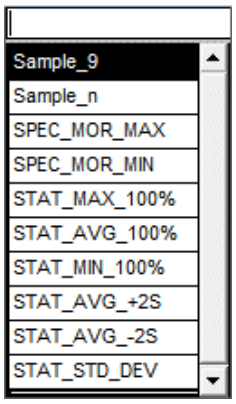


Figure 1-10 - List of the types of curves

The list includes these groups of curves:

- The sample curves **Sample**_ (see paragraph 4.10.2)
- The **envelope** curves (see paragraph 4.10.3)
- The curves calculated according to a **defined percentage** (see paragraph 4.10.4)
- The curves calculated according to a **standard deviation** (see paragraph 4.10.5)

4.10.2. Sample curves

The **GRAIN_SIZE_POINT**, **GRAIN_SIZE**, **PROCTOR_POINT**, **PROCTOR**, **CONSOLIDATION_POINT**, **CONSOLIDATION**, **LIMITS** and **CUR_LI** graphs display all the samples that have results associated to the graphs present in the style file. The display of the curves for these samples is defined with the **Sample_x** rows of the **Symbol** panel. The expression "**Sample**_" is reserved and cannot be modified.

Sample_1 defines the presence and the display of the curves associated to the first sample returned by the query; **Sample_2** defines the curves associated to the second sample, etc.

In the list associated to the cells of the **Name** column, the proposed **Sample_y** curve depends on the number of **Sample_x** curves already in the panel. If the panel contains four **Sample_x** curves, whatever the values of **x**, the proposed sample curve in the list will be **Sample_5**, even if a Sample_5 curve already exists. Once the **Sample_y** curve is selected, the user can modify the value of **y**, which changes its title.

In addition to **Sample_y**, the list associated to the cells of the **Name** column has the **Sample_n** element, if no row of the table in the **Symbol** panel already has this name. The display associated to the **Sample_n** row will be used for the curves of all the samples that do not have a specific definition in the **Symbol** panel (in other words, which doesn't constitute a row). If the user does not want to represent the curves grouped as **Sample_n**, he can uncheck the undesired samples in the box opened by clicking the # button of the navigation, or hide the drawing attributes associated to the **Sample_n** row by clicking on the "**-**" button for each

component of the curves: line, marker, text. If all the samples returned by the query are not represented in the **Symbol** panel, the **Sample_n** row will be generated automatically.

The value of the **Hide** cell in the **Sample_n** row of the table of the **Symbol** panel is always set to **Yes** and cannot be changed. This row is always hidden in the tables of significant values because it does not represent a unique sample.

Paragraph 4.10.7.7 indicates the default title of a sample curve.

4.10.3. Envelope curves

The envelope curves have their points defined in the **GRAIN_SIZE_POINT** table for the **SPEC** site, ***ENVELOPE*** boring and **MIN** and **MAX** samples.

In the **Symbol** panel, the list of the curves displayed contains the minimum and maximum curves of the envelope selected in the **Sieves** panel (see paragraph 2.4.1 of chapter 2) with the following syntax:

- **SPEC_*ENVELOPE*_MAX (**and _**MIN)** where ***ENVELOPE*** represents a material for which an envelope is defined.

Paragraph 2.7.4 of chapter 2 presents the envelope curves in details.

4.10.4. Curves calculated according to a percentage

The curves calculated according to a percentage only pertain to the **GRAIN_SIZE** and **GRAIN_SIZE_POINT** graphs. Paragraph 2.7.2 of chapter 2 presents these curves in details.

4.10.5. Curves calculated according to a standard deviation

The curves calculated according to a standard deviation only pertain to the **GRAIN_SIZE** and **GRAIN_SIZE_POINT** graphs. Paragraph 2.7.3 of chapter 2 presents these curves in details.

4.10.6. Number of defined rows and symbols

As curves are added or removed in the **Symbol** panel, the values of the non-modifiable fields **Current number of rows** and **Number of defined symbols** are adjusted.

The current number of rows includes all the non-hidden curves of the **Symbol** panel. The number of defined symbols shows the total number of rows (curves).

4.10.7. Characteristics of the curves

4.10.7.1. Type of the curves

The **Type** column of the **Symbol** panel is not used presently.

4.10.7.2. Period of the markers

If the **Period** of a curve is **0 or a negative value**, no marker will be drawn on the points of the curve. If this cell contains a value greater or equal to **1**, **all** the points of the curve will have a marker.

4.10.7.3. Size of the markers

The **Size** cell of a curve is used to specify the size of the markers, in millimeters. Specifying a size of **0** is a way to hide the markers.

4.10.7.4. Smoothing of the curves

The **Smoothing** column of the **Symbol** panel is inactive. It shows the smoothing used for each curve. See paragraph 7 for more details about the smoothing.

4.10.7.5. Presentation order of the curves

The **Order** column is used to define the presentation order of the curves and associated information in the tables of materials and significant values.

With an **order of 0** or a negative value, the **statistics curves** and the **specs** will be displayed in the graph but hidden in the tables.

If the user exits the Symbol panel and re-enters it, the rows are then sorted by ascending order of the values in the **Order** cells.

4.10.7.6. Presence of symbols in the tables of materials and significant values

A curve displayed in a graph, for example the one of grain size curves, must not necessarily appear in the tables of materials and significant values. By setting to "**Yes**" its "**Hide**" column, the sample curves will be displayed in the graph but not in the tables.

For the **statistics curves** and the specs, if the **Hide** cell is set to **Yes**, these curves will be hidden in the graph and the tables.

The **Hide** cell of the **Sample_n** row is set to **Yes** and cannot be modified. It is always hidden in the tables of significant values because it does not represent a unique sample.

The number of elements containing **No** in their **Hide** column appears in the non-modifiable field **Current number of rows**. This number is the maximum number of rows that can be displayed in the tables of materials and of significant values.

4.10.7.7. Titles associated to the symbols

By default, a title is associated to each element defined in the table of the **Symbol** panel and is displayed in the **Title** column. This title can be edited. If a title is erased, the default title is automatically re-written.

The site, boring and sample numbers associated to each **Sample_x** element are written by default and separated by a space, for example: "**SMALL-DAM TP-02 1**". A part of this information will be displayed in the eventual legends of the graphs. If there are more rows defined than samples retrieved, the expression "**All samples retrieved**" is written in the title of the curves not used.

The default title associated to a curve calculated according to a percentage is **Maximum/Average/Minimum of *n*%**, for example **Minimum of 100%**.

The default title associated to a curve calculated according to a standard deviation is **Average +/- *n.n*S**, for example **Average +2S**.

The default title associated to the **STAT_STD_DEV** curve is **Standard deviation**.

The default title associated to an envelope curve is **Spec $$*ENVELOPE* MIN** or **Spec $$*ENVELOPE* MAX**" depending on the curve selected.

4.10.7.8. Drawing attributes of the curves

The user can define the presentation of all the curves and other elements of the **Symbol** panel, which are saved in the style file.

To modify the drawing attributes of one or several curves associated to one or several rows of the **Symbol** panel, select the desired row(s) in the table and click on the button at the bottom left of the panel. It is possible to define the following attributes:

- The type, color and thickness of the line;
- The marker, its color, its size and its period;

  Remember that the size and period of the markers can also be defined in the **Size** and **Period** cells of the table in the **Symbol** panel;
- The color, filling and pattern for the envelope curves; these attributes are generally defined directly in the **Sieves** panel;
- The format of the values;

  This format will apply to the values of the row associated to the selected element in the tables of materials and of significant values.

  In a cell of a table of materials or of significant values, if a format is defined for the row to which the cell belongs, this format has priority over the format defined for the column.

4.10.7.9. Simultaneous modification of several curves

It is possible to modify some characteristics of several curves simultaneously. To do this:

1. change the desired characteristic(s) (**Period**, **Size**) in the first curve of the series to be modified;
2. select the series of curves to be modified;
3. for each characteristic to be changed, double-click in the heading of its column. The value of the characteristic of the first curve in the selection is then attributed to all the other selected curves.

   With the **Hide** column, double-clicking in the heading changes the value (Yes for No and vice versa) of the first curve selected and enters the value obtained in the **Hide** cell of the other selected curves.

To modify simultaneously the drawing attributes of several curves, select them all and click on the button at the bottom left of the **Symbol** panel.

4.10.8. "Manual" management of the presentation of the samples retrieved

If the box **Automatic marker sequencing** is not checked, the user must select and define the presentation for each sample retrieved. All the symbols of samples defined are saved in the style file.

- By selecting “**Sample_n**”, all the curves retrieved (and not defined individually as Sample_x) are displayed with the same symbol. These curves are never presented in the tables.
- By selecting “**Sample_x**”, the user must define the line and the marker of each curve to be displayed.
    - If there are more rows defined than samples retrieved, the expression “**All samples retrieved**” is written in the title of the curves not used.
    - If there are fewer rows defined than samples retrieved, the “**Sample_n**” curve is used for all the samples without a symbol, as it exists or created by default.

      When creating a new symbol, the insertion is always done just after the selected symbol. If the symbol selected refers to a sample, the added symbol will have a number of 1 more than the number of sample symbols defined. For example, if 4 sample curves exist, the 5th created will be **Sample_5**, no matter the subscript of the other sample curves. The number of the marker assigned to the symbol of a new sample is equal to the number of the marker of the original symbol, increased by 1.

      Although symbols are automatically proposed by default for each new insertion to facilitate the editing, the purpose of not selecting the **Automatic marker sequencing** box is to allow the user to define the symbols of all the samples.

4.10.9. Automatic management of the presentation of the samples retrieved

If the box **Automatic marker sequencing** is checked, a sample curve is attributed to each sample in the **Symbol** panel and is presented with the default attributes generated by **Lab**. After checking the box, click **OK** and enter the options window again to view in the table the result from checking the box.

With the automatic management, the “Sample_n” curve is not in the table of the Symbol panel. Only the envelope curves and statistic curves are managed by the user and saved in the style file.

With this option, the symbols of the sample curves are generated automatically before each display as follows:

- As long as there are samples to display, in the same order as their retrieval and selected by site, boring or sample:
    - A symbol is initialised with the default attributes for the line and the dimensions of the marker;
    - The **Sample_x** symbol has the order number and the **marker number x** assigned to the row;
    - The presence of the samples in the tables (“hide” column) is initialised this way:
    - If there are rows already defined for the samples, the option of the last symbol is used for all the additional symbols.
    - If there is no symbol defined for the samples, the “Not hidden” option is initialised by default.

- It is possible to modify the line and marker of a symbol generated automatically. However, these modifications will be lost if the series of default symbols is recreated, for example if the **Automatic marker sequencing** box is clicked again.

5. DATA MENU

The options of the **Data** menu are detailed in chapter 7 of the X3D guide. The options are mainly used to retrieve data in the tables of the **Geotec** database.

In Lab, the data entry options available in the **Data** menu (**Entry** option) and with the buttons of the application toolbar ( ) are those of **Site**, **Boring**, **Stratigraphy**, **Sample**, **Grain Size**, **Proctor**, **Consolidation** and **Atterberg limits**. The user first inserts the sites, followed by the borings related to the sites, then the layers and samples from the borings. He can then add results for those four lab tests done on the samples. Some fields are mandatory and are identified by different background and text colors, defined in the preferences editing window (see paragraph 7 of chapter 6 of the X3D guide).

In Lab, the default retrieval (**simple query**) is done on the **Sample** table or the last table of the four lab tests where a query was done.

6. WINDOW AND HELP MENUS

None of the options of the **Window** and **Help** menus is specific to Lab. A detailed description of each option of these menus is done in chapter 8 of the X3D guide.

7. SMOOTHING

In most cases, the line joining the points of lab test results is a kriged curve. The position of the curve relative to each point is a function of a numeric coefficient: the **smoothing** or minimal offset around the points.

An offset of **0** indicates that the curve is smoothed and passes through all the points, except if an offset is applied to some points (see below). The larger the offset, the farther the curve will be from the points, until it becomes the best-fit curve through the points.

The smoothing can be defined on 3 levels:

- **For the points of the curves**, in the **Z** field of the **GRAIN_SIZE_POINT**, **PROCTOR_POINT** and **CONSOLIDATION_POINT** tables.

  The smoothing defined at this level has priority over the smoothing defined at the other levels. This smoothing is defined in the entry forms.

  If a point from a grain size, consolidation or compaction curve has a **negative offset other than -1**, it will be considered a **fit point**; the curve will necessarily pass through this point, no matter the offset specified at other points or for the entire curve.

- **For the whole curve**; this level of smoothing exists only for the grain size curves defined in the **SMOOTHING** field of the **GRAIN_SIZE** table. This smoothing has priority over the global smoothing value.

  It is possible to enter a negative offset in the **OFFSET** field of the **GRAIN_SIZE** table. These curves will not be kriged; they will be broken lines. The offset values specific to the points of the curves will not be taken into account.

- **At the global level**, the smoothing can be defined in the **General** panel of the options window (see paragraph 4.5.4).

  The scope of the global smoothing is all the curve points **without an offset** in the **GRAIN_SIZE_POINT**, **PROCTOR_POINT** and **CONSOLIDATION_POINT** tables, and, for the grain size curves, for which no offset value is inputted in the **OFFSET** field of the **GRAIN_SIZE** table. This smoothing is also used for the combined curves.

The smoothing for the envelope curves and the one for the statistic curves are defined in the **Sieves** panel of the options window.

8. INTERACTIVE EDITING

When a style file contains one or several graphs of points, i.e. **GRAIN_SIZE_POINT**, **CONSOLIDATION_POINT** or **PROCTOR_POINT**, it is possible to add fit points interactively with the mouse. When the cursor is on a curve point, it takes the format +?. By clicking with the right button of the mouse, the contextual menu shown in figure 1-11 is displayed.

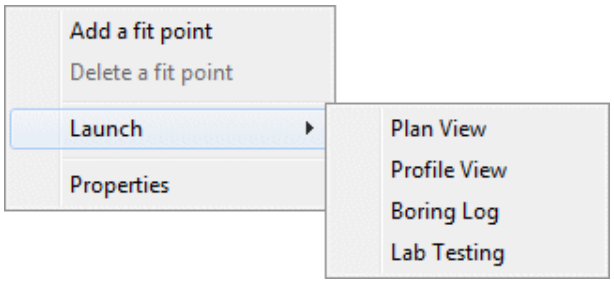


Figure 1-11 - Interactive menu

It is possible to add a fit point by clicking on **Add a fit point**. The cursor then becomes +. When the left button of the mouse is pressed, a dotted line shows the outline that the curve would have if the point was added. The point is added at the position of the cursor in X and Y when the button is released. Once the button of the mouse is released, a message is displayed, similar to figure 1-12.

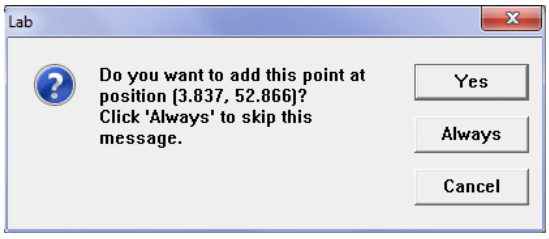


Figure 1-12 - Adding a fit point

This new point is considered a **fit point** and has a smoothing of -2 in the tables of curve points. It can be displayed with different attributes, by modifying the attributes of the **Sample_+** curve in the legend and curve editing window (see paragraphs 2.2.3, 2.2.6 and 2.2.4 of chapters 2, 3 and 4 respectively).

The fit points can be moved. By placing the cursor on the fit point, the cursor takes the format +. By clicking on the point, it takes the format . Move the point to the desired position, and release the button of the mouse; a message is displayed, similar to figure 1-13.

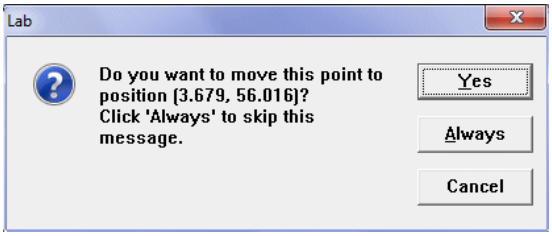


Figure 1-13 - Moving a fit point

It is also possible to delete fit points, by placing the cursor on the fit point to delete (the cursor takes the format +) and clicking on the right button of the mouse to display the interactive menu (see figure 1-11). The option **Delete a fit point** will be active. By selecting this option, a message is displayed, similar to figure 1-14.

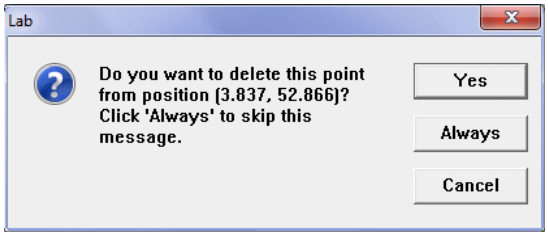


Figure 1-14 - Deleting a fit point

By clicking on **Always** in one of the messages, the future actions on fit points will be done without displayed a confirmation message. The next time that Lab is opened, the messages will be displayed again.

With the interactive menu, it is possible to launch the modules of Geotec with the options **Plan View**, **Profile View** and **Boring Log** under **Launch,** to show the various types of data that can be displayed for the current sample with the Site, Pro and Log modules respectively.

Finally, by placing the cursor on a point, it is possible to click the **Properties** option of the interactive menu, which will open the appropriate entry form on the data of the selected point. Double-clicking on the point has the same role.

CHAPTER 2. LAB - GRAIN SIZE ANALYSES

1. GENERALITIES

This chapter describes the particularities of the display of the results of grain size analyses done on samples in the laboratory. These results are presented in various formats:

- a display zone of the grain size curves that corresponds either to the **GRAIN_SIZE_POINT** graph, to the **GRAIN_SIZE** graph, or to both superimposed;
- a table presenting the classification of the materials constituting the samples in terms of particle size; it corresponds to the **CLASSIFICATION** graph;
- a table presenting the interpolated percentages of the materials constituting the samples in terms of particle size; it corresponds to the **TABLE_MAT** graph;
- up to three tables where significant values are interpolated, such as the percentages passing the reference sieves, the particle diameters corresponding to specific passing percentages, and where other information can be presented such as the uniformity and concavity coefficients; these tables correspond to the **TABLE_1**, **TABLE_2** and **TABLE_3** graphs.

The graphs are defined in the style file by their number, their name and their graphic characteristics.

2. GRAIN_SIZE_POINT AND GRAIN_SIZE GRAPHS

2.1. Definition of the graph of grain size curves

Lab produces grain size curves by reading data in the **GRAIN_SIZE_POINT** or **GRAIN_SIZE** table. The first table contains the percentages passing the different sieves really used in the laboratory; the second table contains the percentages passing the main sieves corresponding to the divisions of the USCS materials classification.

In addition to reading the sites, borings, samples and grain size data corresponding to the query done in the **SITE**, **BORING**, **SAMPLE**, **GRAIN_SIZE** and **GRAIN_SIZE_POINT** tables, Lab reads:

- The values defining a grain size envelope;

  These values are points of curves read in the **GRAIN_SIZE_POINT** table, belonging to the **MIN** and **MAX** samples associated to the dummy **SPEC** site and to the dummy boring representing the material for which an envelope was defined.

  A dummy site necessarily called **SPEC** must exist in the **SITE** table. Dummy borings associated to the **SPEC** site and with numbers being the codes of the materials for which envelopes are defined (for example, 2A for 2A material) must exist in the **BORING** table. Dummy samples, necessarily **MIN** and **MAX** and associated to each of the envelope materials, must exist in the **SAMPLE** table. These samples have a **length of 1m**, a **state** of **P** and the **top depth** of the **MIN** samples must be **0**, the one of the **MAX** samples, **1**.

Paragraph 46 of chapter 2 of the guide of entry forms describes the specifications entry form.

- The records in the **COBBLE** table associated to the borings in order to add to the grain size analyses the percentages of cobbles and of boulders, if the user selects the options in the **Materials** panel of the options window (see paragraph 2.5.1).
- The records in the **STRATIGRAPHY** table associated to the borings in order to add to the grain size analyses the percentages of cobbles and of boulders, if the user selects the options in the **Materials** panel of the options window (see paragraph 2.5.1).

The **GRAIN_SIZE_POINT** and **GRAIN_SIZE** graphs have the same characteristics.

The X-axis of the graph of grain size curves is logarithmic. Its lower limit must be greater than 0. The X-axis can be inverted by checking the **Invert** box in the axes editing window for the X-axis of the graph of grain size curves.

The Y-axis of the graph of grain size curves is linear. Its limits are normally between 0 and 100.

2.2. Predefined curves of the graph of grain size curves

The curves editing window for the graph of grain size curves, illustrated in figure 2-1, shows three predefined curves:

- The **Spec** curve for the specification envelopes;
- The **Sieves** curve for the graphic characteristics of the lines symbolizing the reference sieves;
- The **Sample_+** curve for the graphic characteristics of the points added to the grain size curves.

2.2.1. Spec curve

The "**Spec**" curve actually has the name of the material selected in the **Sieves** panel of the options window as the specification envelope to display (see paragraph 2.4.1). Its title is by default the keyword **$$Spec_name** showing the envelope name.

The drawing attributes for the representation of the specification envelopes are the line, the filling and the pattern. The user will define these attributes in the **Sieves** panel of the options window (see paragraph 2.4.1).

2.2.2. Sieves curve

The **Sieves** curve contains the graphic characteristics of the lines symbolizing the reference sieves defined in the **Sieves** panel of the options window (see paragraphs 2.4.3 and 2.4.4).

The drawing attributes for the representation of the reference sieves are the line and the text. The user can define how will be displayed the lines representing the sieves and their labels, i.e. the titles of the sieves, with the button located under **Delete** in the curves editing window for the **Sieves** curve, or by the button located at the bottom left of the **Sieves** panel of the options window for the reference sieves.

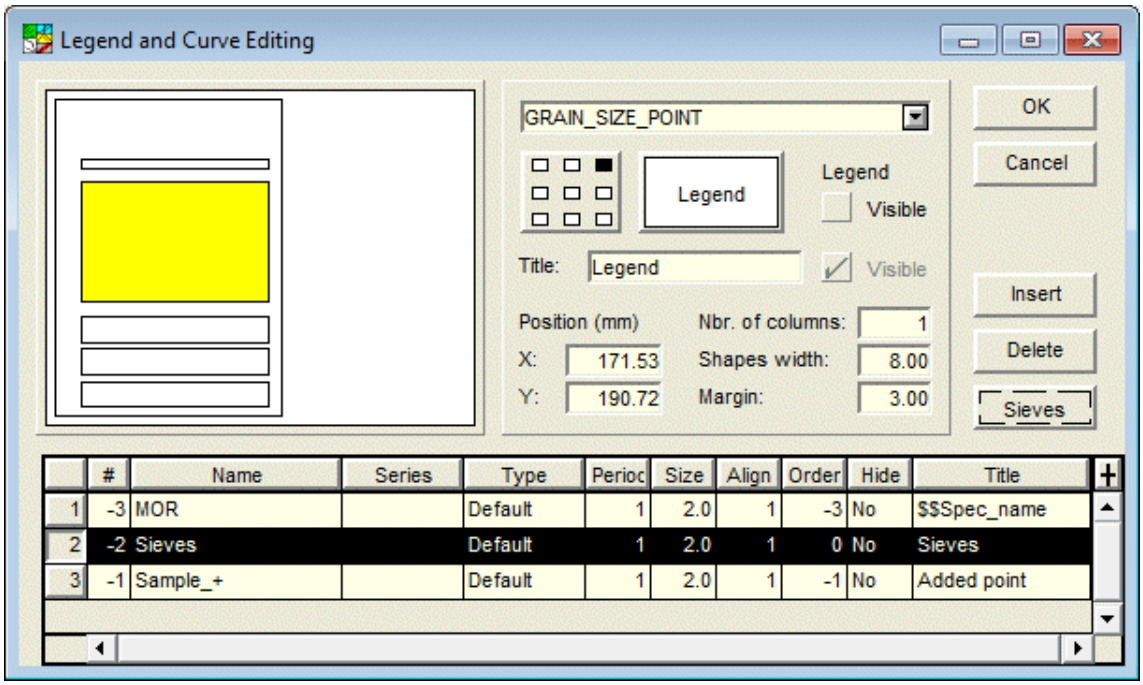


Figure 2-1 - Curves of the graph of grain size curves

2.2.3. Sample_+ curve

The **Sample_+** curve contains the graphic characteristics of the points “added” to the grain size curves. When a point of a grain size curve is added, the curve necessarily passes through this point. These points are considered fit points. The drawing attribute used for these fit points is the marker.

If a point from a grain size curve has a **negative offset other than -1**, it is then considered a **fit point** (see paragraph 7 of chapter 1). The fit points can be added interactively with the mouse. See paragraph 8 of chapter 1 for the details about the interactive editing.

2.3. Legend of the graph of grain size curves

By default, the order in the **Order** column of the **Spec**, **Sieves** and **Sample_+** curves is -3, 0 and -1 respectively. By changing the order values to values greater than **0**, these curves can be displayed in the legend of the graph.

If we check the upper box **Legend Visible** of the curves editing window opened on the graph of grain size curves, the legend of this graph will be displayed. It will show the **Spec**, **Sieves** and **Sample_+** curves if their order number is positive, followed by as many symbols of curves as there are **Sample_x** symbols defined in the **Symbol** panel of the options window (see paragraph 4.10.2 of chapter 1). The **Sample_n** symbol and the calculated curves are not shown in the legend.

In the legend, the label of the **Spec**, **Sieves** and **Sample_+** curves is the expression in their title; the label of the grain size curves is made of the site, boring and sample numbers separated by a space. The site number is not displayed if the curves are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

Clicking on the button left of the **Legend** label opens the drawing attributes configuration window where it is possible to define the attributes of the text, background and border of the legend.

2.4. Definition and representation of the sieves

As indicated in paragraph 2.2.2, the sieves represented in the graph of grain size curves are displayed with the attributes associated to the **Sieves** predefined curve. The definition of the sieves to represent is done in the **Sieves** panel of the options window, as shown in figure 2-2.

The left part of the panel is used to define the values at which vertical lines will represent the reference sieves in the graph of grain size curves. The right part of the panel is used to define the reference sieves that will be involved in the calculation of the statistic curves and the combinations of grain size curves. See paragraphs 2.7.2, 2.7.3 and 2.6.2. The top part of the panel is used to define which grain size envelope will be displayed, its drawing attributes and its smoothing, as well as the smoothing for the statistic curves.

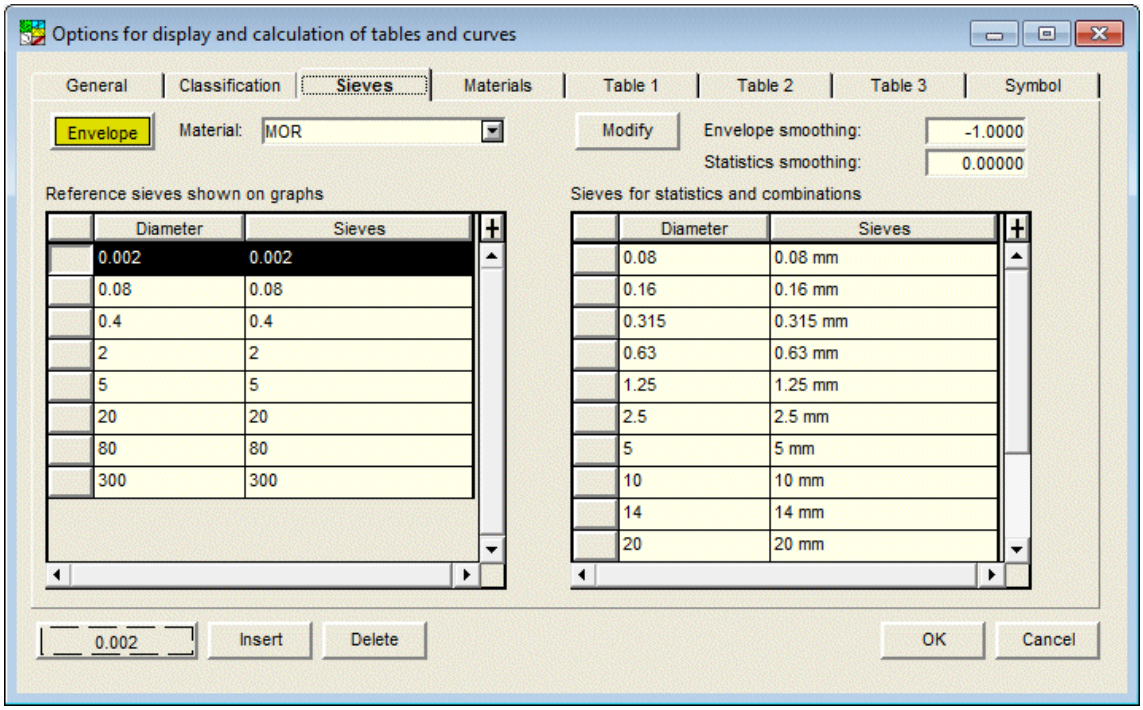


Figure 2-2 - Sieves definition panel

2.4.1. Definition of the specification envelope

Only one grain size envelope can be displayed at once in the zone of grain size curves. To the right of the **Material** field, the user selects the desired material from the list. The list shows all the dummy borings belonging to the **SPEC** site and with values defined in the **GRAIN_SIZE_POINT** table for its **MIN** and **MAX** samples (the envelopes can be defined directly in the specifications entry form; see paragraph 46 of chapter 2 of the entry forms guide). By selecting an envelope, the envelope curves in the **Symbol** panel are automatically modified (see paragraph 2.7.4). If you do not want to display an envelope, erase the value in the **Material** field or hide the specification curves in the **Symbol** panel.

If a record exists in the **MATERIAL** table for the **SPEC** site, the **Strata** type and the **envelope material** (for example: MOR), the color defined for the material will be used for the corresponding envelope.

The drawing attributes for the representation of the specification envelopes are the line, the filling, the pattern and the marker. They can be modified via the button labeled **Envelope** at the top left of the window.

With the **Modify** button, the user can make modifications to the values of the passing percentages or of the diameters for the envelopes in the specifications entry form that opens. The window opened by clicking **Modify** displays a table with the diameters, the passing percentages of the **MIN** sample, then of the **MAX** sample, in order from left to right.

Finally, the user can apply a smoothing for the envelope curves. He defines the value in the **Envelope smoothing** field.

2.4.2. Definition of the smoothing for statistic curves

The user can apply a smoothing for the calculated statistic curves. He defines the value in the **Statistics smoothing** field. Note that the smoothing value for the **STAT_STD_DEV** curve is necessarily -1.

2.4.3. Definition of the reference sieves

The user defines the reference sieves to be represented in the zone of the grain size curves (**GRAIN_SIZE** or **GRAIN_SIZE_CURVE** graph) in the left table of the **Sieves** panel.

For a reference sieve, enter the diameter of the sieves in the **Diameter** cell. By default, the value entered is copied with the “mm” unit in the **Sieves** cell; the user can modify this expression.

The reference sieves are represented by vertical lines located at the diameters defined and whose labels situated above the upper X axis are the expressions in the **Sieves** column.

The reference sieves can be metric or imperial (US standard) sieves; however, the values of the diameters are always in millimeters.

2.4.4. Drawing attributes of the reference sieves

Clicking on the button left of the **Insert** button opens the drawing attributes configuration window to define how the lines representing the sieves (line) and their labels (text) will be displayed.

2.4.5. Definition of the sieves for the calculation of the statistic curves and combinations of grain size curves

In the table on the right side of the panel, the user defines the reference sieves that will be used in the calculation of the statistic curves and combinations of grain size curves. This table is filled the same way as the left one.

The reference sieves used in the calculation of the statistic curves and combinations of grain size curves are not represented in the zone of grain size curves.

2.4.6. Selection, insertion and deletion of sieves

In the **Sieves** panel, the **Insert** and **Delete** buttons at the bottom of the window are used the same way as in the other panels of the **Layout** window (see paragraph 4.4 of chapter 1) but only one row can be selected at once.

2.5. Correction of grain size curves

2.5.1. Including the percentages of cobbles and boulders

The grain size curves can be corrected by taking into account the percentages of cobbles and boulders. To do this, open the **Materials** panel of the options window and check the box **Include % of cobbles** and the box **and % of boulders**. The values can be the ones from the **COBBLE** table or the **STRATIGRAPHY** table. The grain size curves are then modified, and the percentages passing the sieves can be recalculated and saved in the GRAIN_SIZE table.

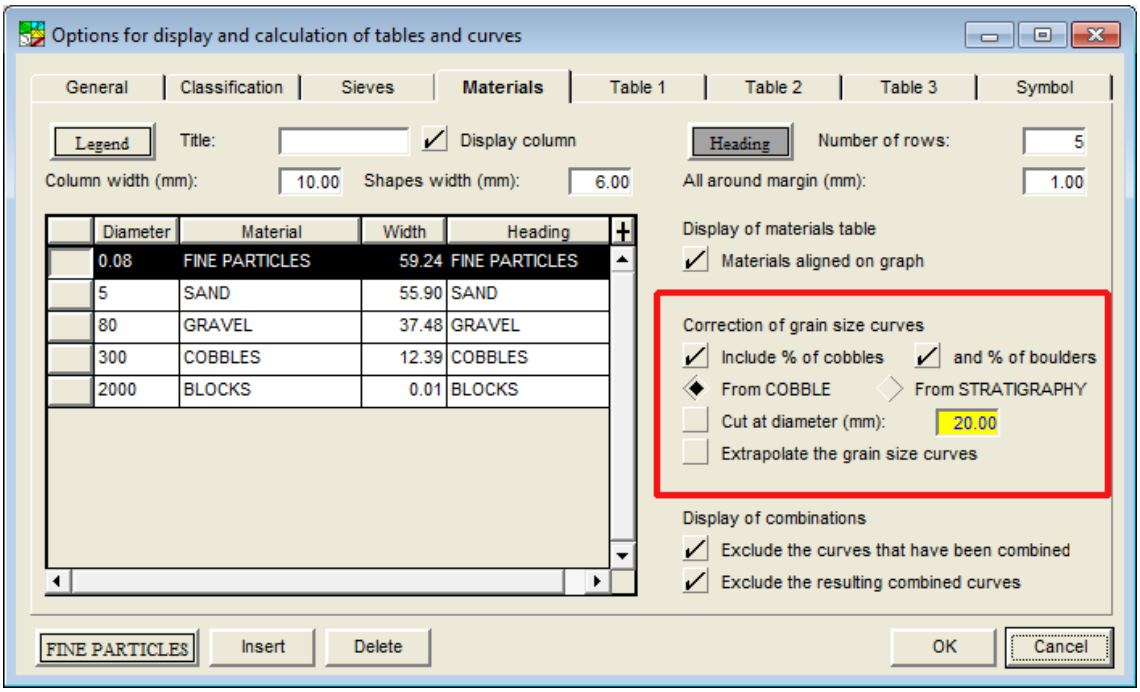


Figure 2-3 - Correction of the grain size curves

If there are percentages of cobbles or boulders already entered in the **GRAIN_SIZE_CURVE** table for the sample, so if a record for a diameter greater than 80 mm exists or the passing percentage at the 80 mmm sieve is smaller than 100%, the percentages of cobbles and boulders from the **COBBLE** or **STRATIGRAPHY** table will not be taken into account.

Checking the box **Include % of cobbles** (see figure 2-3) has an effect only if the sample for which a grain size curve will be displayed is included in a layer of cobbles or stratigraphy where a percentage is entered in the field **COBBLE_RET** or **COBBLE**, respectively. When the box **and % of boulders** is checked, the percentage entered in the field **BOULDER_RET** or **BLOCK**

is taken into account, respectively. **Please note: we can include the % of boulders only if the % of cobbles is also included.**

When the percentages of cobbles and boulders are included:

- The percentage passing the 300mm sieve (**P300**, the boulders) becomes: **100% - PCB**;
- The percentage passing the 80mm sieve (**P80**, the cobbles) becomes: **100% - PCB - PCC**;
- The other percentages are adjusted based on this formula: **PPT * (100 - PCB - PCC) / 100**; where **PCB** is the percentage of **boulders**, **PCC** is the percentage of **cobbles** and **PPT** is the percentage passing a given sieve in the **GRAIN_SIZE** or **GRAIN_SIZE_POINT** table.

2.5.2. Cutting at a sieve diameter

The grain size curves can be corrected to take into account cutting at a given sieve. To do this, open the **Materials** panel of the options window, check the box **Cut at diameter (mm)**, then enter the desired diameter (see figure 2-3). The grain size curves are then modified. **The percentages passing the sieves cannot be recalculated when a cut is applied.**

2.5.3. Extrapolation of the grain size curves

The passing percentages, the equivalent diameters, the cc and cu, the grain size description and the USCS are based on the grain size curve. The values are interpolated in between the existing curve points. When the option **Extrapolate the grain size curves** is checked, the equivalent diameters are extrapolated if they are smaller than the smallest value of the curve. The extrapolation is never done towards diameters larger than the greatest value of the curve.

2.6. Combinations of grain size curves

Grain size curves obtained from samples belonging to various borings of a given site can be combined. See paragraph 2.6.2 for details about how to do combinaisons.

2.6.1. Display of the curves before combination and the results of combinations

The **Materials** panel of the options window has controls for the display of grain size combinations, as shown in figure 2-4.

- The checkbox **Exclude the curves that have been combined** is used to hide (or display) in the GRAIN_SIZE_POINT graph and in the tables of values the curves that were combined. If the box is checked, the grain size analyses with the category “CMB-xx” are not displayed.
- The checkbox **Exclude the resulting combined curves** is used to hide (or display) in the GRAIN_SIZE_POINT graph and in the tables of values the results of the combinations. If the box is checked, the grain size analyses with the category “RCMB-xx” are not displayed.

  The curves that have been combined and the resulting combined curves are presented in the **Symbol** panel of the options window if the boxes are not checked. They are then displayed in the graph with the drawing attributes defined in the **Symbol** panel (see paragraph 4.10.7.8 of chapter 1), with the smoothing defined in the **General** tab of the options window.

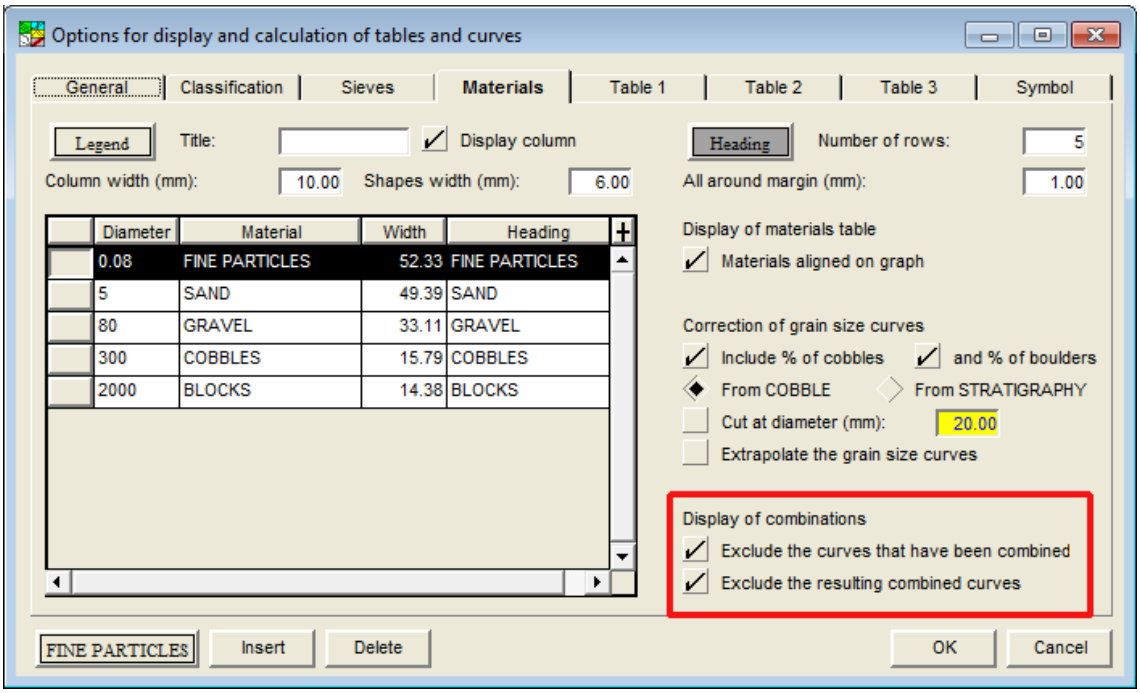


Figure 2-4 - Grain size combinations and display of results

2.6.2. Combination

To perform a grain size combination, grain size curves must be retrieved and displayed in the **GRAIN_SIZE_POINT** graph of the style file. After the query, click the **Combine** button in the **Grain Size** entry form. The combination form shown in figure 2-5 opens.

- The **site** automatically shows the site number of the grain size curves to combine.
- The **boring** is a concatenation of the type, of CMB and of the sample number. This number is automatically created and must not be modified.
- The **sample** increments from 01 to 99 with each combination. This number is automatically created and must not be modified.
- The **type** can be modified to indicate the material type for the combination.
- The **category** is automatically **CMB-xx** and incremental. This value will be entered in the **Category** field of the sample and grain size records of the combined curves, after the combination.

In the table of records at the bottom of the form, the user selects the records to combine by clicking in their first cell. Information about the samples is indicated, such as their top depth, their length, and the top and bottom depths of the representative sample. These depths are the depths of the stratum to which the sample belongs, if the sample is entirely in a defined stratum, or otherwise, the top and bottom depths of the sample.

The user then clicks on the **Calculate** button in the menu bar of the form to calculate the result of the combination. The percentages of the particles passing the reference sieves for the combinations (see paragraph 2.4.5) are calculated from the points of the grain size curves to combine, read in the **GRAIN_SIZE_POINT** table, while taking into account the weight of each grain size test in the combination. The weight is a function of the difference between the top

and bottom depths of the representative sample. The calculation also determines for each combination all information present in the **GRAIN_SIZE** table.

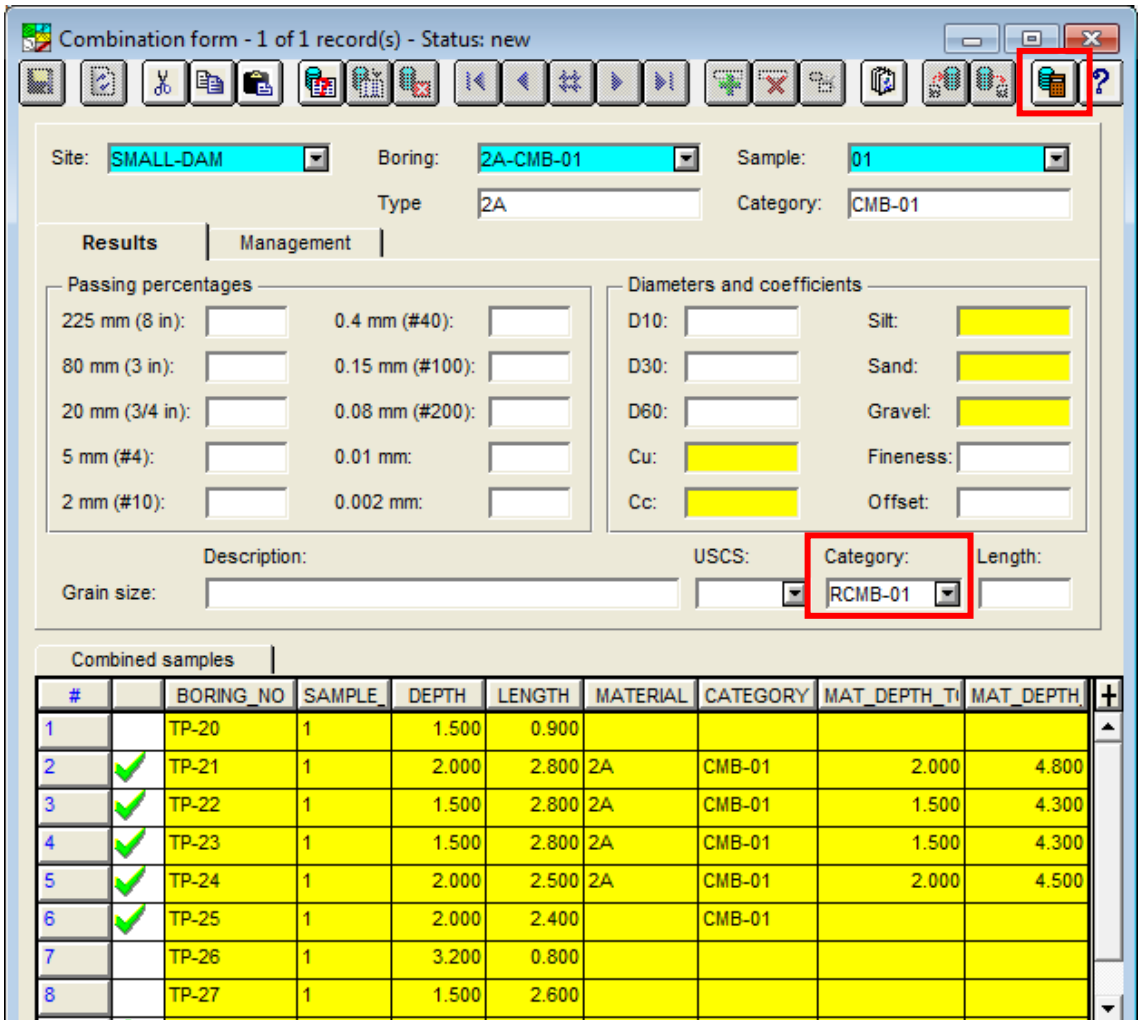


Figure 2-5 - Combination form of the grain size curves

After the calculation, the results of the combination are displayed under the **Resulting curve** tab. Under the **Combined samples** tab, the list of combined samples in this combination is available. Figure 2-6 shows the result of the combination, as well as a textbox indicating the records that were inserted or modified in the database.

During the combination, here are all the records that are created or modified automatically:

- A new record in the **BORING** table:

Field	Value
BORING_NO	Concatenation of the type, of CMB and of the sample number
TYPE	Type entered in the combination form
STATE	“Planned”

- A new record in the **SAMPLE** table:

Field	Value
BORING_NO	Boring number of the resulting combination

SAMPLE_NO	Increment number of the combination
DEPTH	Smallest top depth of the combined samples - this value does not correspond to a real geotechnical depth
LENGTH	Sum of the lengths of the combined samples - this value does not correspond to a real geotechnical depth
TYPE	Type entered in the combination form
STATE	"Remolded"
TESTS	"Combined sample inserted by Lab on" date and time when the combination was saved
SAMPLED_BY	Lab module
CATEGORY	"RCMB-xx" for the result of the *xx* combination

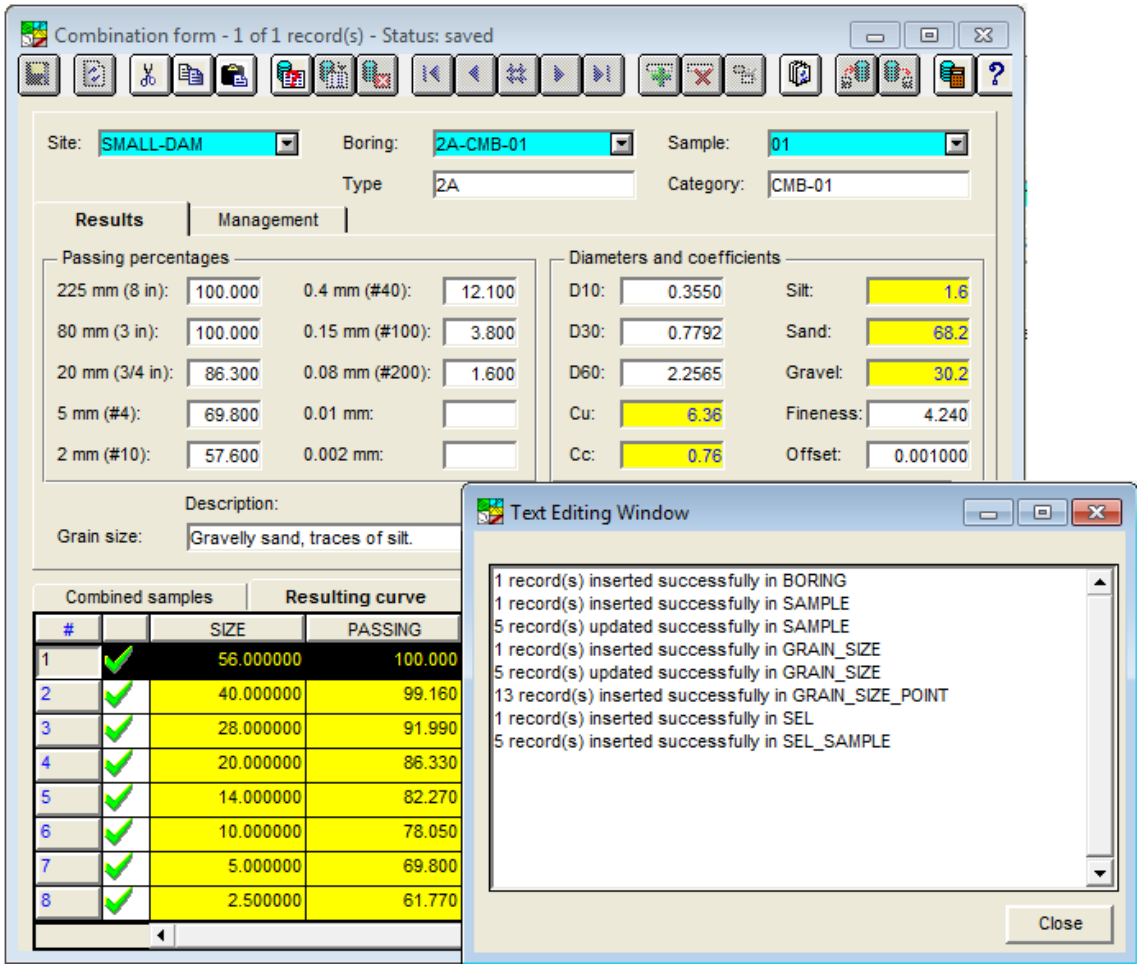


Figure 2-6 - Combination form after the calculation

- A new record in the **GRAIN_SIZE** table:

Field	**Value**
P*x*	Percentages passing the main sieves based on the grain size curve
FINENESS	Fineness module
D*x*	Diameters corresponding to 10%, 30% and 60% of the passing particles based on the grain size curve
Cu and Cc	Uniformity and conformity coefficients

Field	Value
Silt, Sand, Gravel	Percentages of silt (or fine particles), sand and gravel
DESCRIPTION	Description of the combination based on the grain size curve
USCS	USCS classification of the combination
ADJUSTED_ LENGTH	Sum of the lengths of the combined samples - this value does not correspond to a real geotechnical depth
CARRIED_OUT_BY	"Lab module"
CARRIED_OUT_ DATE	Date and time of the calculation of the combination
CATEGORY	"RCMB-xx" for the result of the *xx* combination
REMARK	"Calculated combination"

- As many records in the **GRAIN_SIZE_POINT** as there are reference sieves defined for the combinations (see paragraph 2.4.5)
- Modification to the records of combined samples in the **SAMPLE** table:

Field	Value
CATEGORY	"CMB-xx"

- Modification to the records of combined grain size analyses in the **GRAIN_SIZE** table:

Field	Value
CATEGORY	"CMB-xx"

2.6.3. Deleting combinations

To delete combinations saved in the database, open the combination form and execute a query for the given combination. Then, delete the record. All records created during the combination (in BORING, SAMPLE, GRAIN_SIZE, GRAIN_SIZE_CURVE, SEL and SEL_SAMPLE) will be deleted.

2.7. Curves to display: choice, representation and presence in the tables

The **Symbol** panel, shown in figure 2-7, is used to select the curves to be displayed in the graphs, to define their presence in the tables of significant values and to define their drawing attributes. It is presented in details in paragraph 4.10 of chapter 1.

If statistics curves defined in the **Symbol** panel are hidden, their values in the tables and their curve will be hidden.

2.7.1. Sample curves

The **GRAIN_SIZE_POINT** and **GRAIN_SIZE** graphs, as well as the **CONSOLIDATION_POINT**, **CONSOLIDATION**, **PROCTOR_POINT**, **PROCTOR**, **LIMITS** and **CUR_LI** graphs, show all the samples that have results associated in the graphs present in the style file. The display of the curves for these samples is defined with the **Sample_x** rows in the **Symbol** panel. The expression "**Sample_**" is reserved and cannot be modified. See paragraph 4.10.2 of chapter 1.

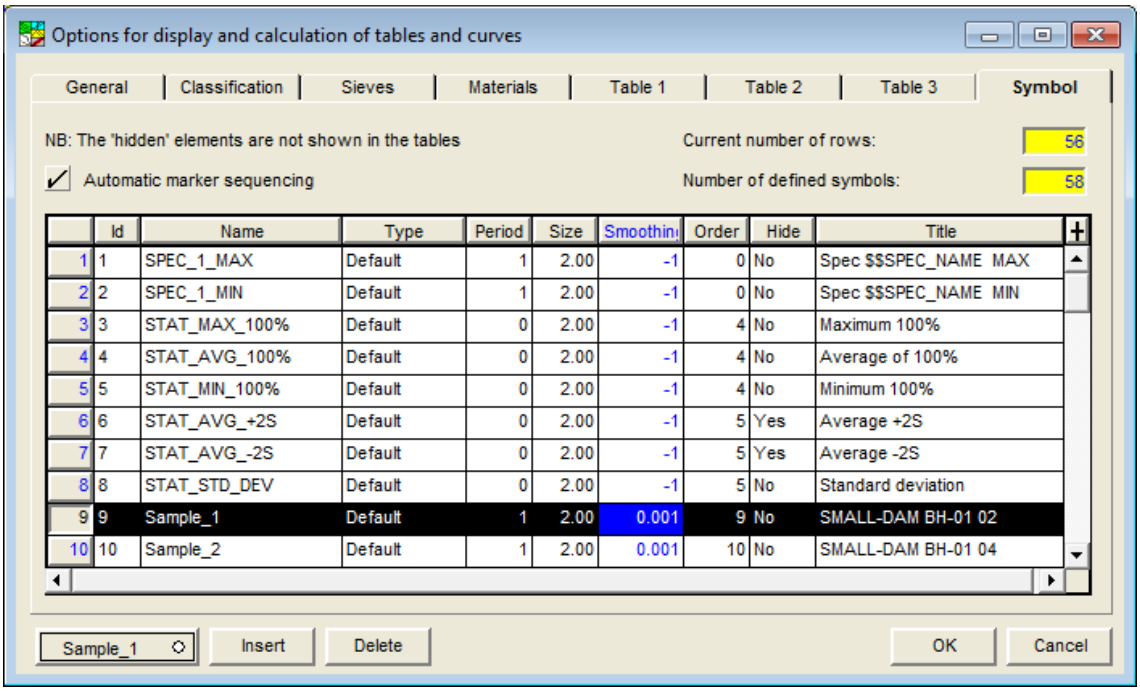


Figure 2-7 - Symbols definition panel

2.7.2. Curves calculated according to a percentage

The curves calculated according to a percentage only pertain to the **GRAIN_SIZE** and **GRAIN_SIZE_POINT** graphs. They are the statistic curves (minimum, average and maximum, at different percentages) of the existing grain size curves for the samples retrieved. The points of the calculated curves are the minimum, average and maximum passing percentages at the diameters of the sieves for the calculation of the stats, defined in the table on the right of the **Sieves** panel (see paragraph 2.4.5) in the options window.

For all the sieves defined in the **Sieves** panel, the values used for the calculation of the minimum, average and maximum curves are the passing percentages interpolated or extrapolated for these sieves on the grain size curves while taking into account the smoothing defined for each curve.

The curves calculated at 100% take into account, for each sieve, the passing percentages of all the samples retrieved. The curves calculated at 80%, for example, take into account, for each sieve, 80% of the passing percentages of the samples retrieved; the upper and lower 10% are ignored.

The calculated curves proposed in the list (see paragraph 4.10.1 of chapter 1) are always the **STAT_MAX_100%**, **STAT_AVG_100%** and **STAT_MIN_100%** maximum, average and minimum curves, respectively. When one of these curves is selected, the user can change the percentage indicated. The expressions “**STAT_MAX_**”, “**STAT_AVG_**” and “**STAT_MIN_**” are reserved and cannot be modified.

The description associated to the **DESCRIPTION** field of the **SAMPLE** table for a curve calculated according to a percentage and presented in a table of significant values is indicative

of the statistics curve, for example: "**Average of 80%**". This description is the title defined in the table of the **Symbol** panel and can be modified.

2.7.3. Curves calculated according to a standard deviation

The curves calculated according to a standard deviation only pertain to the **GRAIN_SIZE** and **GRAIN_SIZE_POINT** graphs. The estimation is based on the standard normal distribution.

The curves calculated according to a standard deviation proposed in the list (see paragraph 4.10.1 of chapter 1) are always **STAT_AVG_+2S** and **STAT_AVG_-2S**, corresponding to the average curves plus or minus 2 standard deviations, statistically containing 95% of the values. The user can change the value of the standard deviation. For this, he can:

- replace the value of **2** for another value with the keyboard; or,
- double-click in the **Name** cell of a **STAT_AVG_+*n.n*S** or **STAT_AVG_-*n.n*S** curve to display the window shown in figure 2-8.

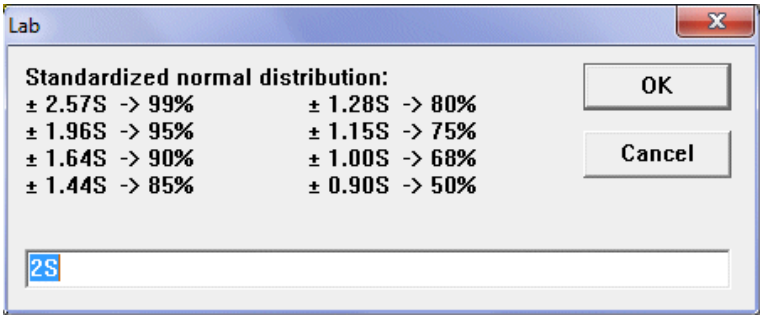


Figure 2-8 - Selection of the standard deviation

This window shows the values corresponding to the main percentages. The user enters the desired value and clicks on OK. The minimum value is 0.1s and the maximum value is 2.575s.

The description associated to the **DESCRIPTION** field of the **SAMPLE** table for a curve calculated according to a standard deviation and presented in a table of significant values is indicative of the statistics curve, for example: "**Average +2S**". This description is the title defined in the table of the **Symbol** panel and can be modified.

In addition to the **STAT_AVG_+2S** and **STAT_AVG_-2S** elements, the scrolling list in the cells of the **Name** column of the table in the **Symbol** panel shows the **STAT_STD_DEV** element. The selection of this element displays in the table of significant values the standard deviation for the sieves represented in the table. It is possible to not display the curve corresponding to **STAT_STD_DEV** in the graph of grain size curves by hiding its drawing attributes.

The description associated to the **DESCRIPTION** field of the **SAMPLE** table for the curve of standard deviation and presented in a table of significant values is "**Standard deviation**". This description is the title defined in the table of the **Symbol** panel and can be modified.

2.7.4. Envelope curves

As described in paragraph 2.4.1, only one grain size envelope can be displayed at once in the zone of grain size curves. This envelope is selected in the **Sieves** panel of the options window,

in the list associated to the **Material** field containing all the dummy borings belonging to the **SPEC** site and with values defined in the **GRAIN_SIZE_POINT** table for its **MIN** and **MAX** samples. The envelopes can be defined directly in the specifications entry form; see paragraph 46 of chapter 2 of the entry forms guide

By selecting an envelope, its minimum and maximum curves are automatically available in the scrolling list of the cells in the **Name** column of the table in the **Symbol** panel with the following syntax: **SPEC**_***ENVELOPE***_**MAX** (and _**MIN**) where ***ENVELOPE*** represents a material for which an envelope was defined. If both envelope curves are inserted in the **Symbol** panel, the filling corresponding to the envelope will be displayed in the graph.

The description associated to the **DESCRIPTION** field of the **SAMPLE** table for the row associated to an envelope curve will be its title defined in the table of the **Symbol** panel; the default title associated to an envelope curve is **Spec *ENVELOPE* MAX** or **Spec *ENVELOPE* MIN**.

3. CLASSIFICATION GRAPH

3.1. Definition of the graph of materials classification

Generally, the zone of the grain size curves is under a table presenting the ranges of the different materials. This table usually has two rows; the top row shows the main divisions of the materials; the second row shows the secondary divisions. This materials classification table is defined by the **CLASSIFICATION** graph.

For the **CLASSIFICATION** graph to be aligned on the graph of grain size curves, the **CLASSIFICATION** graph must have as its **#P** the number of the **GRAIN_SIZE_POINT** or **GRAIN_SIZE** graph. Then, modifying the X axis, the width or the horizontal position of the **GRAIN_SIZE_POINT** or **GRAIN_SIZE** graph will automatically modify the **CLASSIFICATION** table.

3.2. Predefined curves of the graph of materials classification

The curves editing window for the CLASSIFICATION graph, illustrated in figure 2-9, shows two curves: the **Main** and **Secondary** curves for the main and secondary divisions of the materials.

3.2.1. Main curve

The **Main** curve contains the graphic characteristics of the cells of the main divisions in the materials classification table.

The drawing attributes that can be edited for these cells are the line, the filling and the text, for the border, the background of the cells and the identification of the main divisions, respectively.

3.2.2. Secondary curve

The **Secondary** curve contains the graphic characteristics of the cells of the secondary divisions in the materials classification table.

The drawing attributes that can be edited for these cells are the line and the text, for the vertical limits between the secondary divisions and their identification, respectively.

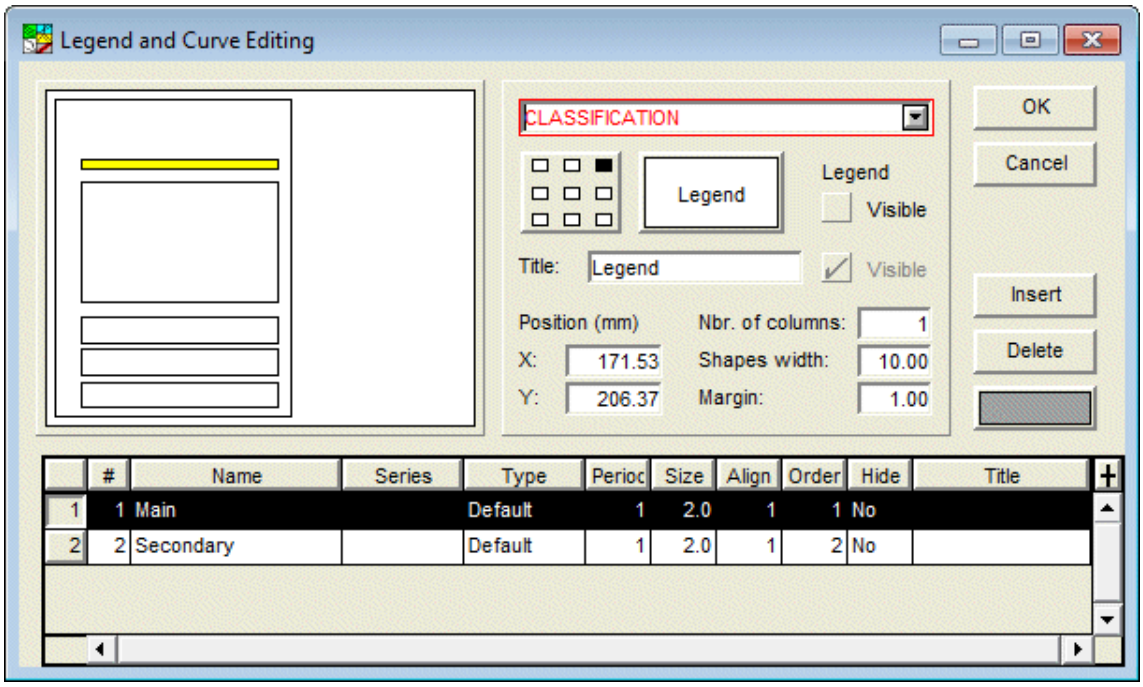


Figure 2-9 - Curves of the classification graph

To define a background for the cells of the secondary divisions, the user must define a background for the **CLASSIFICATION** graph via the graph editing window. This background is drawn first for the entire graph; the eventual background of the cells of the main divisions would cover the graph's background. The border of the classification table is also established in the graph editing window with the line attributes.

3.3. Configuration of the graph of materials classification

The **Classification** panel of the options window, shown in figure 2-10, is used to configure the classification table of the materials constituting the samples by particle size, represented by the **CLASSIFICATION** graph.

In the left table, the user defines the main divisions; in the right table, the secondary divisions. Each division, main or secondary, is defined by the value of its upper limit, in millimeters, in the **Diameter** column and by its title in the **Material** column.

For the classifications defined in the **Classification** panel to be displayed, a **CLASSIFICATION** graph must be defined in the style file.

3.3.1. Definition of the divisions

The classification table normally has as width the length of the X-axis of the graph of grain size curves, of which it respects the direction and limits. Some classifications may not be displayed, depending on the imposed limits of the X-axis of the zone of grain size curves.

3.3.2. Selection, insertion and deletion of divisions

In the **Classification** panel, the **Insert** and **Delete** buttons at the bottom of the window are used the same way as in the other panels of the **Layout** window (see paragraph 4.4 of chapter 1) but only one row can be selected at once.

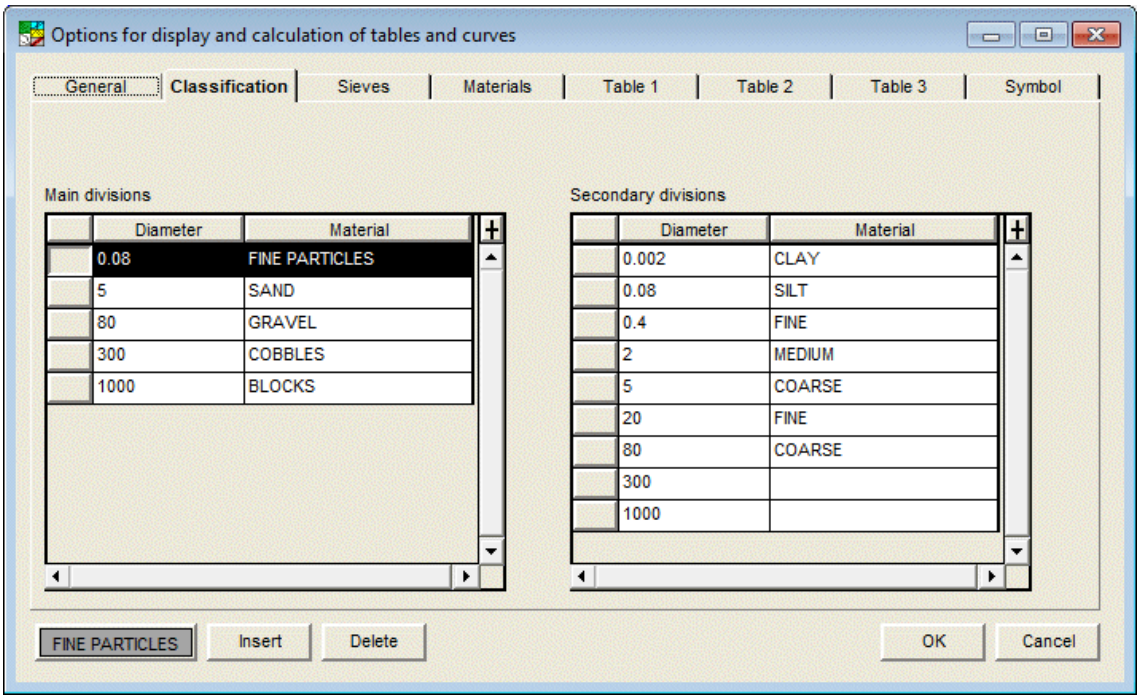


Figure 2-10 - Materials classification panel

3.3.3. Drawing attributes of the divisions

Clicking on the button at the bottom left of the **Classification** panel opens the drawing attributes window. If a row of the main divisions is selected, the line, filling and text attributes can be edited, for the border, background of cells and identification of the main divisions, respectively. If a row of the secondary divisions is selected, the line and text attributes can be edited, for the vertical limits between the secondary divisions and their identification, respectively.

The filling of the cells of the secondary divisions and the border of the classification table are defined with the configuration of the drawing attributes of the **CLASSIFICATION** graph.

4. TABLE_MAT GRAPH

4.1. Definition of the table of materials

The graphic reports of grain size analyses often show a table where are displayed the percentages of the various materials constituting the samples.

This table of materials percentages is the representation of the **TABLE_MAT** graph, which must have a number **greater or equal to 100**. The percentages of the various materials constituting the samples are interpolated from the grain size curves.

The definition of the materials that will be represented in this table is done in the **Materials** panel of the options window, shown in figure 2-11. Generally, the materials defined in this table are the same as the main divisions of the classification.

The table of materials has a number of rows fixed by the user in the field **Number of rows** of the **Materials** panel. The number of rows cannot exceed the value in the field **Current number of rows** of the **Symbol** panel, which is the number of defined curves with "**No**" in the **Hide** cell.

The number of rows that can be displayed in the materials table depends on the height of the **TABLE_MAT** graph, the margin around the texts, the height of the markers in the symbols column and the alignment for the legend of the **TABLE_MAT** graph. If no alignment is defined, the materials table will occupy the entire area set for the **TABLE_MAT** graph, not showing all the rows planned or leaving an empty space, depending on the height of each row. If an alignment is defined, the materials table will occupy the area necessary to display the number of rows defined.

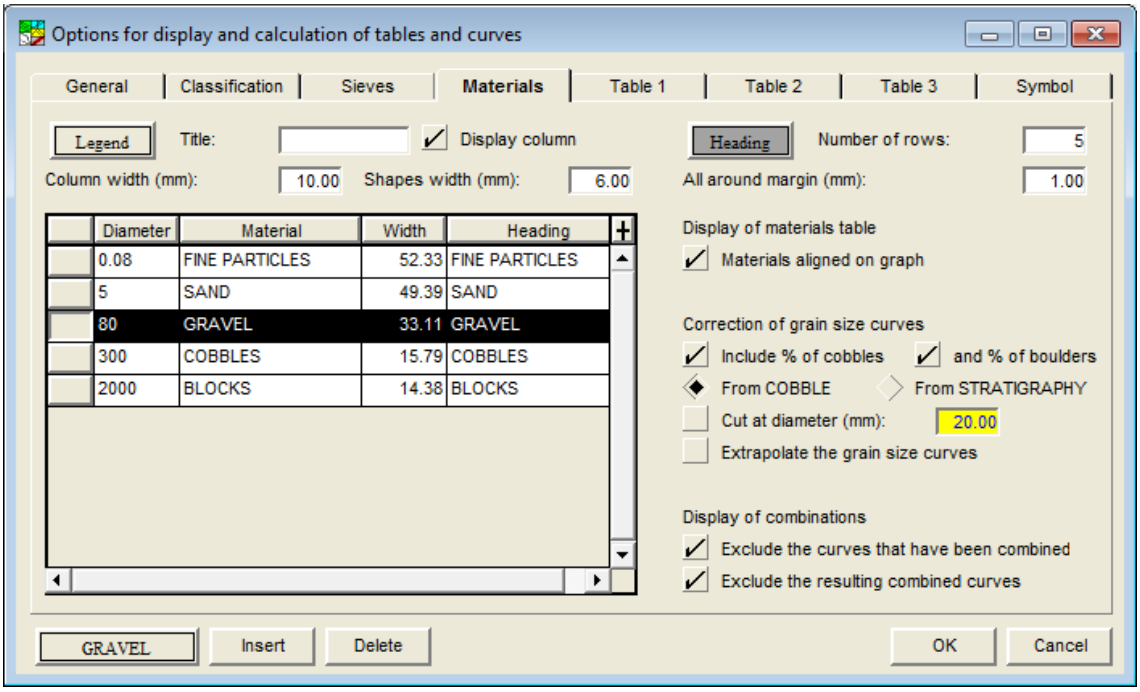


Figure 2-11 - Definition panel of the materials constituting the samples

In the graph editing window, by clicking on the **Attributes** button for the **TABLE_MAT** graph, it is possible to modify the following characteristics of the materials table:

- the border, with the line attributes;
- the background of the entire table, with the filling and/or pattern attributes; for this filling to be visible, the columns of the table must not have a background defined.

The user can modify the display of all the headings of the materials table by clicking on the button labeled **Heading** in the **Materials** panel of the options window. The elements that can be edited for the row of headings are:

- the background of the cells of the row, with the XVT filling and/or pattern attributes;
- the lower limit of the row, with the line attributes;
- the font, color, style, size, alignment and format of the headings, with the text attributes.

4.2. Columns of the table of materials

The TABLE_MAT table editing window is shown in figure 2-12. The window has as many columns (represented as rows in the table) as the number of materials defined in the **Materials** panel of the options window (see paragraph 4.3).

The columns, numbered **1** to ***n*** in the table editing window, have as **names** and **columns headings** the strings entered in the **Material** and **Heading** columns of the **Materials** panel, respectively. In addition to these columns, there is the column **0** which represents the symbols column. This column, if displayed, appears on the left of the materials table as an additional column. This column contains the graphic symbols associated to the curves defined in the **Symbol** panel of the options window (see paragraph 4.10.7.6 of chapter 1) whose value in the **Hide** cell is **No**.

The various parameters of the materials table and its columns are modified in the **Materials** panel of the options window (see figure 2-11). The values are also shown in the table editing window, but should not be modified in that window.

4.2.1. Symbol column

To display the symbols column, check the box **Display column** in the **Materials** panel. The **Symbol** column is characterized by its number **0** in the table editing window.

The user can define the drawing attributes of the **Symbol** column with the **Legend** button at the top left of the **Materials** panel. The drawing attributes that can be modified are:

- the background of the cells of the symbols column, with the filling and/or pattern attributes;
- the lower limit of each row of the materials table (except the row of headings), with the line attributes;
- the alignment of the symbols in the cells with the alignment button.

The user can change the title of the **Symbol** column in the **Title** field of the **Materials** panel.

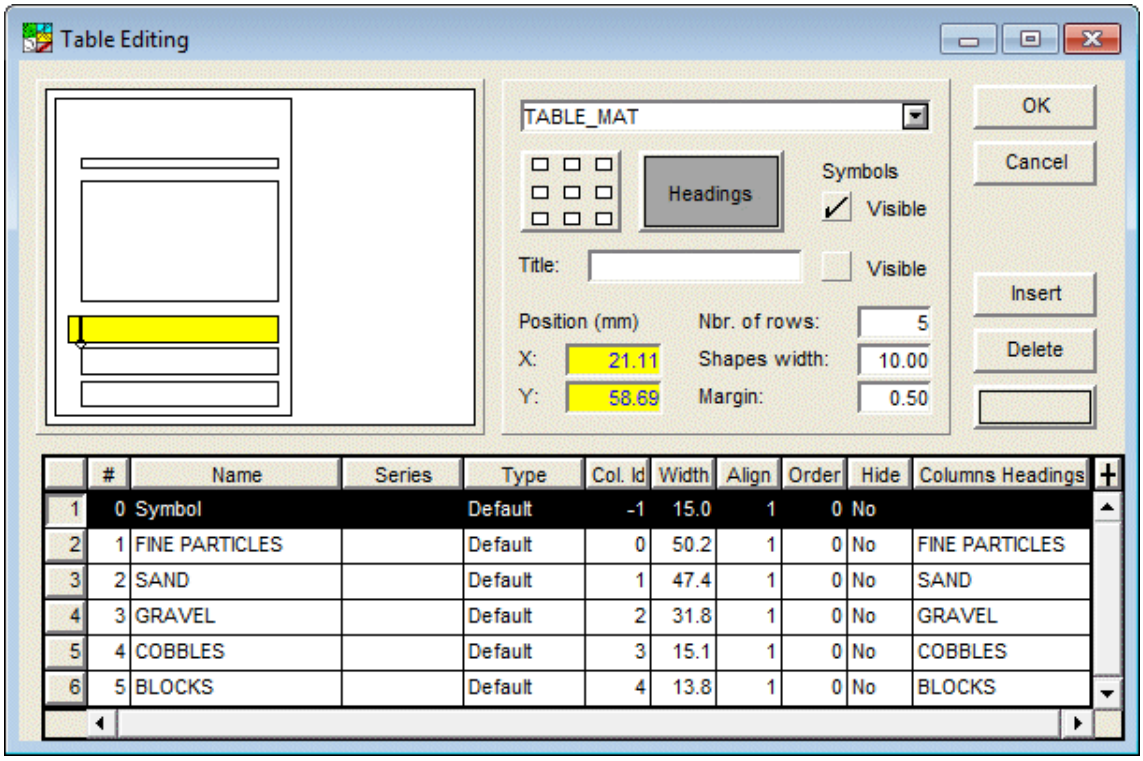
The field **Column width (mm)** of the **Materials** panel defines the width of the symbols column.

The field **Shapes width (mm)** of the **Materials** panel defines the width of the symbols in this additional column. For the symbols to be markers only (not a marker at the center of a line segment), the user enters **0.01** as the shapes width.

The field **All around margin (mm)** defines the margin above and below the texts. This value applies to all the rows of the table.

The **Display column** box, the **Legend** and **Heading** buttons, the **Column width (mm)**, **Shapes width (mm)**, **All around margin (mm)** and **Number of rows** fields are also present in the **Table 1**, **Table 2** and **Table 3** panels.

The **Column width**, **Shapes width**, **All around margin** and **Number of rows** controls are effective for all the tables displayed.



	#	Name	Series	Type	Col. Id	Width	Align	Order	Hide	Columns Headings
1	0	Symbol		Default	-1	15.0	1	0	No	
2	1	FINE PARTICLES		Default	0	50.2	1	0	No	FINE PARTICLES
3	2	SAND		Default	1	47.4	1	0	No	SAND
4	3	GRAVEL		Default	2	31.8	1	0	No	GRAVEL
5	4	COBBLES		Default	3	15.1	1	0	No	COBBLES
6	5	BLOCKS		Default	4	13.8	1	0	No	BLOCKS

Figure 2-12 - Columns of the table of materials

4.2.2. Materials column

The columns numbered **1** to ***n*** in the table editing window, which represent the materials columns, contain the graphic characteristics of the cells of the table of materials percentages. The characteristics that can be edited for each column are:

- the background of the cells of the column, with the XVT filling and/or pattern;
- the left vertical limit of the column, with the line attributes;
- the font, color, style, size, alignment and format of the written values, with the text attributes.

These characteristics can be modified via the **Materials** panel of the options window by clicking on the button at the bottom left for each material.

4.3. Configuration of the table of materials

The Materials panel of the options window, shown in figure 2-11, is used to configure the materials table, represented by the TABLE_MAT graph. A TABLE_MAT graph must therefore be defined in the style file, its # being **100 or greater**.

4.3.1. Definition of the zones of materials

Each zone of material is represented by a column defined in the **Materials** panel by:

- The upper limit of the material's diameter, in the **Diameter** column; this value is in millimeters. The diameters entered in the **Diameter** column **must be defined in ascending order**.
- The material name, in the **Material** column.
- The width of the column, in the **Width** column; this value is in millimeters.
- The title of the column, in the **Heading** column.

  By default, the values of the cells in the **Material** column are copied in the columns of the **Heading** column.

4.3.2. Values displayed in the table of materials

The percentages shown in the materials table are interpolated from the grain size curves. If it is not possible to calculate the percentage of one or several materials for a sample or if the sample display in the table does not have a grain size curve associated, the cells will contain the expression defined in the **Missing value** field of the **Default** panel of the preferences editing window (see paragraph 7.2.9 of chapter 6 of the X3D guide).

4.3.3. Management of the display of the table of materials

Generally, the zones created are identical to the main divisions of the classification. The display of the materials table depends on several conditions:

- In order for the display of the materials table to be associated to the display of the graph of grain size curves, the **#P** of the **TABLE_MAT** graph must be the number of the **GRAIN_SIZE** or **GRAIN_SIZE_POINT** graph and the box **Materials aligned on graph** in the **Materials** panel must be checked.

  When the box **Materials aligned on graph** is checked, the width of the **TABLE_MAT** graph is modified, if necessary, to be equal to the width of the graph of grain size curves. The orientation of the X-axis of the graph of grain size curves is applied to the display of the materials table. Some materials may not be displayed, depending on the imposed limits of the X-axis of the zone of grain size curves.

  When the user checks the box **Materials aligned on graph**, the widths of the materials columns are calculated by the application and replace the ones entered in the **Width** column of the **Materials** panel.
- If the box **Materials aligned on graph** of the **Materials** panel of the options window is checked, the orientation and the limits of the X-axis of the graph of grain size curves will have no effect on the display of the materials table.
  - if an alignment is defined for the legend of the **TABLE_MAT** graph (alignment button left of the **Headings** button in the table editing window), the columns of the materials table will have as widths the values entered by the user in the **Width** column of the **Materials** panel. The anchor point of the table is displayed in the preview area according to the defined alignment.
  - if no alignment is defined for the legend of the **TABLE_MAT** graph, the materials table occupies the entire area set for the **TABLE_MAT** graph in the graph editing window. The

widths of the columns respect the proportions between the values of widths entered in the **Width** column of the **Materials** panel.

4.3.4. Selection, insertion and deletion of materials

In the **Materials** panel, the **Insert** and **Delete** buttons at the bottom of the window are used the same way as in the other panels of the **Layout** window (see paragraph 4.4 of chapter 1).

5. TABLE_*N* GRAPHS OF SIGNIFICANT VALUES

The eventual **TABLE_1**, **TABLE_2** and **TABLE_3** graphs can show grain size information. The detailed description of these graphs is done in chapter 6.

The following table shows the information specific to grain size analyses that can be selected via lists associated to the cells of the **Table** and **Field** columns of the **Table 1**, **Table 2** and **Table 3** panels of the options window.

Table	Field
Sieve	Diameters x

Table	Field
Diameter	10
	15
	30
	50
	60
	85

Table	Field
Result	C300
	C80
	Cc
	Cu
	D100
	Descr
	E300
	E80
	Fineness
	Gravel
	Sand
	Silt
	USCS

The sieves proposed are those defined in the **Sieves** panel of the options window as sieves for the calculation of the statistic curves and grain size combinations. The user can edit the values of sieves and diameters in the **Field** cells.

6. KEYWORDS SPECIFIC TO THE GRAIN SIZE ANALYSIS

When grain size data are read, values are assigned to a series of keywords specific to grain size analyses. The following table shows the first series of keywords:

Keywords	**Meaning**
Grn_Site_Nbr	Number of sites read in the query
Grn _Site_List	List of sites read in the query
Grn _Site_List_N	List of sites read in the query with the number of samples with data of grain size curves and belonging to each site
Grn _Boring_Nbr	Number of borings read in the query
Grn _Boring_List	List of borings read in the query

Keywords	Meaning
Grn _Boring_List_N	List of borings read in the query with the number of samples with data of grain size curves and belonging to each boring
Grn _Sample_Nbr	Number of samples read in the query
Grn _Sample_List	List of samples read in the query.

In the lists of sites, borings or samples, the numbers are separated by a comma and a space. The site number is not displayed if the curves are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

The second series of keywords presented in the following table shows the values calculated on the grain size curve of the **current** sample.

Keywords	Meaning
SPEC_NAME	Name of the envelope curve
GRN_Sample_Selected	Identification of the current sample; this identification contains the site and boring numbers if necessary to prevent any ambiguity
P300 to P_001	Interpolated percentages passing the 300mm to 0.001mm sieves (see note 1)
D10, D30, D60, D100	Interpolated diameters corresponding to 10, 30, 60 and 100 % passing
Cu, Cc	Interpolated coefficients of uniformity and concavity
Silt, Sand, Gravel	Percentages of silt (or fine particles), sand and gravel
Fineness	Fineness module
C80, C300, E80, E300	Percentages: of cobbles, of boulders, estimated of cobbles and estimated of boulders (see note 2)
USCS	Calculated unified classification based on the grain size curve
Descr	Calculated sample description based on the grain size curve
Grn_smoothing	Smoothing of the grain size curve

Note 1: The interpolated values of percentages passing the sieves take into account the smoothing and the cut-off, if applicable.

Note 2: The percentages of cobbles and boulders and the estimated percentages of cobbles and boulders determined for a sample are those read in the **COBBLE** or in the **STRATIGRAPHY** table in the section of the boring that contains the sample. If the **COBBLE** or **STRATIGRAPHY** table does not contain percentages or if the correction of the grain size curves as a function of the percentage of cobbles and boulders is not requested, these keywords are empty.

7. EXAMPLE OF A REPORT FOR GRAIN SIZE ANALYSES

Sobek TECHNOLOGIES

GRAIN SIZE ANALYSIS

Appendix: A Figure: 1

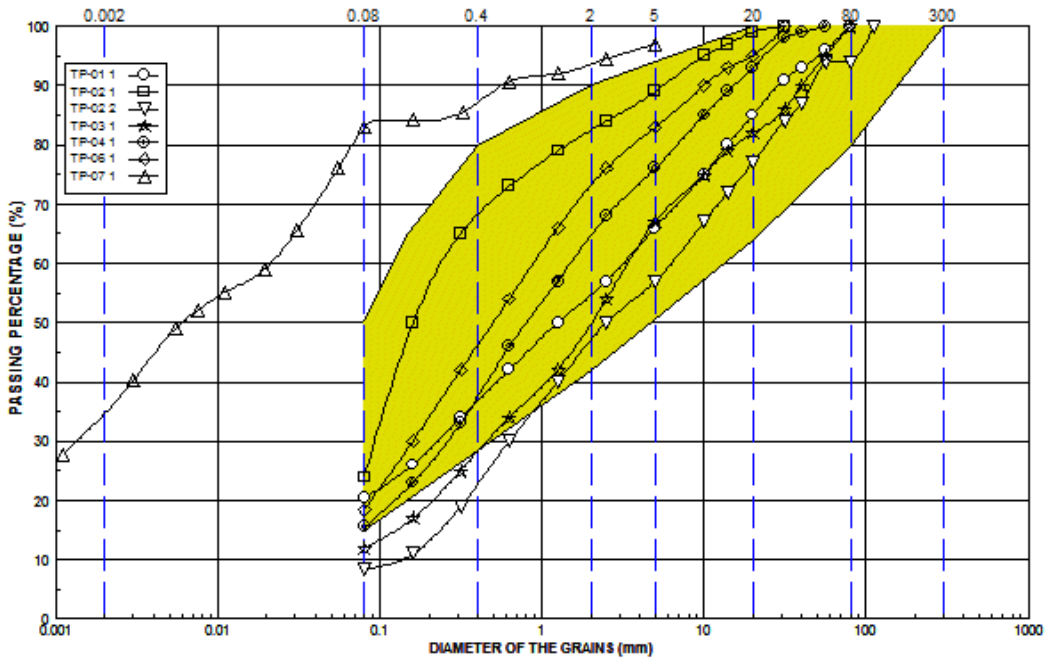
Project: SRH

Site no: SMALL-DAM (Dam on Small River)

Boring no: TP-01

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

FINE PARTICLES		SAND			GRAVEL		COBBLES	BLOCKS
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE		



	FINE PARTICLES	SAND	GRAVEL	COBBLES	BLOCKS
	15.0	35.8	29.2	20.0	0.0
	50.0	44.0	6.0	0.0	0.0
	20.4	45.6	34.0	0.0	0.0
	23.9	65.1	11.0	0.0	0.0
	8.4	48.6	37.0	6.0	0.0

	20mm	5mm	2mm	0.4mm	0.08mm	0.01 mm	0.002mm	D10	D30	D60
	64.0	50.8	42.0	28.5	15.0	-	-	-	0.48	13.16
	100.0	94.0	90.0	80.0	50.0	-	-	-	-	0.12
	85.0	66.0	54.6	36.8	20.4	-	-	-	0.23	3.19
	99.0	89.0	82.5	68.3	23.9	-	-	-	0.09	0.24
	77.0	57.0	47.1	22.7	8.4	-	-	0.14	0.63	6.31

	BORING	SAMPLE	DEPTH (m)	DESCRIPTION	USCS
	MOR	-	-		GM
	MOR	-	-		SM
	TP-01	BS-1	0.52 - 0.74	Silty gravelly sand	SM
	TP-02	BS-1	1.40 - 1.60	Silty sand, some gravel	SM
	TP-02	BS-2	1.84 - 2.30	Sand and gravel, traces of silt	SP-SM

Figure 2-13 - Example of a report for grain size analyses

CHAPTER 3. LAB - CONSOLIDATION TESTS

1. GENERALITIES

This chapter describes the particularities of the display of results of consolidation tests done on samples in the laboratory. These results are presented in various formats:

- a display zone of the consolidation curves that corresponds to the **CONSOLIDATION_POINT** graph, or to the **CONSOLIDATION** graph;
- a table where significant values are interpolated, such as the void ratio (**E0**), the in situ effective soil stress (**P0**), the compression (**CC**) and recompression (**CCR**) indexes, the lower and upper limits of the preconsolidation stress (**PCmin** and **PCmax**) and the probable preconsolidation stress determined by the Casagrande method (**PC**); these values are presented in one of the **TABLE_1**, **TABLE_2** or **TABLE_3** graphs.

The graphs are defined in the style file by their number, their name and their graphic characteristics.

2. CALCULATION METHOD OF THE CONSOLIDATION PARAMETERS

The values in the CONSOLIDATION table can be entered by the user, or calculated based on the points of the consolidation curve while taking the smoothing into account. The calculations are done when the user clicks the “Calculate” button at the top of the Consolidation entry form, and can be done for several curves at once. If the smoothing or the curve values are modified, the calculation must be done again.

The details of the consolidation calculations are given below. Figure 3-1 shows the points used in the calculations.

- There are **200 points** calculated at regular intervals (on logarithmic scale) for each curve.
- The **Casagrande construction** is used for the calculation and is represented in red.
- Lab first finds the **inflection point IP** (where the second derivative is null) as well as the **point of maximum curvature**.
- The **Cci** is the slope at the IP.
- The **Pc max** is found with the Casagrande construction. We take the bisector line between the horizontal from the point of maximum curvature and the tangent to the same point. The Pc max is the intersection between this bisector line and the slope at the IP.
- The **Pc** is the intersection between the slope at the IP and the extension of the portion before the Pc.
- The **Pc min** is the intersection between the slope at the IP and the horizontal from e0.
- For the **Ccr**, we take a point at 25% and another at 50% of the load in logarithmic scale and calculate the slope between these 2 points.

- We do not use the recompression curve if it is present, but it is shown on the graph of consolidation tests.

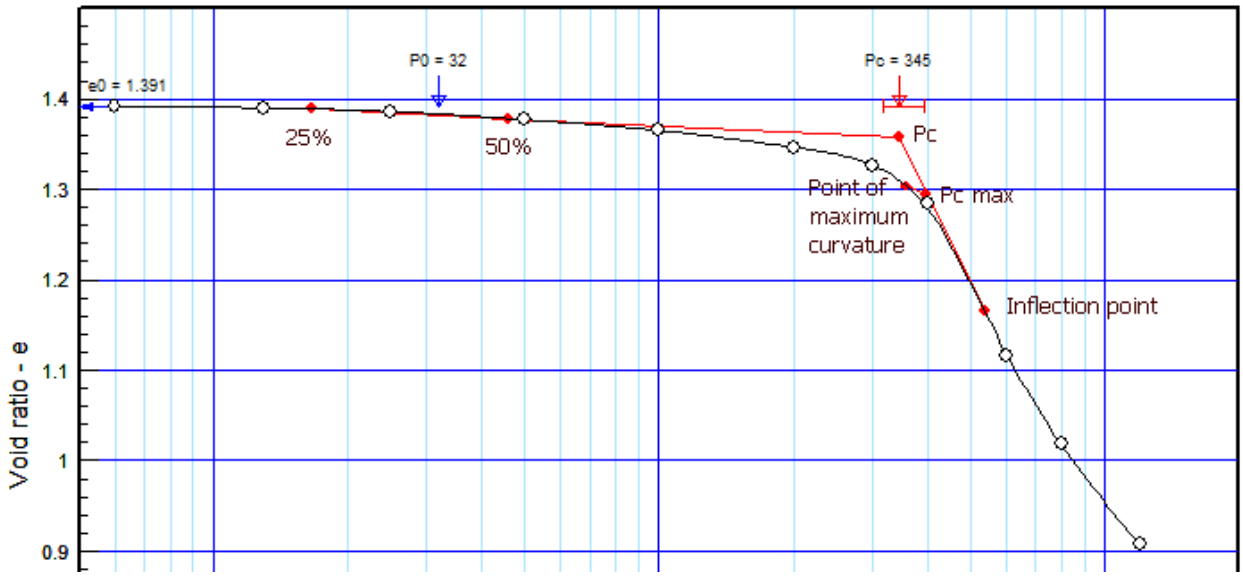


Figure 3-1 - Details of the consolidation calculations

3. CONSOLIDATION_POINT GRAPH

3.1. Definition of the graph of consolidation tests

Lab produces consolidation curves by reading data in the **CONSOLIDATION_POINT** table. If the **CONSOLIDATION** graph is displayed, only the consolidation results (PCmin, PCmax, e0, etc.) are displayed. The curve points will not be.

The X-axis of the graph of consolidation curves is logarithmic. Its lower limit must be greater than 0. The Y-axis of the graph of consolidation curves is linear.

It is not possible to enter a negative value in the **Consolidation** field of the **Smoothing of curves** zone in the **General** panel of the options window. Indeed, it is not possible to have a broken line as a consolidation curve because it would not be possible to apply the Casagrande construction.

3.2. Predefined curves of the graph of consolidation tests

The curves editing window for the graph of consolidation tests, illustrated in figure 3-2, shows six predefined curves:

- The **Casagrande** curve
- The **PcMinMax** curve
- The **Pc** curve
- The **P0** curve
- The **e0** curve
- The **Sample_+** curve

The calculation of the values presented by the **Casagrande**, **PcMinMax** and **Pc** curves takes into account the smoothing of the consolidation curves (see paragraph 7 of chapter 1). However, it is not taken into account for the determination of the **e0** and **P0** values.

3.2.1. Casagrande curve

The **Casagrande** curve contains the graphic characteristics for the representation of the Casagrande construction lines.

The drawing attributes that can be edited are the line, for the construction lines, and the marker, for the significant points in the construction.

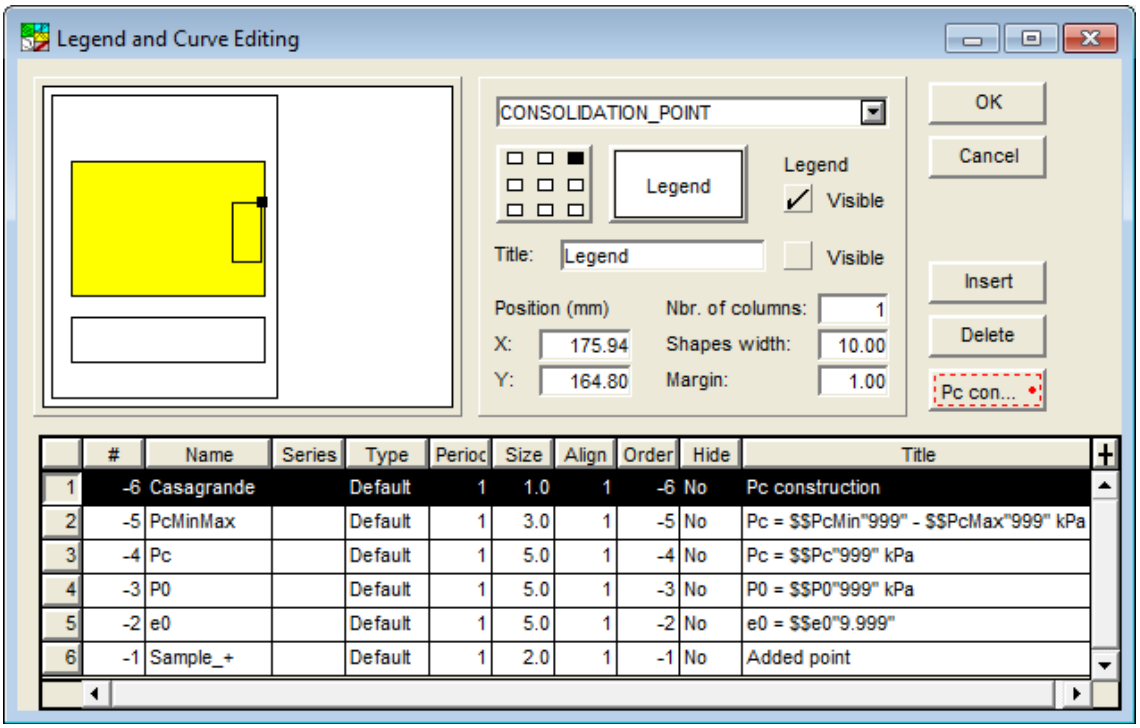


Figure 3-2 - Curves of the graph of consolidation tests

3.2.2. PcMinMax curve

The **PcMinMax** curve contains the graphic characteristics for the representation of the upper and lower limits of the preconsolidation stresses. These limits are generally represented by vertical dashes joined by a horizontal line. The marker for the probable preconsolidation stress (**Pc** curve) points onto this horizontal line.

The drawing attributes that can be edited are the line for the horizontal segment, the marker for the limits and the text for the values.

By default, the title of the **PcMinMax** curve is **Pc = $$PcMin"999" - $$PcMax"999" kPa**, which shows the values of PcMin and of PcMax (without decimals) linked by a hyphen. By default, the text is displayed under the vertical dashes but its alignment can be modified.

If the title of the **PcMinMax** curve is deleted, only the values of **PcMin** and **PcMax** are displayed, under their respective dash. To display no value, remove the text attribute.

3.2.3. Pc curve

The **Pc** curve contains the graphic characteristics for the representation of the probable preconsolidation stresses determined by the Casagrande method.

The drawing attributes that can be edited are the text for the values and the marker (usually a vertical down arrow).

By default, the title of the **Pc** curve is **Pc = $$Pc"999" kPa**, which shows the Pc value without decimals. By default, the text is displayed above the marker, but its alignment can be modified.

3.2.4. P0 curve

The **P0** curve contains the graphic characteristics for the representation of the in-situ effective soil stresses.

The drawing attributes that can be edited are the text for the values and the marker (usually a vertical down arrow).

By default, the title of the **P0** curve is **P0 = $$P0"999" kPa**, which shows the P0 value without decimals. By default, the text is displayed above the marker, but its alignment can be modified.

3.2.5. e0 curve

The **e0** curve contains the graphic characteristics for the representation of the initial void ratios.

The drawing attributes that can be edited are the text for the values and the marker (usually a horizontal left arrow).

By default, the title of the **e0** curve is **e0 = $$e0"9.999"**, which shows the e0 value with 3 decimals.

3.2.6. Sample_+ curve

The **Sample_+** curve contains the graphic characteristics of the points “added” to the consolidation curves. When a point of a consolidation curve is added, the curve necessarily passes through this point. These points are considered fit points. The drawing attribute used for these fit points is the marker.

If a point from a consolidation curve has a **negative offset other than -1**, it is then considered a **fit point** (see paragraph 7 of chapter 1). The fit points can be added interactively with the mouse. See paragraph 8 of chapter 1 for the details about the editing.

3.3. Legend of the graph of consolidation tests

By default, the order in the **Order** column of the curves of calculated values is the same as their number in the # column, so -6 to -1. By changing the order values to values greater than **0**, these curves can be displayed in the legend of the graph.

If we check the upper box **Legend Visible** of the curves editing window opened on the graph of consolidation tests, the legend of this graph will be displayed. It will show the predefined curves if their order number is positive, followed by as many symbols of curves as there are **Sample_x**

symbols defined in the **Symbol** panel of the options window (see paragraph 4.10.2 of chapter 1). The **Sample_n** symbol is never shown in the legend.

In the legend, the label of the predefined curves is the expression in their title; the label of the consolidation curves is made of the site, boring and sample numbers separated by a space. The site number is not displayed if the curves are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

Clicking on the button left of the **Legend** label opens the drawing attributes configuration window where it is possible to define the attributes of the text, background and border of the legend.

3.4. Curves to display: choice, representation and presence in the tables

The **Symbol** panel, shown in figure 3-3, is used to select the curves to be displayed in the graphs, to define their presence in the tables of significant values and to define their drawing attributes. It is presented in details in paragraph 4.10 of chapter 1.

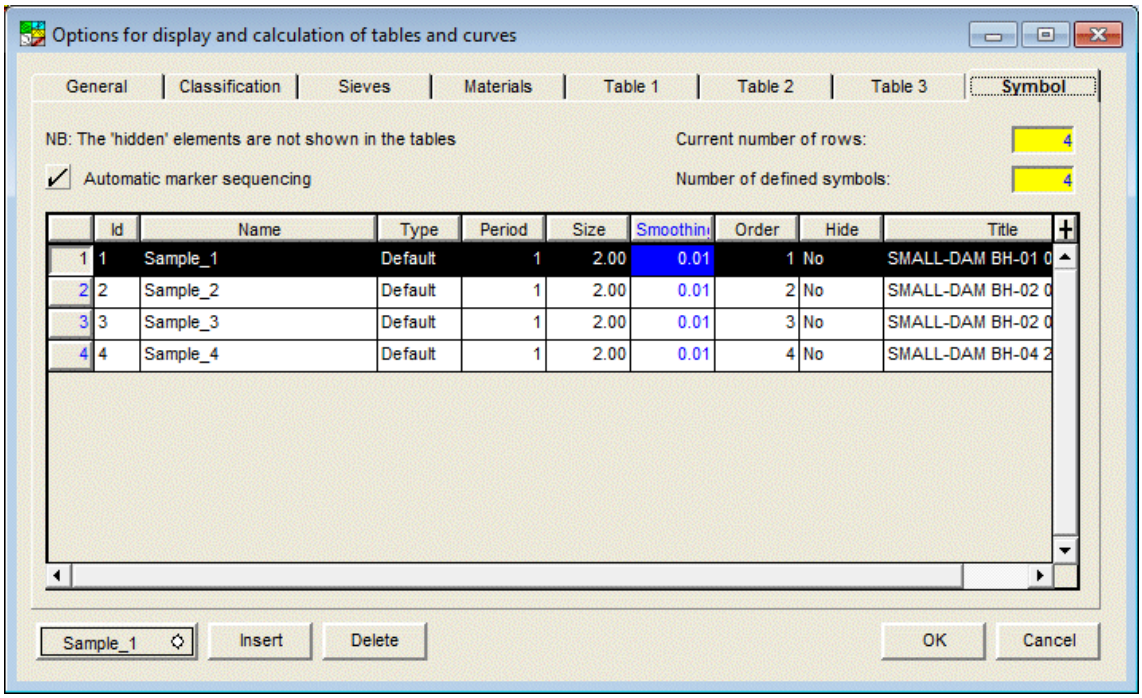


Figure 3-3 - Symbols definition panel

3.4.1. Sample curves

The **CONSOLIDATION_POINT** and **CONSOLIDATION** graphs, as well as the **GRAIN_SIZE_POINT**, **GRAIN_SIZE**, **PROCTOR_POINT**, **PROCTOR**, **LIMITS** and **CUR_LI** graphs, show all the samples that have results associated in the graphs present in the style file. The display of the curves for these samples is defined with the **Sample_x** rows in the **Symbol** panel. The expression "**Sample_**" is reserved and cannot be modified. See paragraph 4.10.2 of chapter 1.

4. PRESENTATION OF SIGNIFICANT VALUES OF CONSOLIDATION TESTS

In a graph of consolidation tests or a table of significant values, the values of **Pcmin**, **Pc**, **Pcmax**, **Cci** and **Ccr** presented are those saved in the **CONSOLIDATION** table. These values are either entered by the user or calculated by the Lab module according to the points of the consolidation curve and taking into account the smoothing.

The in-situ effective soil stress **P0** and the initial void ratio **E0** are always read from the **CONSOLIDATION** table.

The **geotec8.mrk** file, included with Lab, contains markers that **Lab** associates by their name to the predefined curves of the **CONSOLIDATION_POINT** and **CONSOLIDATION** graph. These markers are:

- The "**e0**" marker (a solid arrow pointing left) for the initial void ratio (**e0**) of each consolidation test
- The "**Pc**" marker (an empty arrow pointing down) for the probable preconsolidation stress (**PC**) and for the in-situ effective soil stress (**P0**) for each consolidation test
- The "**vert_bar**" marker (a vertical dash) for the minimal and maximum consolidation stresses for each consolidation test

Other markers and / or markers files can be used.

5. TABLE_*N* GRAPHS OF SIGNIFICANT VALUES

The eventual **TABLE_1**, **TABLE_2** and **TABLE_3** graphs can show consolidation information. The detailed description of these graphs is done in chapter 6.

The following table shows the information specific to the consolidation that can be selected via lists associated to the cells of the **Table** and **Field** columns of the **Table 1**, **Table 2** and **Table 3** panels of the options window.

Table	Field
Result	Cci
	Ccr
	E0
	OCR
	P0
	Pc
	Pc_P0
	Pcmax
	Pcmin
	Pn_P0
	Px_P0

6. KEYWORDS SPECIFIC TO THE CONSOLIDATION

When consolidation data are read, values are assigned to a series of keywords specific to the consolidation. The following table shows the first series of keywords:

Keywords	Meaning
Csd_Site_Nbr	Number of sites read in the query
Csd_Site_List	List of sites read in the query
Csd_Site_List_N	List of sites read in the query with the number of samples with data of consolidation curves and belonging to each site
Csd_Boring_Nbr	Number of borings read in the query
Csd_Boring_List	List of borings read in the query
Csd_Boring_List_N	List of borings read in the query with the number of samples with data of consolidation curves and belonging to each boring
Csd_Sample_Nbr	Number of samples read in the query
Csd_Sample_List	List of samples read in the query

In the lists of sites, borings or samples, the numbers are separated by a comma and a space. The site number is not displayed if the curves are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

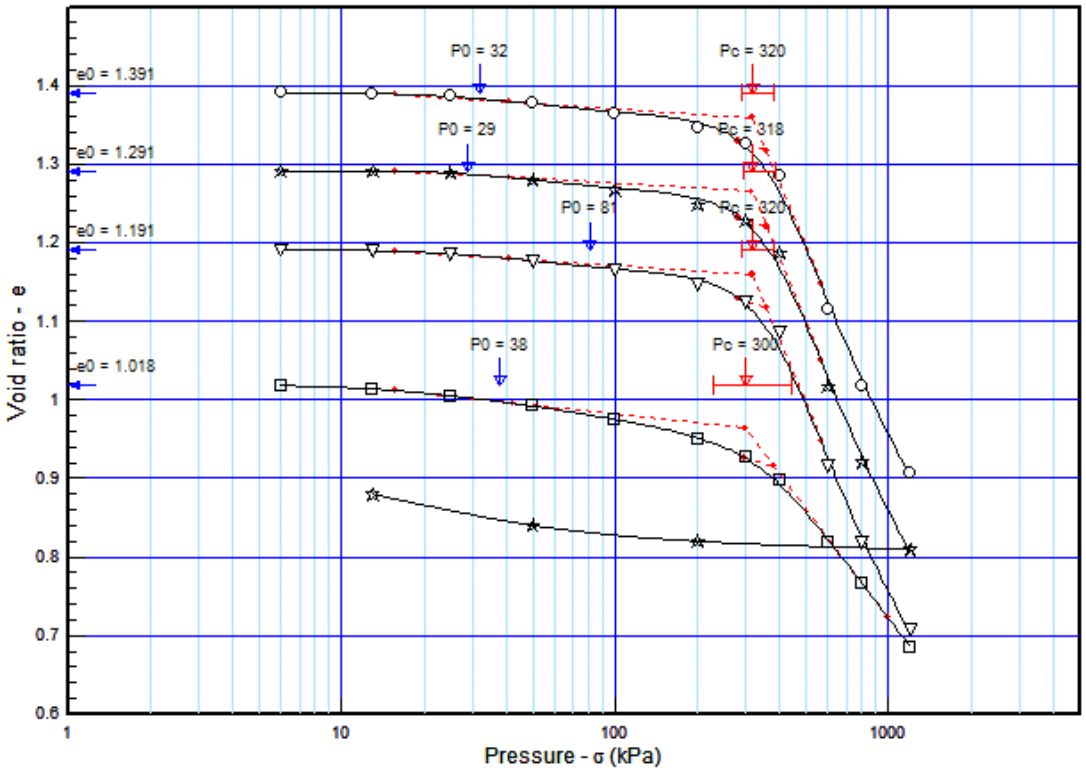
The second series of keywords presented in the following table shows the values entered or calculated on the consolidation curve of the **current** sample.

Keywords	Meaning
CSD_Sample_Selected	Identification of the current sample; this identification contains the site and boring numbers if necessary to prevent any ambiguity
E0	Initial void ratio
OCR	Overconsolidation ratio (Pc / P0)
P0	In-situ effective soil stress
Pcmin	Lower limit of the preconsolidation stress
Pc	Probable preconsolidation stress
Pcmax	Upper limit of the preconsolidation stress
Pn_P0	Lower limit of the surplus of consolidation stress
Pc_P0	Surplus of probable consolidation stress
Px_P0	Upper limit of the surplus of consolidation stress
Cci	Compression index
Ccr	Recompression index
Csd_smoothing	Smoothing of the consolidation curve

7. EXAMPLE OF A REPORT FOR CONSOLIDATION TESTS

CONSOLIDATION TEST

SITE SMALL-DAM (Dam on Small River)
BORING BH-01
PROJECT SRH (Hydroelectric development project on the Small River)
LOCATION East extremity of the future dam



	Boring	Sample	Depth (m)	Density (kg/m3)	Water content (%)	Pcmin (kPa)	Pcmax (kPa)	Pc (kPa)	e0 (kPa)	Ccr	Cci
○	BH-01	ST-03	2.20 - 2.35	1692.0	-	145	240	210	1.391	0.024	0.847
□	BH-02	ST-02	1.50 - 2.26	1910.0	29	230	440	300	1.018	0.040	0.461
▽	BH-02	ST-05	4.50 - 5.26	1890.0	36	290	380	320	1.191	0.024	0.847
☆	BH-04	ST-2	2.00 - 2.72	-	32	295	385	318	1.291	0.021	0.847

REMARKS:

Files: C:\Geotec80\Style\Lab_conso_Eng.sty C:\Geotec80\Access\Geotec805_Demo_Eng.mdb
C:\Geotec80\Style\Geotec8.mrk C:\Geotec80\Style\Geotec8.ptn
2014-03-03T12:10:28

Figure 3-4 - Example of a report for consolidation tests

CHAPTER 4. LAB - PROCTOR COMPACTION TESTS

1. GENERALITIES

This chapter describes the particularities of the display of results of Proctor compaction tests done on samples in the laboratory. These results are presented in various formats:

- a display zone of the compaction curves that corresponds to the **PROCTOR_POINT** graph, or to the **PROCTOR** graph;
- a table where significant values are interpolated, such as the optimum water content, the maximum density, the optimum saturation percentage; these values are presented in one of the **TABLE_1**, **TABLE_2** or **TABLE_3** graphs.

The graphs are defined in the style file by their number, their name and their graphic characteristics.

2. PROCTOR_POINT GRAPH

2.1. Definition of the graph of compaction tests

Lab produces compaction curves by reading data in the **PROCTOR_POINT** table. If the **PROCTOR** graph is displayed, only the results will be displayed, not the points of curves.

It is not possible to enter a negative value in the **Compaction** field of the **Smoothing of curves** zone in the **General** panel of the options window. Indeed, it is not possible to have a broken line as a compaction curve because it would not be possible to obtain an optimum.

2.2. Predefined curves of the graph of compaction tests

The curves editing window for the graph of compaction tests, illustrated in figure 4-1, shows four predefined curves:

- The ***x*%** curve(s)
- The **Opt_Avg** curve
- The **Opt_Pnt** curve
- The Sample_+ curve

2.2.1. *x*% curve(s)

Each ***x*% curve** contains the graphic characteristics for the ***x*%** saturation curve. These curves are defined in the **General** panel of the options window (see paragraph 2.4.2). The name and the title of an ***x*%** curve are respectively the values of the degree and the label defined for this curve in the **General** panel.

The drawing attributes that can be edited for these curves are the line and the text for the labels. The text angle is set by default to 0, which displays the label parallel to the curve. With the alignment button, it is possible to position the label with respect to its anchor point located in the middle of the saturation curve.

The ***x*%** curves are edited in the options window.

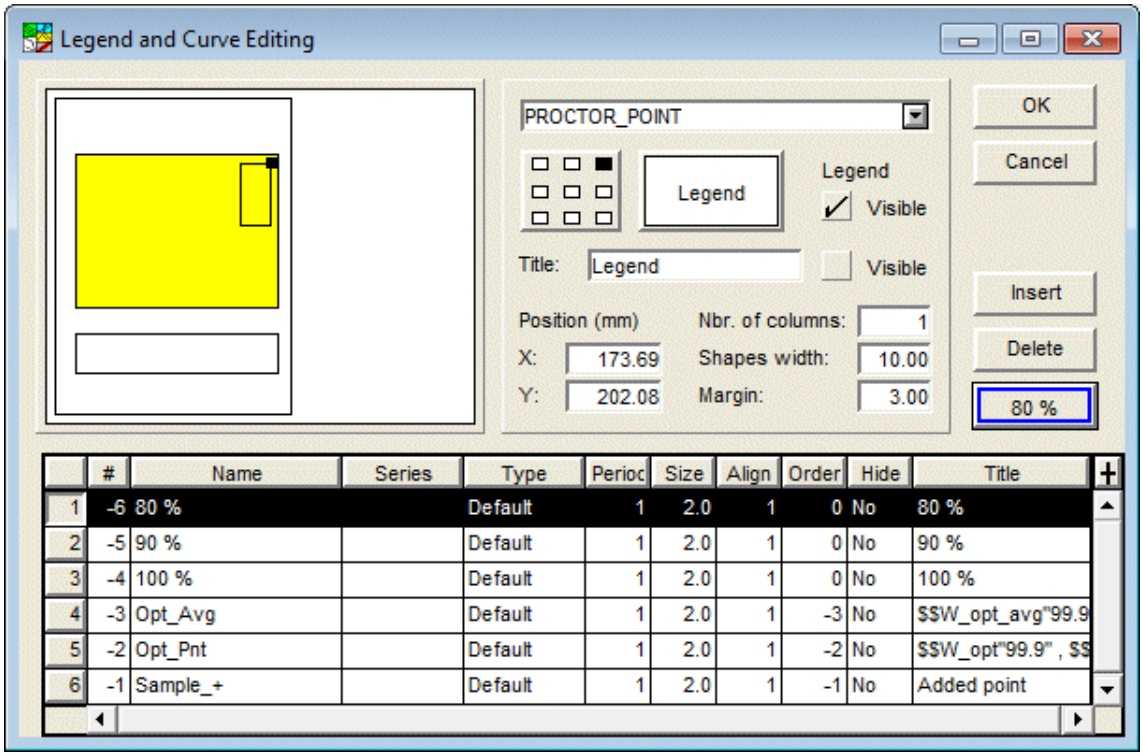


Figure 4-1 - Curves of the graph of compaction tests

2.2.2. Opt_Avg curve

The **Opt_Avg** curve is used to display the average of the corrected optimum water contents and of the corrected maximum densities. A marker generally indicates the location of these coordinates, as well as the values themselves. The projections of the point onto the graph axes can be drawn with the line attribute.

The drawing attributes that can be edited are the line for the projections, the marker and the text for the values of the optimum.

By default, the title of the **Opt_Avg** curve is **$$W_opt_avg"99.9" , $$D_max_avg"9999"** , which shows the average of the corrected optimum water contents, followed by the average of the corrected maximum densities. The “99.9” and “9999” formats indicate 1 decimal and no decimal, respectively. It is possible to change the format and to modify the title to include normal text.

If the **Opt_Avg** curve does not have a title or if the title is a textual expression only, the two default values will be displayed on the graph. To hide the values, the marker and / or the projection lines, remove the text, marker and / or line attribute in the drawing attributes window for the **Opt_Avg** curve, or set the “**Hide**” cell to **Yes** to hide all the attributes of the curve.

2.2.3. Opt_Pnt curve

The **Opt_Pnt** curve is used to display the corrected optimum water content and the corrected maximum density for each sample, i.e. the X and Y coordinates of the peak of each compaction curve. A marker generally indicates the peak of each compaction curve, and the values of the coordinates are also written.

The drawing attributes that can be edited are the marker and the text for the values of the peak of each curve.

By default, the title of the **Opt_Pnt** curve is **$$W_opt"99.9" , $$D_max"9999"** , which shows the corrected optimum water content, followed by the corrected maximum density. The “99.9” and “9999” formats indicate 1 decimal and no decimal, respectively. It is possible to change the format and to modify the title to include normal text.

To hide the values, remove their call in the title. To hide the marker and / or the text, remove the marker and / or text attribute in the drawing attributes window for the **Opt_Pnt** curve, or set the “**Hide**” cell to **Yes** to hide all the attributes of the curve.

2.2.4. Sample_+ curve

The **Sample_+** curve contains the graphic characteristics of the points “added” to the compaction curves. When a point of a compaction curve is added, the curve necessarily passes through this point. These points are considered fit points. The drawing attribute used for these fit points is the marker.

If a point from a compaction curve has a **negative offset other than -1**, it is then considered a **fit point** (see paragraph 7 of chapter 1). The fit points can be added interactively with the mouse. See paragraph 8 of chapter 1 for the details about the editing.

2.3. Legend of the graph of compaction tests

By default, the order in the **Order** column of the **Opt_Avg**, **Opt_Pnt** and **Sample_+** curves is the same as their number in the # column, so -3, -2 and -1. By changing the order values to values greater than **0**, these curves can be displayed in the legend of the graph. The order of the ***x*%** saturation curves is defined in the **General** panel of the options window. If this order is greater than 0, the curves will be displayed in the legend.

If we check the upper box **Legend Visible** of the curves editing window opened on the graph of compaction tests, the legend of this graph will be displayed. It will show the predefined curves if their order number is positive, followed by as many symbols of curves as there are **Sample_x** symbols defined in the **Symbol** panel of the options window (see paragraph 4.10.2 of chapter 1). The **Sample_n** symbol is never shown in the legend.

In the legend, the label of the predefined curves is the expression in their title; the label of the compaction curves is made of the site, boring and sample numbers separated by a space. The site number is not displayed if the curves are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

Clicking on the button left of the **Legend** label opens the drawing attributes configuration window where it is possible to define the attributes of the text, background and border of the legend.

2.4. Definition of the saturation curves

The definition of the saturation curves is done in the **General** panel of the options window, shown in figure 4-2.

2.4.1. Water unit weight and relative density

The **General** panel of the options window has two fields used to enter the **water unit weight** and the **relative density** of the solid grains. The values entered determine the look of the saturation curves. The values are also used to know which unit system is used: with a water unit weight around 1000, in kg/m^3; with a value around 9.8, in kN/m^3.

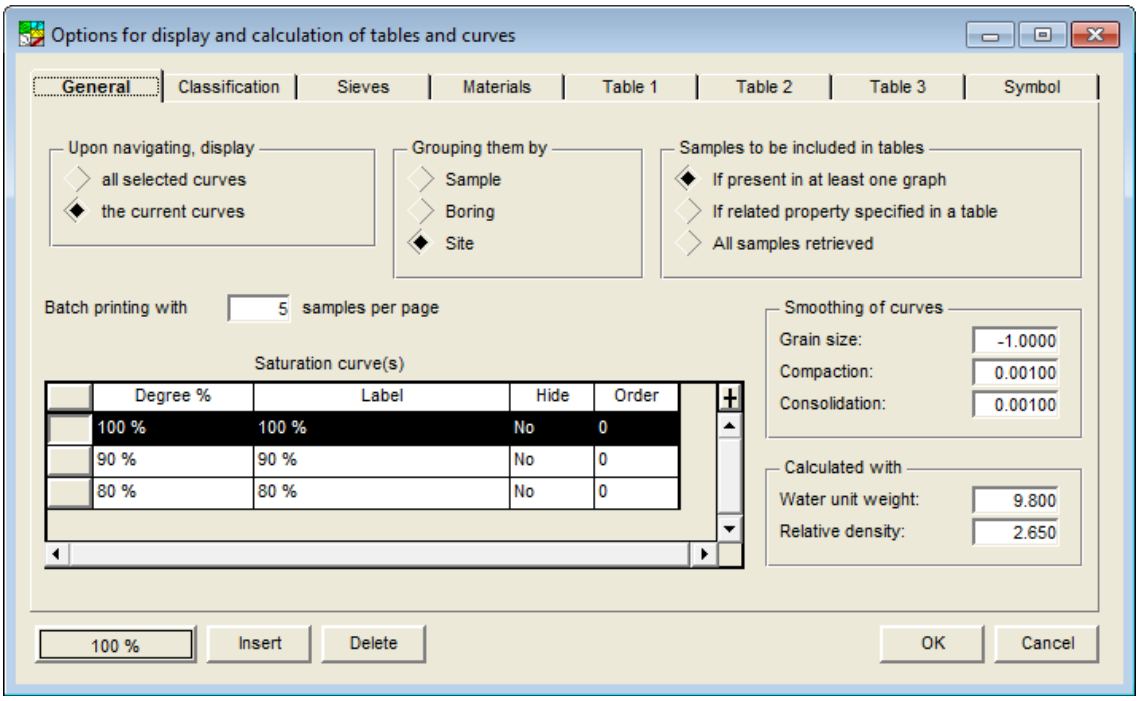


Figure 4-2 - Definition of the saturation curves

2.4.2. Definition of the saturation curves

The saturation curves are defined in the table of the **General** panel of the options window. The default curves are those of **100%**, **90%** and **80%** saturation, and the values can be modified. The **Degree %** column is used to indicate the desired saturation percentages; the **Label** column is used to indicate the strings that will identify the saturation curves in the graph of compaction curves.

To hide a saturation curve from the graph of compaction curves, set its "**Hide**" cell to **Yes** by double-clicking in the cell.

If the **order** of a saturation curve is greater than **0**, this curve will be presented in the legend of the graph if it is displayed. The curves are presented by their order number.

2.4.3. Selection, insertion, deletion of saturation curves

In the **General** panel, the **Insert** and **Delete** buttons at the bottom of the window are used the same way as in the other panels of the options window (see paragraph 4.4 of chapter 1).

2.4.4. Drawing attributes of the saturation curves

The button at the bottom left of the **General** panel opens the drawing attributes window to modify the attributes of the saturation curve represented by the selected row. If several rows are selected, they will all take the attributes defined.

- The text attributes will affect the labels of the saturation curves.

  The text angle is set by default to 0, which displays the label parallel to the curve. With the alignment button, it is possible to position the label with respect to its anchor point located in the middle of the saturation curve.

- The line attributes define the line of the saturation curves.

- Markers can be associated to a saturation curve, but its period must be set high, otherwise the markers will be superimposed.

2.5. Curves to display: choice, representation and presence in the tables

The **Symbol** panel, shown in figure 4-3, is used to select the curves to be displayed in the graphs, to define their presence in the tables of significant values and to define their drawing attributes. It is presented in details in paragraph 4.10 of chapter 1.

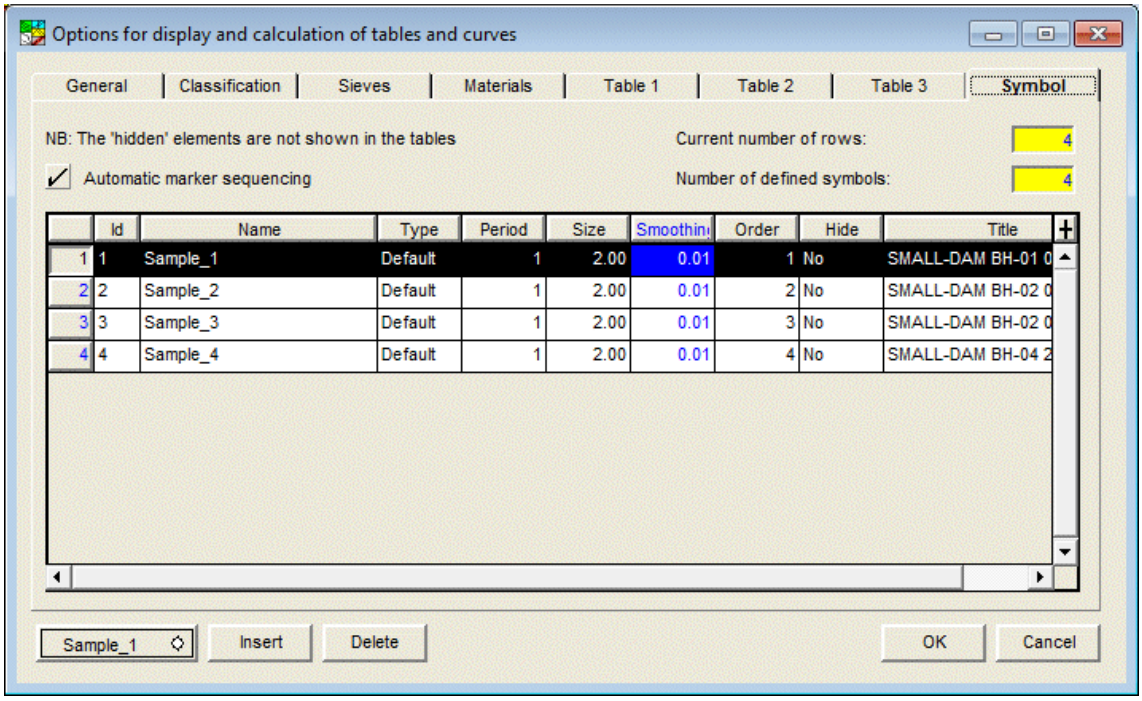


Figure 4-3 - Symbols definition panel

2.5.1. Sample curves

The **PROCTOR_POINT** and **PROCTOR** graphs, as well as the **GRAIN_SIZE_POINT**, **GRAIN_SIZE**, **CONSOLIDATION_POINT**, **CONSOLIDATION**, **LIMITS** and **CUR_LI** graphs, show all the samples that have results associated in the graphs present in the style file. The display of the curves for these samples is defined with the **Sample_x** rows in the **Symbol** panel. The expression "**Sample**_" is reserved and cannot be modified. See paragraph 4.10.2 of chapter 1.

3. TABLE_N GRAPHS OF SIGNIFICANT VALUES

The eventual **TABLE_1**, **TABLE_2** and **TABLE_3** graphs can show compaction information. The detailed description of these graphs is done in chapter 6.

The following table shows the information specific to the compaction that can be selected via lists associated to the cells of the **Table** and **Field** columns of the **Table 1**, **Table 2** and **Table 3** panels of the options window.

Table	Field
Result	D_max
	D_max_test
	Gs
	Gw
	S_opt
	S_opt_test
	W_opt
	W_opt_test

4. KEYWORDS SPECIFIC TO THE COMPACTION

When compaction data are read, values are assigned to a series of keywords specific to the compaction. The following table shows the first series of keywords:

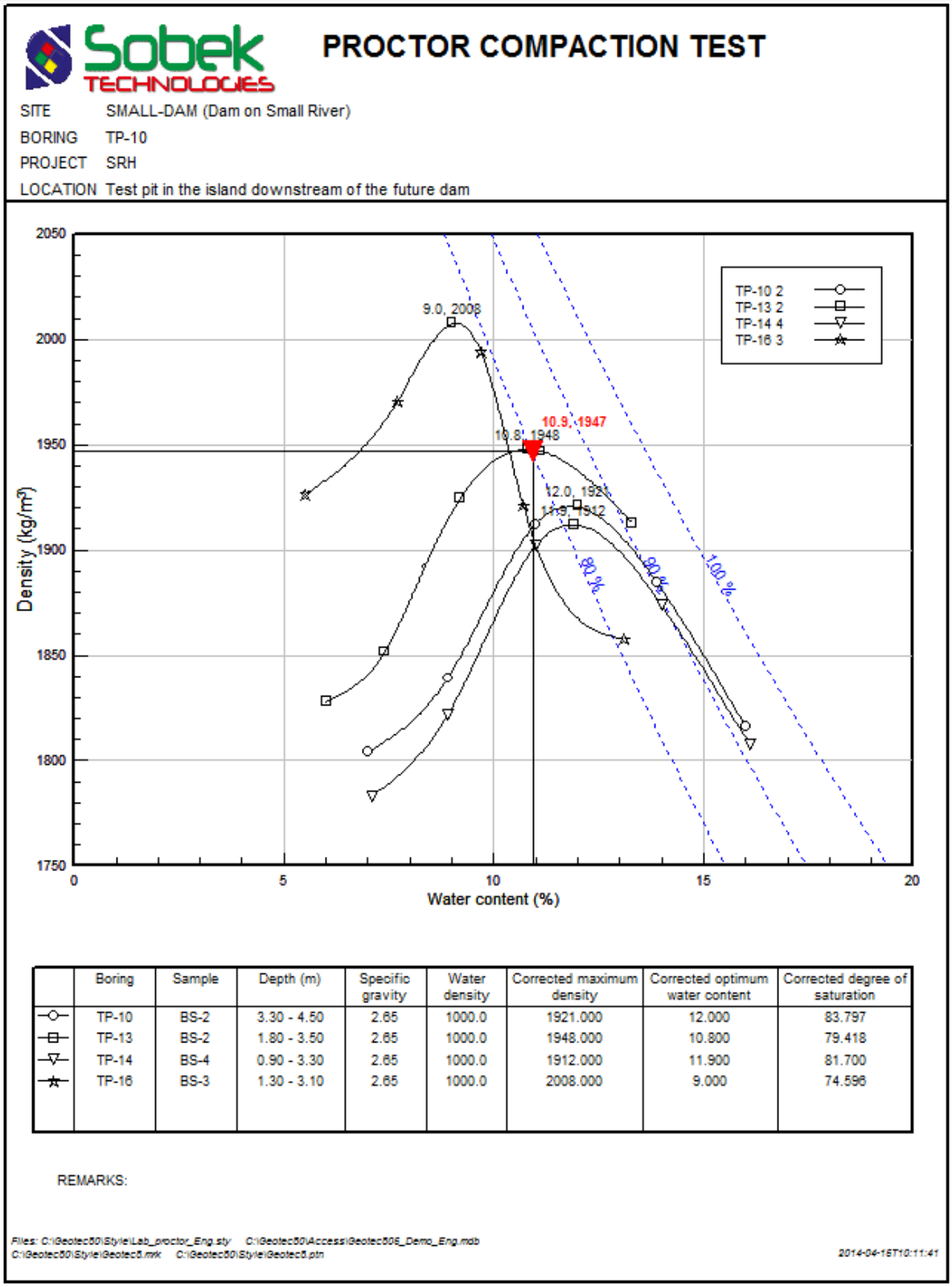
Keywords	**Meaning**
Cmp_Site_Nbr	Number of sites read in the query
Cmp_Site_List	List of sites read in the query
Cmp_Site_List_N	List of sites read in the query with the number of samples with data of compaction curves and belonging to each site
Cmp_Boring_Nbr	Number of borings read in the query
Cmp_Boring_List	List of borings read in the query
Cmp_Boring_List_N	List of borings read in the query with the number of samples with data of compaction curves and belonging to each boring
Cmp_Sample_Nbr	Number of samples read in the query
Cmp_Sample_List	List of samples read in the query

In the lists of sites, borings or samples, the numbers are separated by a comma and a space. The site number is not displayed if the curves are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

The second series of keywords presented in the following table shows the values calculated on the compaction curve of the **current** sample.

Keywords	Meaning
CMP_Sample_Selected	Identification of the current sample; this identification contains the site and boring numbers if necessary to prevent any ambiguity
Gw	Water unit weight defined in the General panel of the options window
Gs	Relative density defined in the General panel of the options window
D_max	Corrected maximum dry density (kg/m^3)
D_max_test	Measured maximum dry density (kg/m^3)
W_opt	Corrected optimum water content (%)
W_opt_test	Measured optimum water content (%)
S_opt	Corrected optimum saturation percentage (%)
S_opt_test	Measured optimum saturation percentage (%)
D_max_avg	Average of the corrected maximum dry densities (kg/m^3)
W_opt_avg	Average of the corrected optimum water contents (%)
Cmp_smoothing	Smoothing of the compaction curve

5. EXAMPLE OF A REPORT FOR COMPACTION TESTS



	Boring	Sample	Depth (m)	Specific gravity	Water density	Corrected maximum density	Corrected optimum water content	Corrected degree of saturation
○	TP-10	BS-2	3.30 - 4.50	2.65	1000.0	1921.000	12.000	83.797
□	TP-13	BS-2	1.80 - 3.50	2.65	1000.0	1948.000	10.800	79.418
▽	TP-14	BS-4	0.90 - 3.30	2.65	1000.0	1912.000	11.900	81.700
☆	TP-16	BS-3	1.30 - 3.10	2.65	1000.0	2008.000	9.000	74.596

REMARKS:

Files: C:\Geotec50\Style\Lab_proctor_Eng.sty C:\Geotec50\Access\Geotec506_Demo_Eng.mdb
C:\Geotec50\Style\Geotec5.mrk C:\Geotec50\Style\Geotec5.ptn

2014-04-15T10:11:41

Figure 4-4 - Example of a report for compaction tests

CHAPTER 5. LAB - CONSISTENCY LIMITS

1. GENERALITIES

This chapter describes the particularities of the display of measurements of Atterberg consistency limits done on samples in the laboratory. These results are presented in various formats:

- a display zone of the points of limits (plasticity index as a function of liquid limit) that corresponds to the **LIMITS** graph;
- a table where significant values are displayed, such as the plasticity and liquidity indexes, the plastic and liquid limits and the water content; these values are presented in one of the **TABLE_1**, **TABLE_2** or **TABLE_3** graphs.

The graphs are defined in the style file by their number, their name and their graphic characteristics.

2. LIMITS GRAPH

2.1. Definition of the graph of consistency limits

Lab produces points of Atterberg limits by reading data in the **LIMITS** table.

2.2. Predefined curve of the graph of consistency limits

The curves editing window for the graph of consistency limits, illustrated in figure 5-1, shows only one predefined curve, the **Pnt_Avg** curve.

2.2.1. Pnt_Avg curve

The **Pnt_Avg** curve is used to display the point representing the average of all the points of limits displayed. Often, the projections of the average point on the graph axes are drawn, a marker indicates its location and the coordinate values are written close to the marker.

The drawing attributes that can be edited are the line for the projections, the marker and the text for the values of the average point.

By default, the title of the **Pnt_Avg** curve is **$$LL_Avg"99.9" , $$PI_Avg"99.9"** , which shows the average liquid limit, followed by the average plasticity index. The “99.9” format indicates 1 decimal. It is possible to change the format and to modify the title to include normal text.

If the **Pnt_Avg** curve does not have a title or if the title is a textual expression only, the two default values will be displayed on the graph. To hide the values, the marker and / or the projection lines, remove the text, marker and / or line attribute in the drawing attributes window for the **Pnt_Avg** curve, or set the “**Hide**” cell to **Yes** to hide all the attributes of the curve.

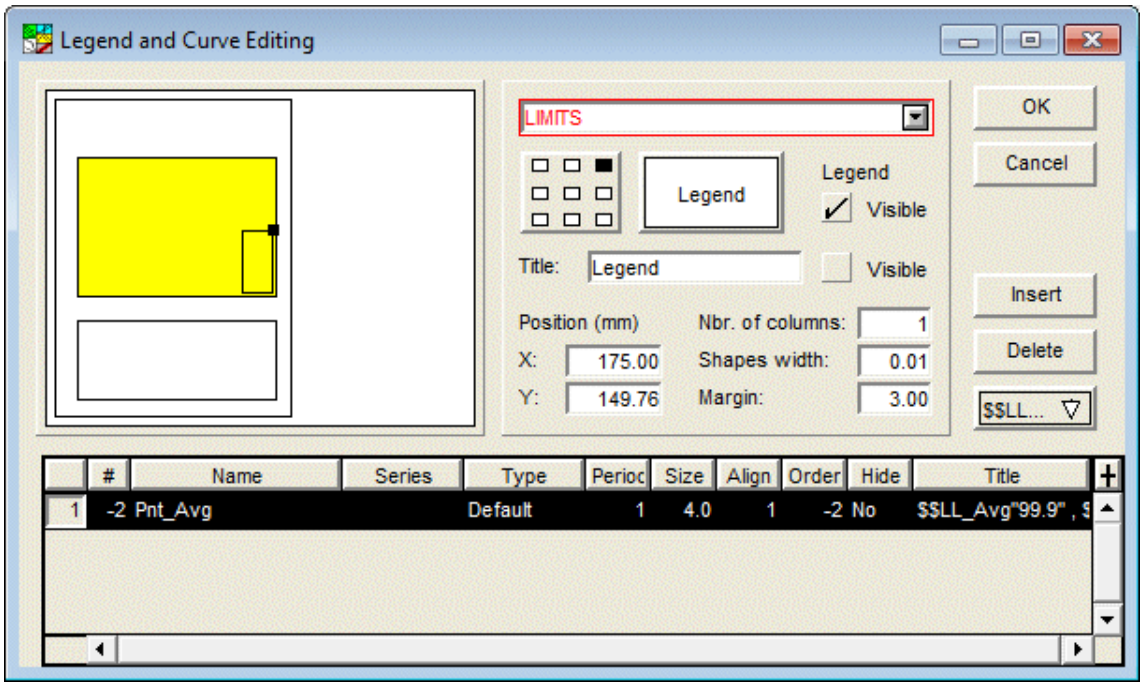


Figure 5-1 - Curve of the graph of consistency limits

2.3. Legend of the graph of consistency limits

By default, the order in the **Order** column of the **Pnt_Avg** curve is the same as its number in the # column, so -2. By changing the order value to a value greater than **0**, this curve can be displayed in the legend of the graph.

If we check the upper box **Legend Visible** of the curves editing window opened on the **LIMITS** graph, the legend of this graph will be displayed. It will show the predefined curve if its order number is positive, followed by as many symbols of points as there are **Sample_x** symbols defined in the **Symbol** panel of the options window (see paragraph 4.10.2 of chapter 1). The **Sample_n** symbol is never shown in the legend.

In the legend, the label of the predefined curve is the expression in its title; the label of the points of limits is made of the site, boring and sample numbers separated by a space. The site number is not displayed if the points are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

Clicking on the button left of the **Legend** label opens the drawing attributes configuration window where it is possible to define the attributes of the text, background and border of the legend.

2.4. Points to display: choice, representation and presence in the tables

The **Symbol** panel, shown in figure 5-2**,** is used to select the points to be displayed in the graphs, to define their presence in the tables of significant values and to define their drawing attributes. It is presented in details in paragraph 4.10 of chapter 1.

2.4.1. Sample curves

The **LIMITS** graph, as well as the **GRAIN_SIZE_POINT**, **GRAIN_SIZE**, **PROCTOR_POINT**, **PROCTOR**, **CONSOLIDATION_POINT**, **CONSOLIDATION** and **CUR_LI** graphs, shows all the samples that have results associated in the graphs present in the style file. The display of the points for these samples is defined with the **Sample_x** rows in the **Symbol** panel. The expression "**Sample**_" is reserved and cannot be modified. See paragraph 4.10.2 of chapter 1.

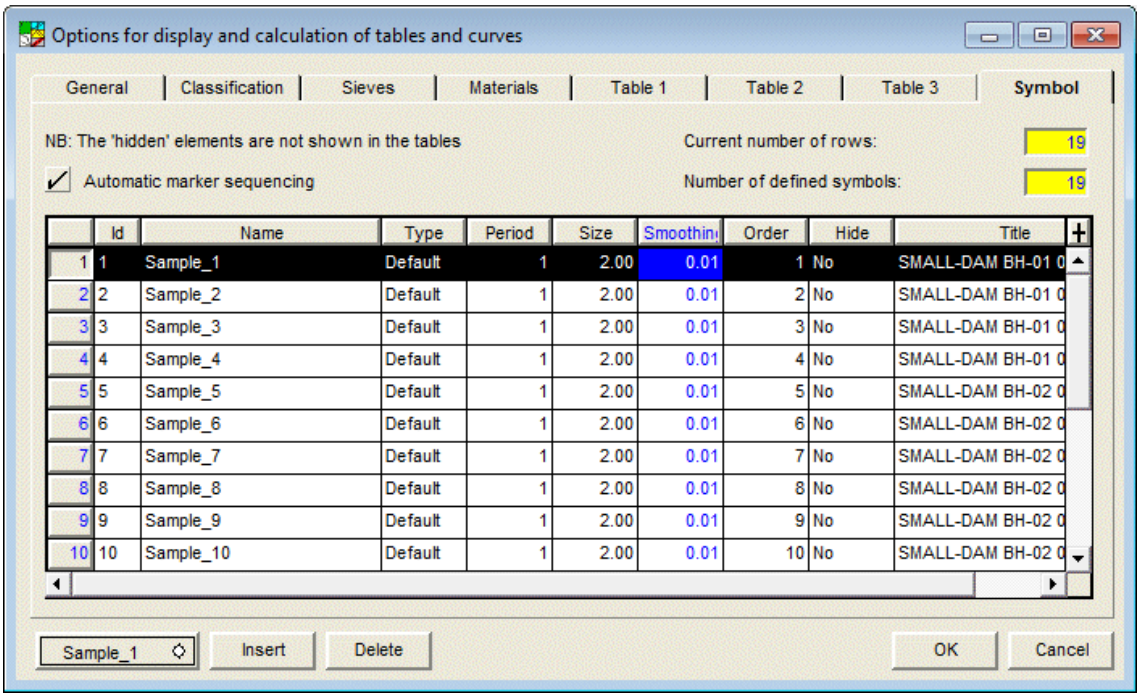


Figure 5-2 - Symbols definition panel

2.5. Plasticity chart

Generally, the graphic representation of the consistency limits places the measured points on a plasticity chart from which the user can view the different classification zones. All the lines of the plasticity chart are drawn from graphic objects (see paragraph 15 of chapter 4 of the X3D guide).

The plasticity chart presented in both style files for Atterberg limits provided as well as the evaluation of the unified classification are based on the ASTM 487 norm. Any modification to the zones of the chart would create differences between the classification displayed on the graph and the classification calculated from the norm. The lines of the chart should always be locked to prevent any accidental modification to the normalized zones.

3. TABLE_N GRAPHS OF SIGNIFICANT VALUES

The eventual **TABLE_1**, **TABLE_2** and **TABLE_3** graphs can show information about consistency limits. The detailed description of these graphs is done in chapter 6.

The following table shows the information specific to the consistency limits that can be selected via lists associated to the cells of the **Table** and **Field** columns of the **Table 1**, **Table 2** and **Table 3** panels of the options window.

Table	Field
Result	LI
	PI
	USCS

4. KEYWORDS SPECIFIC TO THE CONSISTENCY LIMITS

When data of consistency limits are read, values are assigned to a series of keywords specific to the limits. The following table shows the first series of keywords:

Keywords	**Meaning**
Lim_Site_Nbr	Number of sites read in the query
Lim_Site_List	List of sites read in the query
Lim_Site_List_N	List of sites read in the query with the number of samples with data of consistency limits and belonging to each site
Lim_Boring_Nbr	Number of borings read in the query
Lim_Boring_List	List of borings read in the query
Lim_Boring_List_N	List of borings read in the query with the number of samples with data of consistency limits and belonging to each boring
Lim_Sample_Nbr	Number of samples read in the query
Lim_Sample_List	List of samples read in the query

In the lists of sites, borings or samples, the numbers are separated by a comma and a space. The site number is not displayed if the curves are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

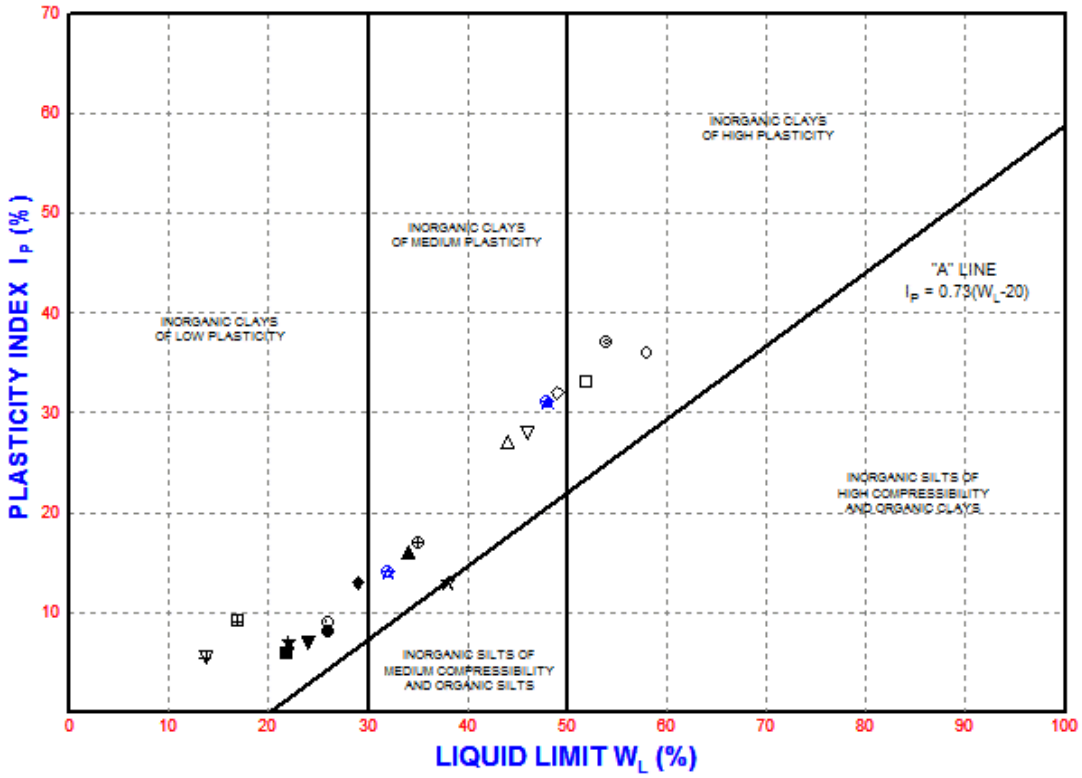
The second series of keywords presented in the following table shows the significant values of the limits of the **current** sample or the average point.

Keywords	**Meaning**
LIM_Sample_Selected	Identification of the current sample; this identification contains the site and boring numbers if necessary to prevent any ambiguity
W	Water content (%)
LL	Liquid limit (%)
PL	Plastic limit (%)
PI	Plasticity index (%) PI = LL - PL
LI	Liquidity index LI = (W - PL) / PI
USCS	Calculated unified classification based on the consistency limits
LL_Avg	Average of the liquid limits (%)
PI_Avg	Average of the plasticity indexes (%)

5. EXAMPLE OF A REPORT FOR CONSISTENCY LIMITS

PLASTICITY CHART

SITE: SMALL-DAM (Dam on Small River)
BORING: BH-01
PROJECT: SRH
LOCATION: East extremity of the future dam



	Boring	Sample	Depth (m)	w (%)	W_L (%)	W_P (%)	I_P	I_L	USCS	Description
○	BH-01	ST-01	0.20 - 0.96	33.0	58.0	22.0	36.0	0.31	CH	Natural soil, gray-brown clay
□	BH-01	ST-02	1.00 - 1.76	37.0	52.0	19.0	33.0	0.55	CH	Oxidized clay
▽	BH-01	ST-03	1.85 - 2.00	41.2	46.0	18.0	28.0	0.83	CL	Silty clay
☆	BH-01	ST-03	2.38 - 2.53	42.5	38.0	25.0	13.0	1.35	ML	Silty clay, non-rigid consistency
◎	BH-02	ST-01	0.50 - 1.26	24.0	54.0	17.0	37.0	0.19	CH	-
◇	BH-02	ST-02	1.50 - 2.26	29.0	49.0	17.0	32.0	0.38	CL	-
△	BH-02	ST-03	2.50 - 3.26	32.0	44.0	17.0	27.0	0.56	CL	Sandy silt with clay horizon
❀	BH-02	ST-04	3.50 - 4.26	38.0	32.0	18.0	14.0	1.43	CL	-
●	BH-02	ST-05	4.50 - 5.26	36.0	26.0	18.0	8.0	2.25	CL	-
■	BH-02	ST-06	5.50 - 6.26	32.9	21.8	16.0	5.8	2.92	CL-ML	-
▼	BH-02	ST-07	6.50 - 7.26	33.0	24.0	17.0	7.0	2.29	CL-ML	-
★	BH-02	ST-08	7.50 - 8.26	33.0	22.0	15.0	7.0	2.57	CL-ML	-
⊙	BH-02	ST-09	8.50 - 9.26	36.0	26.0	17.0	9.0	2.11	CL	-
◆	BH-02	ST-10	9.50 - 10.26	32.0	29.0	16.0	13.0	1.23	CL	-
▲	BH-02	ST-11	10.50 - 10.80	27.0	34.0	18.0	16.0	0.56	CL	-

Remark:

2014-03-03 15:24:36

Figure 5-3 - Example of a report for consistency limits

CHAPTER 6. LAB - TABLES OF VALUES

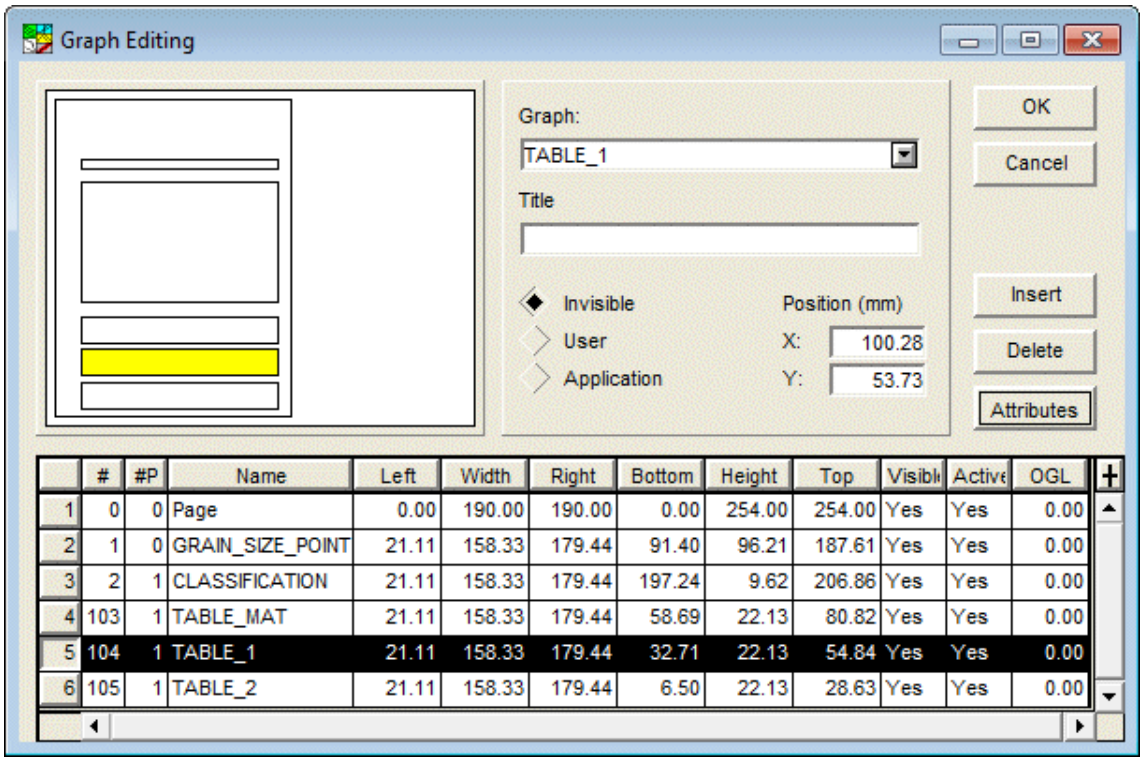
1. GENERALITIES

In addition to the display of curves and points showing the results of grain size analyses, consolidation and compaction tests and measurements of consistency limits, Lab allows the definition of up to three particular tables, **TABLE_1**, **TABLE_2** and **TABLE_3**, to display significant values calculated and associated to the lab tests presented or information from the tables of the **Geotec** database. The **TABLE_*n*** tables are defined via the **Table *n*** panels of the options window.

2. TABLE_*N* TABLES

2.1. Definition of the TABLE_*n* tables

The **Table *n*** is used to associate significant values to a table defined as the **TABLE_*n*** table. The changes made in the **Table *n*** panel only show if the **TABLE_*n*** table exists in the style file. Each row defined in a **Table *n*** panel defines a column of the **TABLE_*n*** table. Up to 3 **TABLE_*n*** tables can be defined in the style file.



	#	#P	Name	Left	Width	Right	Bottom	Height	Top	Visibl	Active	OGL
1	0	0	Page	0.00	190.00	190.00	0.00	254.00	254.00	Yes	Yes	0.00
2	1	0	GRAIN_SIZE_POINT	21.11	158.33	179.44	91.40	96.21	187.61	Yes	Yes	0.00
3	2	1	CLASSIFICATION	21.11	158.33	179.44	197.24	9.62	206.86	Yes	Yes	0.00
4	103	1	TABLE_MAT	21.11	158.33	179.44	58.69	22.13	80.82	Yes	Yes	0.00
5	104	1	TABLE_1	21.11	158.33	179.44	32.71	22.13	54.84	Yes	Yes	0.00
6	105	1	TABLE_2	21.11	158.33	179.44	6.50	22.13	28.63	Yes	Yes	0.00

Figure 6-1 - Definition of the TABLE_*n* tables

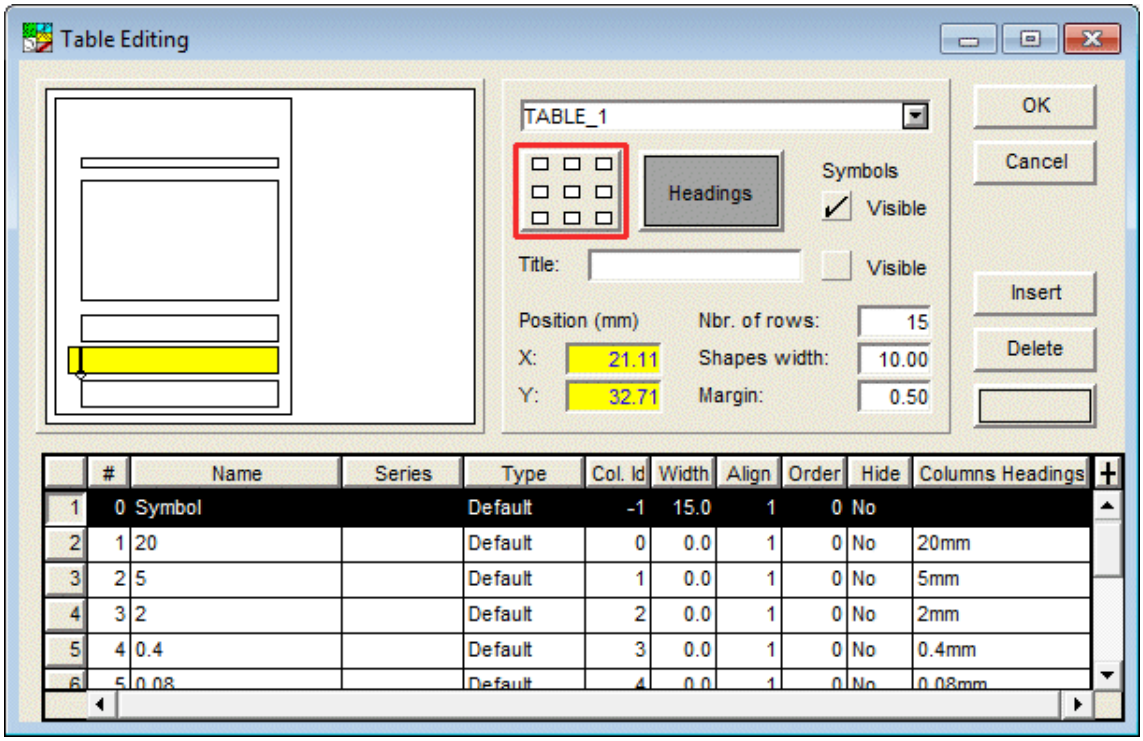
Figure 6-1 shows the graph editing window where two of the three **TABLE_*n*** are defined. Their number # is **100 or greater**, which defines them as “tables” (see paragraph 5.3 of chapter 6 of the X3D guide). Their parent graph is the **page** (**#0**) since they do not depend on a graph.

The cells of position and dimension of the TABLE_*n* tables do not necessarily define the real position and size of the tables. See paragraph 2.3.2 for the details.

2.2. Columns of the TABLE_*n* tables

Each **TABLE_*n*** table shows the same number of columns as defined in the corresponding **Table *n*** panel in the options window, in addition to the **Symbol** column numbered **#0**.

Figure 6-2 shows a TABLE_*n* table editing window. The columns are listed according to the order in which they are defined in the **Table *n*** panel. Their number (#) indicates this order. Their name, width and heading are the values that are written in the **Field**, **Width** and **Heading** cells of the **Table *n*** panel.



	#	Name	Series	Type	Col. Id	Width	Align	Order	Hide	Columns Headings
1	0	Symbol		Default	-1	15.0	1	0	No	
2	1	20		Default	0	0.0	1	0	No	20mm
3	2	5		Default	1	0.0	1	0	No	5mm
4	3	2		Default	2	0.0	1	0	No	2mm
5	4	0.4		Default	3	0.0	1	0	No	0.4mm
6	5	0.08		Default	4	0.0	1	0	No	0.08mm

Figure 6-2 - Columns of the TABLE_1 table

To display the column of symbols, check the box “**Display column**” in the panel of the desired table in the options window. The box “**Symbols**” in the table editing window will then be checked.

Similarly, the **column width (mm)**, the **shapes width (mm)**, the **number of rows** and the **all around margin (mm)** defined in the **Table *n*** panel are found respectively in the **Width** column of the **Symbol** curve and in the fields **Shapes width**, **Nbr. of rows** and **Margin** of the table editing window. Please note that these four controls are effective for all the tables displayed.

2.3. Presentation of a TABLE_*n* table

The Table 1 panel of the options window is shown in figure 6-3. It is important to modify the tables via these panels of the options window, instead of the table editing window.

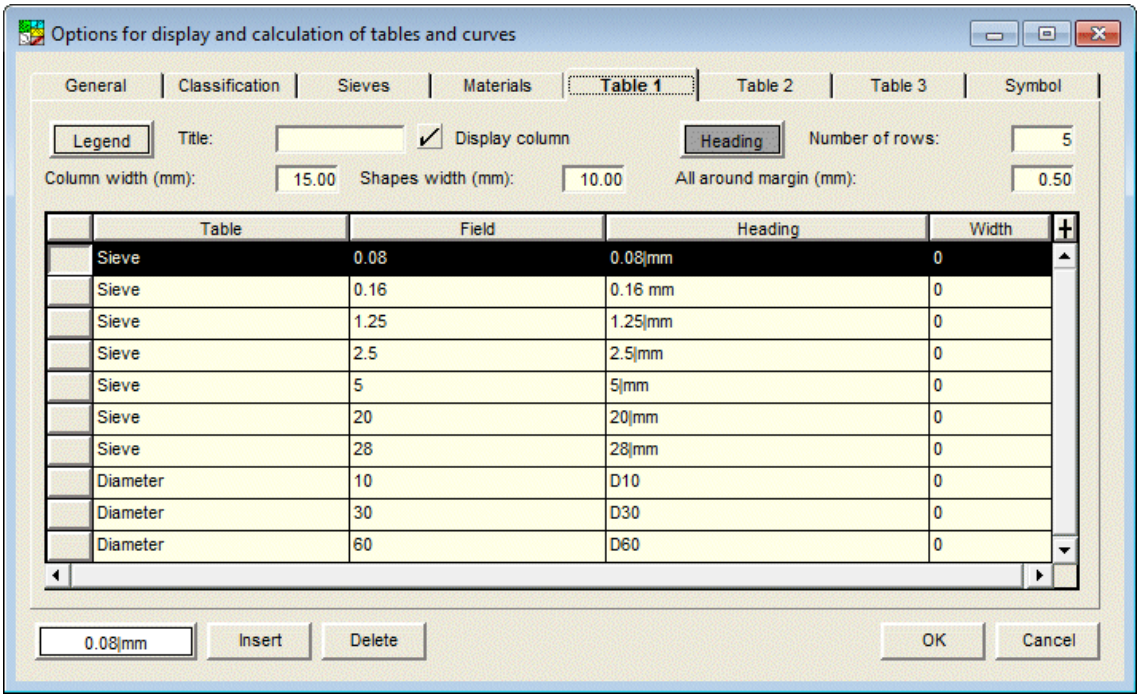


Figure 6-3 - Table *n* panel of the options window

2.3.1. Drawing attributes

In the graph editing window, by clicking on the **Attributes** button for a **TABLE_*n*** table, it is possible to modify the following graphic characteristics of the table of significant values:

- the border, with the line attributes;
- the background of the entire table, with the filling and/or pattern attributes; for this filling to be visible, the columns of the table must not have a background defined.

The drawing attributes described below can be defined in the table editing window, but it is preferable to do it in the options window.

The user can modify the display of all the headings of a table of significant values by clicking on the button labeled **Heading** in its **Table *n*** panel. The elements that can be edited for the row of headings are:

- the background of the cells of the row, with the XVT filling and/or pattern attributes;
- the lower limit of the row, with the line attributes;
- the font, color, style, size, alignment and format of the headings, with the text attributes.

The user can define the drawing attributes of the **Symbol** column with the **Legend** button at the top left of the **Table *n*** panel.

- the background of the cells of the symbols column, with the filling and/or pattern attributes;
- the lower limit of each row of the table (except the row of headings), with the line attributes;
- the alignment of the symbols in the cells with the alignment button.

The characteristics that can be modified for each column, via the **Table *n*** panel by clicking on the button at the bottom left for each row, are:

- the background of the cells of the column, with the XVT filling and/or pattern;
- the left vertical limit of the column, with the line attributes;
- the font, color, style, size, alignment and format of the written values, with the text attributes.

2.3.2. Widths of the table and its columns

The position and dimensions of a table of significant values defining the table, as they appear in the graph editing window, are those of the table but do not include the **Symbol** column, if visible. These dimensions are function of the alignment, if specified, for the **TABLE_*n*** table in the table editing (see the box in figure 6-2):

- If no alignment is defined for the legend of the **TABLE_*n*** table, this table will occupy the entire area set for the **TABLE_*n*** graph. If the **Symbol** column is visible, the preview area shows that it is placed outside the limits left of the table.
- If an alignment is defined for the legend of the **TABLE_*n*** table, this table occupies the area necessary to display the number of rows defined in the options window for the **Table n** according to the various drawing attributes defined for the headings, columns and table title. The anchor point of the table is shown in the preview area for the **TABLE_*n*** graph based on the defined alignment. If the **Symbol** column is visible, the preview area shows that it is placed outside the limits left of the table.

The widths of the columns depend on the widths specified in the **Width** column of the **Table *n*** panel of the options window.

- The effective width of the columns with a defined **width** greater than **0** depends on this width. In a table without alignment, the proportion between the defined widths is used (except for shapes column). In a table with alignment, the defined widths are used for the display (in mm).
- The effective width of the columns with a **width** of **0** depends on the length of the values contained, including the heading. The display of a column of width **0** is adjusted, **as much as possible**, to fit the longest value on one line. The heading can be displayed on several lines if it is made of several words with a total length exceeding the length of the longest value of the column or if it contains the character "**|**".

In a table without alignment, it is possible that no column can display the totality of its content. In a table with alignment, the columns with a defined width of 0 will show their entire content, while the columns with a defined width greater than 0 will have the defined width.

CHAPTER 7. LAB - CUR_LI CHART

1. GENERALITIES

This chapter describes the particularities of the display of the liquidity index versus remoulded shear strength chart. This chart is presented as a display zone of points (liquidity index as a function of the remoulded shear strength) that corresponds to the **CUR_LI** graph.

The graphs are defined in the style file by their number, their name and their graphic characteristics.

2. CUR_LI GRAPH

2.1. Definition of the CUR_LI graph

Lab produces points on the chart by reading data in the **CUR_LI** view.

The X-axis of the chart is logarithmic. Its lower limit must be greater than 0. The Y-axis of the chart is linear.

2.2. Predefined curve of the CUR_LI graph

The curves editing window for the CUR_LI graph, illustrated in figure 7-1, shows only one predefined curve, the **H&M** curve.

2.2.1. H&M curve

The **H&M** curve shows the Houston & Mitchell Relationship.

The drawing attributes that can be edited are the line for the H&M curve and the marker along the curve.

2.3. Legend of the CUR_LI graph

By default, the order in the **Order** column of the **H&M** curve is **0**. By changing the order value to a value greater than **0**, this curve can be displayed in the legend of the graph.

If we check the upper box **Legend Visible** of the curves editing window opened on the **CUR_LI** graph, the legend of this graph will be displayed. It will show the predefined curve if its order number is positive, followed by as many symbols of points as there are **Sample_x** symbols defined in the **Symbol** panel of the options window (see paragraph 4.10.2 of chapter 1). The **Sample_n** symbol is never shown in the legend.

In the legend, the label of the predefined curve is the expression in its title; the label of the points of limits is made of the site, boring and sample numbers separated by a space. The site number is not displayed if the points are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

Clicking on the button left of the **Legend** label opens the drawing attributes configuration window where it is possible to define the attributes of the text, background and border of the legend.

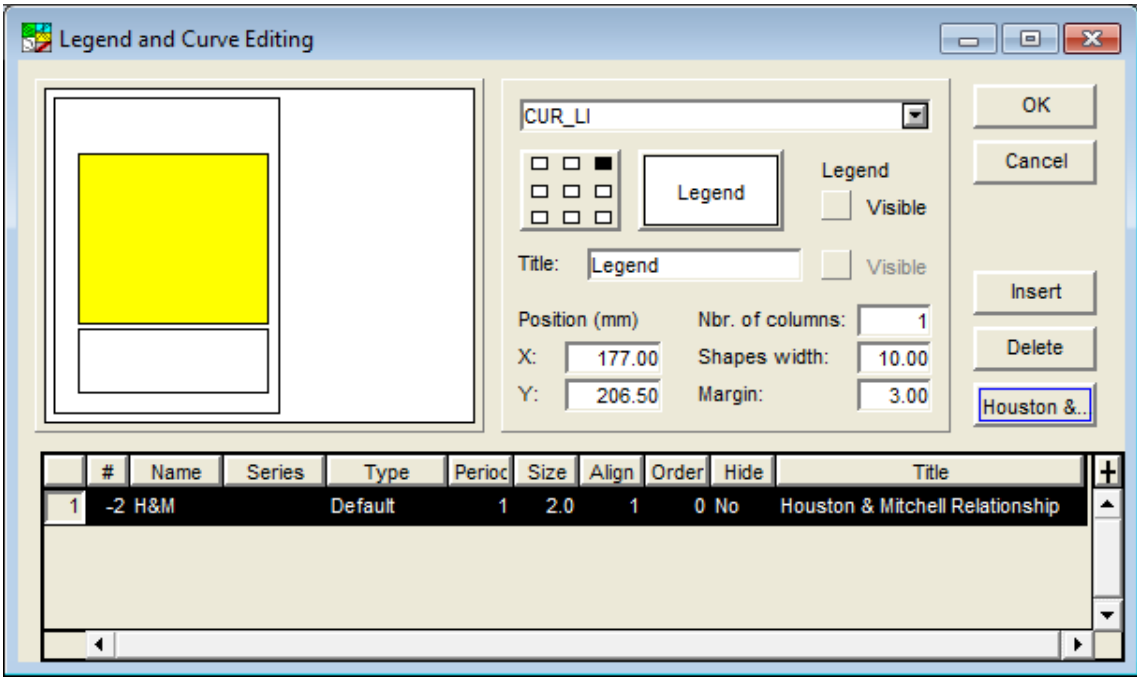


Figure 7-1 - Curve of the CUR_LI graph

2.4. Points to display: choice, representation and presence in the tables

The **Symbol** panel, shown in figure 7-2**,** is used to select the points to be displayed in the graphs, to define their presence in the tables of significant values and to define their drawing attributes. It is presented in details in paragraph 4.10 of chapter 1.

2.4.1. Sample curves

The **CUR_LI** graph, as well as the **GRAIN_SIZE_POINT**, **GRAIN_SIZE**, **PROCTOR_POINT**, **PROCTOR**, **CONSOLIDATION_POINT**, **CONSOLIDATION** and **LIMITS** graphs, shows all the samples that have results associated in the graphs present in the style file. The display of the points for these samples is defined with the **Sample_x** rows in the **Symbol** panel. The expression "**Sample**_" is reserved and cannot be modified. See paragraph 4.10.2 of chapter 1.

3. TABLE_*N* GRAPHS OF SIGNIFICANT VALUES

The eventual **TABLE_1**, **TABLE_2** and **TABLE_3** graphs can show information of the chart such as the values of LI and CUR. The detailed description of these graphs is done in chapter 6. There are no specific results for the chart in the **Table 1**, **Table 2** and **Table 3** panels of the options window.

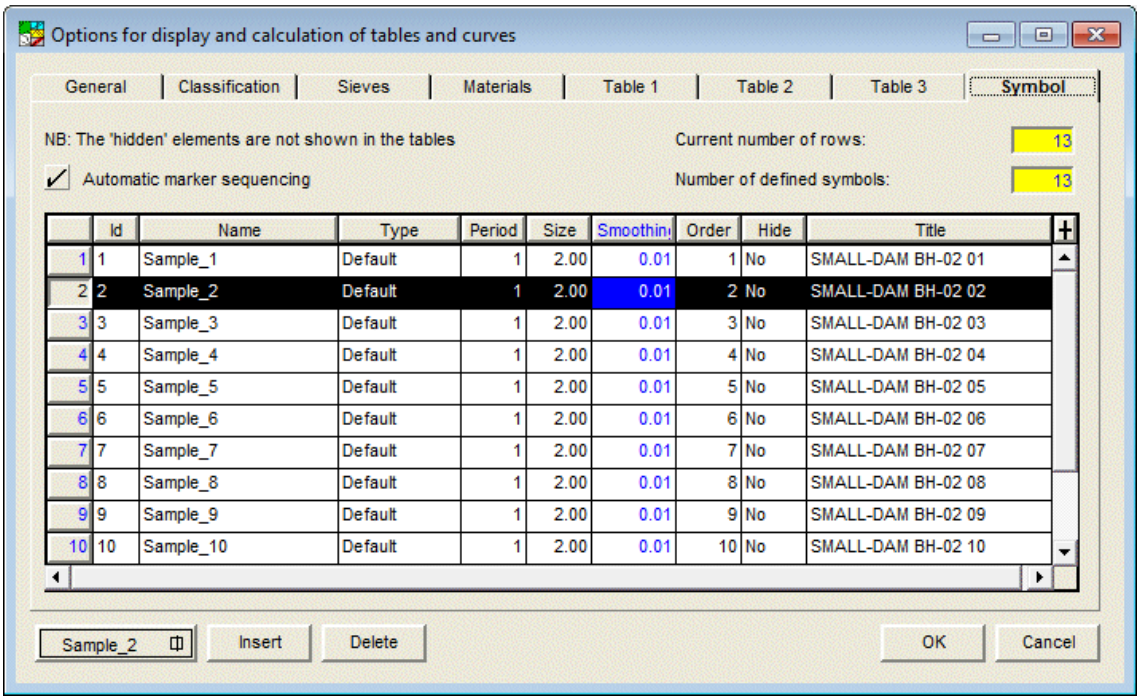


Figure 7-2 - Symbols definition panel

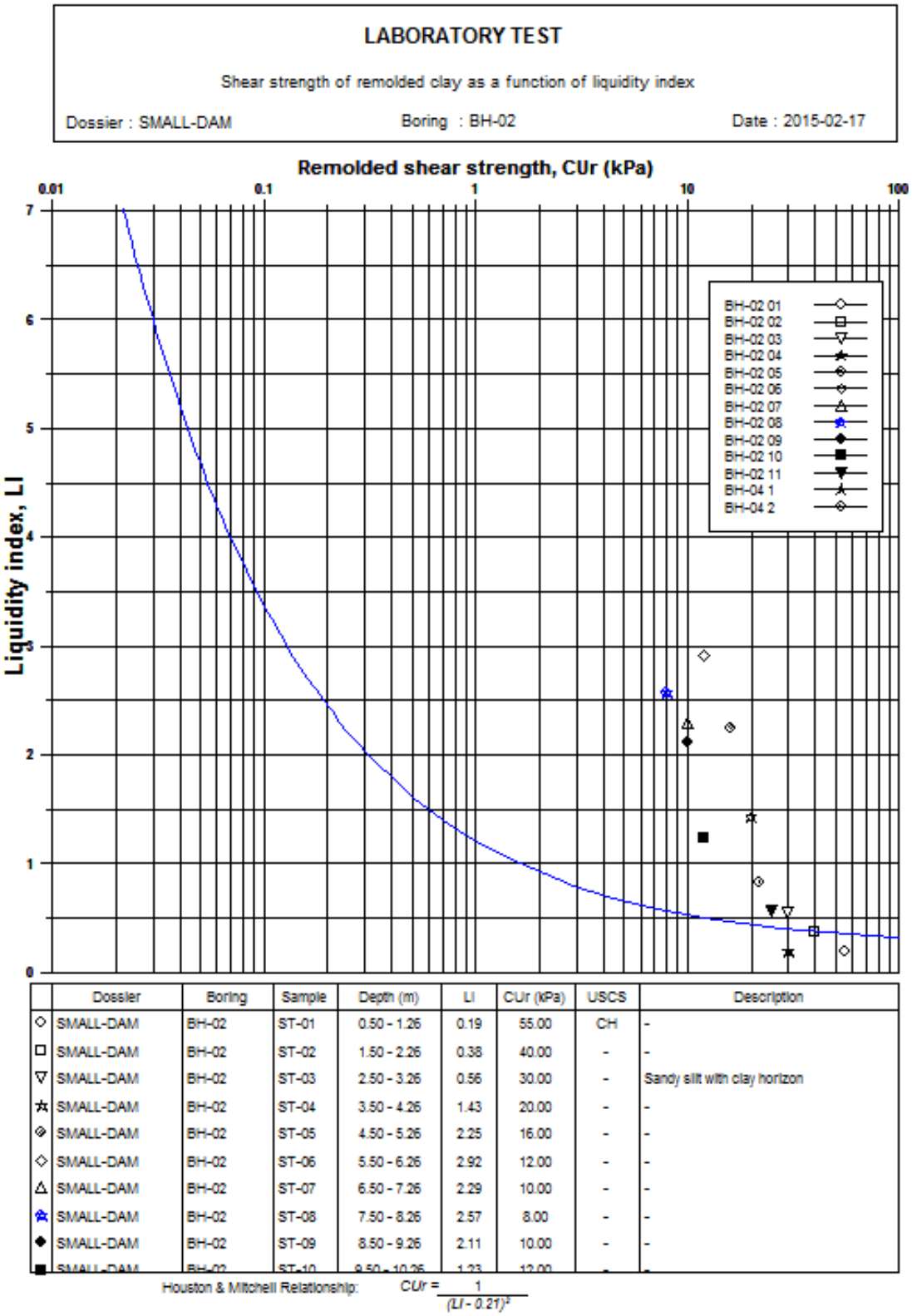
4. KEYWORDS SPECIFIC TO THE CUR_LI CHART

When data of the CUR_LI chart are read, values are assigned to a series of keywords specific to the chart. The following table shows the series of keywords:

Keywords	Meaning
Cur_Site_Nbr	Number of sites read in the query
Cur_Site_List	List of sites read in the query
Cur_Site_List_N	List of sites read in the query with the number of samples with chart data and belonging to each site
Cur_Boring_Nbr	Number of borings read in the query
Cur_Boring_List	List of borings read in the query
Cur_Boring_List_N	List of borings read in the query with the number of samples with chart data and belonging to each boring
Cur_Sample_Nbr	Number of samples read in the query
Cur_Sample_List	List of samples read in the query

In the lists of sites, borings or samples, the numbers are separated by a comma and a space. The site number is not displayed if the curves are all from borings belonging to the same site. Similarly, the boring number is not displayed if all the samples are from the same boring.

5. EXAMPLE OF A CUR_LI CHART



	Dossier	Boring	Sample	Depth (m)	LI	CUr (kPa)	USCS	Description
◇	SMALL-DAM	BH-02	ST-01	0.50 - 1.26	0.19	55.00	CH	-
□	SMALL-DAM	BH-02	ST-02	1.50 - 2.26	0.38	40.00	-	-
▽	SMALL-DAM	BH-02	ST-03	2.50 - 3.26	0.56	30.00	-	Sandy silt with clay horizon
☆	SMALL-DAM	BH-02	ST-04	3.50 - 4.26	1.43	20.00	-	-
◈	SMALL-DAM	BH-02	ST-05	4.50 - 5.26	2.25	16.00	-	-
◇	SMALL-DAM	BH-02	ST-06	5.50 - 6.26	2.92	12.00	-	-
△	SMALL-DAM	BH-02	ST-07	6.50 - 7.26	2.29	10.00	-	-
★	SMALL-DAM	BH-02	ST-08	7.50 - 8.26	2.57	8.00	-	-
◆	SMALL-DAM	BH-02	ST-09	8.50 - 9.26	2.11	10.00	-	-
■	SMALL-DAM	BH-02	ST-10	9.50 - 10.26	1.23	12.00	-	-

Figure 7-3 - Example of a CUR_LI chart