BAKHTI SOFTWARE



CiviLab 2027

User manual — Civil engineering and geotechnical laboratory software

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1. Introduction

1.1 What CiviLab is for

CiviLab 2027 is civil engineering and geotechnical laboratory software developed by **Dr. Bakhti Rachid** and published by **Bakhti Software**. It brings together, in a single project, the data entry, calculation, checking and layout of every test in a study, from the site to the office:

Family	Tests and calculations	Chapter
In-situ tests	Drill hole log (templates A and B), dynamic probing (DPT), Menard pressuremeter test (curves, calibrations, profiles), cone penetration test (CPT / CPTu), SPT	7 to 11
Laboratory tests	Grain size distribution (sieving and hydrometer), Atterberg limits, sand equivalent, Micro-Deval, Los Angeles	12 to 16
Mechanical tests	Proctor, CBR (single test and group of tests), direct shear, triaxial test, oedometer test	17 to 21
Concrete	Dreux-Gorisse, Bolomey, Faury and ACI 211.1 mix design; compression; ultrasonic testing; rebound hammer; SonReb combined method	22 to 26
Roads	Bitumen extraction (Kumagawa), bulk density of bituminous specimens, in-situ density	27
Foundations	Bearing capacity (c-φ, pressuremeter, DPT, CPT, SPT), settlement (oedometer, pressuremeter, linear elasticity), modulus of subgrade reaction	28 to 30
Stability	Slope stability (Bishop, Spencer, Morgenstern-Price; RPA 2024 earthquake; NF P 94-270)	31
Nourin	Geotechnical agent: checking, interpretation, foundation calculations, reports	31

Each test produces a **sheet** (test report) laid out on A4, with the laboratory header, project data, graphs, result tables and the standard applied, ready to print or export to PDF.

1.2 The typical workflow

Step	Where	What you do	Result
1	**File > New project**	Create the project and enter its **general information** (client, location, zones, units)	`.cvb` project
2	**File > Header**	Import the laboratory header (685 × 135 px image)	Header on every sheet
3	**Device** buttons	Declare the equipment: sieves, penetrometers, pressuremeter probes, calibrations	Reusable devices
4	**Test tab > Data**	Enter the measurements of each test and locate it on the map	Calculated tests
5	**Test tab > Sheets**	Create the test sheet	Laid-out test report
6	**Bearing capacity**, **Settlement**	Calculate foundations from the tests	Calculation notes
7	**Nourin**	Check, interpret, write reports	Interpretations and Word reports
8	**Home > Outputs**	Summary, PDF / PNG export, printing	Test file

> **Tip:** objects depend on one another: a sheet relies on a test, a pressuremeter test on calibrations, a profile on tests, a bearing capacity note on a profile. CiviLab therefore refuses to delete an element used elsewhere (for example “Cannot delete this test: Test already used in a sheet”). Delete objects in the reverse order of their creation.

1.3 Conventions used in this manual

- Interface labels are written **in bold**, as they appear in the English version.
- A command path is written **Tab > Group > Button**; for example **in-situ Tests > Pressuremeter test > Profiles**.
- The **Tip**, **Warning** and **Note** boxes give advice, flag a risk of error or add detail.

- The units shown are **SI** units; in the **FPS** system, CiviLab automatically shows the corresponding imperial units (ft, in, lb, psi, pcf).
- The screenshots come from CiviLab 2027; depending on the version, some presentation details may differ.

2. Installation and first start

2.1 System requirements

- Windows 10 or Windows 11, 64-bit.
- .NET 8 Desktop Runtime (installed with CiviLab).
- Screen of at least 1366 × 768; 1920 × 1080 recommended.
- An Internet connection for licence activation, update checks, location maps and Nourin.

2.2 Activating the licence

On first start, CiviLab asks for your **Serial number**:

1. Enter the **Serial number** received on purchase, then the **Lab / Company** name that will appear on the sheets.
2. Click **Activate**. The message “Activation successful, restart CiviLab” confirms activation.
3. Restart CiviLab.

Without an Internet connection, use **Offline activation**: CiviLab creates an **Activation Request file** to send to us; we return an **Activation response file** to load in the same window.

Message	Meaning
Activation failed, check your serial number	Wrong serial number, or already used on another computer
Unable to verify your license, please make sure you are connected.	No connection to the licence server
Your subscription will expire after ... day(s)	Expiry is approaching: remember to renew
Your license has expired. Please contact us to renew it.	The licence is no longer valid

> **Note: About...** shows the CiviLab version, the licence granted and its validity date.

2.3 Choosing the interface language

CiviLab is available in **English**, **French**, **Spanish** and **Italian**.

1. Open **File > Language**.
2. Choose the language in the list, then click **Save**.

The interface, the system layer names and the sheets update immediately; the choice is kept for later sessions (file `Documents\CiviLab\CiviLab.config`).

> **Note:** the comments written by Nourin are produced in French or English; with a Spanish or Italian interface, Nourin answers in English.

2.4 Updates

At each start, CiviLab checks whether a new version exists. If so, the message “A new update of CiviLab is available” offers to **Download** it. A project saved with an earlier version opens in the new version.

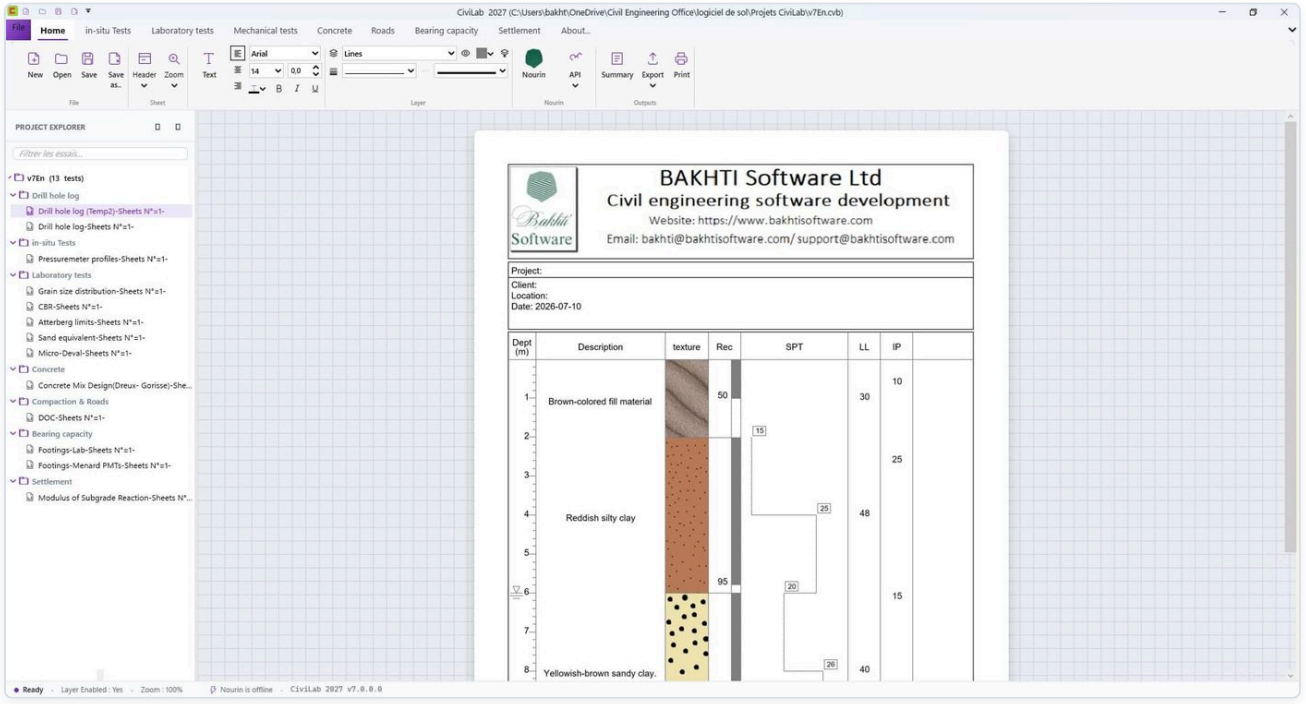
> **Warning:** the reverse is not always true. A project saved with CiviLab 7.1 may contain elements (for example a manually entered pressuremeter profile) that an older version cannot read: “Cannot open this file, make sure you have the latest version of CiviLab”.

3. The interface

3.1 Overview

The main window contains:

- the **File button** (top left): project, export, general information, header, language, help;
- the **quick access toolbar**: new, open, save, save as;
- the **ribbon**, with one tab per family of tests;
- the **PROJECT EXPLORER** (left): the tree of the project's sheets, sorted by family, with a filter box;
- the **drawing area** (centre): the active sheet, as it will be printed;
- the **Nourin panel** (right, hidden by default);
- the **status bar** (bottom): **Ready**, **Layer Enabled**, **Zoom** level, Nourin state (**Nourin is online** / **Nourin is offline**) and CiviLab version.



CiviLab 2027 screen — The interface

3.2 The ribbon tabs

Tab	Groups and buttons
Home	File (New, Open, Save, Save as..); Sheet (Header, Zoom); Text (font, size, alignment, bold, italic, underline, colour); Layer (active layer, visibility, colour, line type and thickness); Nourin (Nourin, API); Outputs (Summary, Export, Print)
in-situ Tests	Drill hole log (Data, Sheets); Drill hole log Temp2 (Data, Sheets); DPT; Pressuremeter test (Curves, Device, Sheets, Profiles, Sheets); CPT; SPT
Laboratory tests	Grain size distribution; Atterberg limits; Sand equivalent; Micro-Deval; Los-Angeles
Mechanical tests	Proctor; CBR (Data, Sheets, Group, Sheets); Shear test; Triaxial; Oedometer test
Concrete	Dreux-Gorisse; Bolomey; Faury; ACI; Compression; Ultrasonic; Rebound hammer; Combined method
Roads	Bitumen Extraction; Density; In-situ density
Bearing capacity	Laboratory tests; Pressuremeter test; Dynamic probing; CPT; SPT
Settlement	Oedometer test; Pressuremeter test; Linear elasticity; Modulus of Subgrade Reaction
Stability	Slope stability
About...	Help; About...

Each test group contains at least two buttons:

- **Data**: opens the entry and calculation window for tests of this type;
- **Sheets**: opens the window that creates and edits sheets of this type.

3.3 The project explorer

The explorer lists the project's sheets, sorted by family (Drill hole log, in-situ Tests, Laboratory tests, Concrete, Compaction & Roads, Bearing capacity, Settlement). Clicking a sheet shows it in the drawing area and passes it to Nourin as the working **context**. The filter box narrows the list to the sheets whose name contains the text typed; ↻ **Refresh** reloads the tree.

3.4 The drawing area

The drawing area shows the active sheet as it will be printed (A4 format). The mouse wheel scrolls the page; **Home > Sheet > Zoom** offers levels from 25 % to 1000 %. On the sheet you can add texts, lines, rectangles, images and arrows, each placed on a **layer** (chapter 6).

4. Managing projects

4.1 The CiviLab project (.cvb)

A CiviLab project is a single **.cvb** file (*CiviLab Workbook*) holding the general information, the devices, all the tests and all the sheets.

Command	Where	Effect
New project	File, quick access, **Home > File > New**	Closes the current project (after confirmation) and creates an empty project
Open Project	File, quick access, **Home > File > Open**	Opens a .cvb file
Save Project	File, quick access, **Home > File > Save**	Saves to the current file (“The project is saved”)
Save project under ...	File, quick access, **Home > File > Save as..**	Saves under another name

On closing, CiviLab asks “Do you want to save the project?” if changes have not been saved. Devices (sieves, penetrometers, probes) and the language are also kept in the CiviLab configuration, so that they are available in later projects.

> **Warning:** images (borehole photos, imported headers) are referenced by their path. If you move the project to another computer, copy the images too; otherwise the message “One (or more) image (s) is not in the saved path” appears on opening.

4.2 The project general information

File > The project general informations opens the project form, in three parts.

General — Project identification. This information appears in the header of the test reports:

Field	Example
Project name	Geotechnical study, North industrial zone
Project No.	Ref 004/2022
Client	EGN Ltd
Phone, **Fax**	Client contact details

Field	Example
Location	City, province
Unit system	**SI (kN, m, kPa)** or **FPS (lb, ft, psi)**
Automatically copy test information	Carries the information (source, tested by, checked by…) of the last test of the same type into a new test

Zones. Each zone (for example “Zone I — Main Building”) groups tests of the project; Nourin organises the geotechnical report by zone.

1. Click **+ Add zone** and enter its **Caption** (description).
2. Select the zone in the list, then click on the map: each click adds a vertex of the outline (latitude and longitude shown).
3. Click ✓ **Close polygon** to finish, or ✕ **Clear** to start again; **Remove** deletes the zone.

Location. Search for an address… then **Search** centres the map; a click places the project marker; **Delete marker** removes it. Click **Save** to confirm the form, or **Cancel**.

4.3 The laboratory header

Every sheet carries your laboratory header:

- **File > Header > Import** (or **Home > Sheet > Header > Import Header**) loads an image of **685 × 135 pixels**: logo, company name, address, phone, e-mail, website;
- **Edit Header** replaces it.

If no header is found, CiviLab shows “Could not find header, please import it”.

> **Tip:** prepare the header in a drawing program at exactly 685 × 135 pixels; an image of another size is distorted.

4.4 Exporting and printing

The **Home > Outputs** group contains:

- **Summary**: the summary sheet of the file, listing the project’s sheets;
- **Export**: **Export as PDF file** or **Export as PNG file** (also in the **File** button);
- **Print**: prints the active sheet or the chosen sheets.

4.5 US units (FPS system)

When the project **Unit system** is **FPS**, CiviLab uses the units in use in the United States (ASTM / AASHTO standards):

Quantity	SI	USA (FPS)
Depths (logs, CPT, SPT, DPT, profiles, foundations)	m	ft
Drop height, penetration step (DPT, SPT)	cm	in
Tip area (DPT), cone and sleeve area (CPT)	cm^2	in^2
Laboratory masses (grain size, Atterberg, LA, MDE, water contents)	g	g
Proctor masses (mould, mould + soil), hammer, concrete specimens	g / kg	lb
Unit weight, dry density	kN/m^3	pcf (lb/ft^3)
Concrete failure load	kN	lbf
Concrete strength (compression, rebound hammer, ultrasonic)	MPa	psi
Tip and sleeve forces (CPT)	kN	ton (short ton)
qc, fs (CPT)	MPa, kPa	tsf
rd, qd (DPT)	bar, MPa, kPa	psi
CBR: pressure (ASTM, AASHTO) / load (NF, BS, NA)	MPa / kN	psi / lbf
CBR references at 0.1 and 0.2 in	6,9 / 10,3 MPa ; 13,35 / 19,93 kN	1000 / 1500 psi ; 3001 / 4480 lbf
Direct shear: displacement, force, stress	mm, N, kPa	in, lbf, psi
Triaxial test: height, force, stress, volume	mm, N, kPa, cm^3	in, lbf, psi, in^3
Foundation stresses, settlements	kPa	psf
Oedometer stress σv	bar	psf
Modulus of subgrade reaction	MN/m^3	pci
Pressuremeter test, ultrasonic (distance, velocity)	MPa, cm^3 ; cm, m/s	identique (SI admis par ASTM D4719 et C597)

Changes in 7.1: depths are in **ft** (formerly yards); for the DPT, the drop height, penetration step and tip area are entered in **in / in²** (formerly ft / ft²); for the CPT, the areas Ac and As are entered in **in²** (formerly ft²); concrete compression is calculated in **psi** from the load in **lbf** (6×12 in and 4×8 in specimens); the CBR load references are **3001 / 4480 lbf** (corrected). In an older FPS project, check these values before recalculating.

5. Common principle: data, location, sheets, devices

All tests follow the same principle: **Data** to enter and calculate, **Sheets** to lay out.

5.1 The data window

1. Click the **Data** button of the test group.
2. In the **Test No.** list, type a new name (CiviLab suggests "... N°=1", "... N°=2"...) or choose an existing test to edit it.
3. Fill in the **Test date**, the **Standard**, the **Layer** (**+** or **+ Layer** button to create one) and the fields specific to the test.
4. Enter the measurements in the tables. Tables accept **pasting from Excel** (**Ctrl+V**) and **importing / exporting Excel or CSV files** (section 5.6).
5. Click **Add/Modify**: CiviLab checks the data, calculates the test and stores it in the project ("Operation achieved").

The **Remove** button deletes the chosen test, if no sheet or other test uses it.

Message	Cause
Please insert the name correctly	Empty or invalid test name
Please select layer	No layer chosen
Please select the standard	No standard chosen
Please add the measures	Empty measurement table
Error: Insert the correct data, please	Non-numeric or inconsistent value
Unacceptable value	Value outside the permitted range
Unable to generate the curve; less than three points are provided	Too few points for the curve

5.2 Test information and location

The **Data** button at the bottom of most test windows opens the **Test data** form:

- **Test data**: **Field / Value** table (title, sample No., source, depth, tested by, checked by...), carried into the sheet header;
- **Location**: **Caption (map)** (title shown on the map), **Zone No.** (project zone), **Coordinates**;
- the map: **Search for an address...**, click to place the test, **Delete marker**. The project zones and the other tests are shown on it.

The coordinates are used for the borehole location figure and Nourin's geotechnical report.

5.3 The sheets window

1. Click the **Sheets** button of the test group.
2. Enter the sheet **Name**; it must be unique in the project ("This name is already used in another sheet").
3. Tick the test(s) to show. Some sheets accept only one test ("Cannot choose more than one test"); others overlay several tests (grading curves, Proctor curves...).
4. Set the options: **Font**, **Display general project informations**, **Display device specifications**, **Grid**, and the options specific to the test.
5. Confirm: the sheet appears in the project explorer and in the drawing area.

To edit a sheet, reopen the window and choose the sheet in the list. **Inherit texts from** reuses the titles and comments of another sheet.

5.4 Devices

Laboratory equipment is declared once and reused in every test:

- **Sieves** and sieve series (grain size distribution, chapter 12);
- **Dynamic penetrometers** (chapter 8);
- **Pressuremeter probes** and volume and pressure **calibrations** (chapter 9).

A device used by a test cannot be deleted ("Cannot delete this device: device already used in a test").

5.5 Displaying, reading and printing the report

To display the report of a test, click the name of its sheet in the project explorer. All test sheets share the same layout:

1. **Sheet header**: laboratory logo and contact details; to import or modify it, click **Home > Header**.
2. **Project name and reference**, client, location and date: taken from the **project general data** (**File** menu).
3. **Test information area**: filled from the **Test data** form (**Data** button of the entry window, see 5.2) and the project general data.
4. **Curve area**: the charts of the test.
5. **Results area**: tables and computed values, with the conclusion when requirements were entered.

6. **Device specifications** (penetrometers, pressuremeter probe...) when the option is checked in the sheets window.

To print or export the report, click **Home**, then **Print** or **Export** (PDF or PNG) in the **Outputs** group.

« Test data » pages

When the sheet of a test does not show all the measurements, CiviLab automatically adds one or more A4 « Test data » pages. They contain the entered data and the calculated values, with the same columns and units as the data entry window. They carry the laboratory header and the project data. If one page is not enough, the tables continue on the following pages, marked « (continued) » with the headers repeated.

Tests concerned: DPT, pressuremeter (curve and profile), CPT, SPT, Atterberg limits, Proctor, CBR, direct shear, triaxial, oedometer and geotechnical cross-section.

- **On screen**: all the pages are displayed one below the other, as in a word processor. Scroll to move from one to the next. The status bar at the bottom of the window shows the visible page (« Page n/N »).
- **Printing**: all the pages are printed, each in its own orientation (A3 landscape for the cross-section, A4 portrait for the data).
- **PDF export**: a single file contains all the pages. **PNG export**: the displayed page.
- **AGS4 export** (AGS 4.1.1 data transfer format, SI projects): **Export > AGS4** lists the tests with their borehole (LOCA_ID) and depth, read from the test data table (rows “Borehole” and “Depth”; otherwise borehole = layer name). Fill in empty cells, then **Export...**: a .ags file is written (groups PROJ, TRAN, LOCA, GEOL, SAMP, LLPL, GRAG/GRAT, CMPG/CMPT, CBRG/CBRT, SHBG/SHBT, TRIG/TRIT, TREG/TRET, CONG/CONS, ISPT, DPRG/DPRB, PMTG/PMTD; EM modulus as user-defined heading PMTG_EM declared in DICT). Incomplete tests are not exported. The file was checked with the official AGS validator (python-ags4). Not exported: CPT (qc and fs calculation to be confirmed), concrete and asphalt tests, foundations and settlements (no AGS4 group).
- The « Page n/N » number is printed at the bottom right.
- **Turning the pages off**: in the sheet window, untick **Add the « Test data » pages**. The choice is made for each sheet and is saved with the project.

5.6 Importing and exporting the measurements (Excel / CSV)

Above the measurement table of each test window, a bar offers:

- 📥 **Import Excel…**: fills the table from an **Excel (.xlsx, .xlsm)** or **CSV / text (.csv, .txt)** file;
- 📤 **Export Excel…**: saves the table (all displayed columns, with their titles) as **.xlsx** or **.csv**;
- ▶ **Calculate**: recalculates all the rows (added to the windows that had no calculation button).

Layout of the file to import

1. Only the **first sheet** of the workbook is read.
2. **Row 1 contains the column titles**: it is not imported.
3. From row 2, **one row = one row of the table**. Empty rows are ignored.
4. The columns of the file fill, **in order**, the **editable columns** of the table (see the table below). Calculated columns (greyed out in CiviLab) must not be in the file: they are recalculated.
5. Exception: if row 1 repeats **exactly the titles** of the CiviLab table (for example a file created with **Export Excel…**), the columns are recognised **by their title**, in any order, and the calculated columns of the file are ignored.
6. Numbers are written as in Excel (the decimal separator is the Windows one). In a CSV file, the column separator (semicolon, comma or tab) is detected automatically.
7. The **units** are those shown in the column titles of the window (metric or imperial system according to the project general data).
8. The .xls format (Excel 97-2003) is not read: save the file as .xlsx or .csv.

Check and calculation

Before importing, CiviLab shows a summary: number of rows, columns filled, current rows that will be replaced, and the detected anomalies (extra or missing columns, non-numeric cells). The import only takes place after your confirmation. The **test calculation then runs automatically**, and a message gives the number of rows imported. First fill in the window fields used by the calculation (total mass, mould volume, γd max, calibrations, device…).

Template files (one sheet with the title row) are supplied with the manual in the **Modeles Excel** folder.

Columns to provide for each test (in order):

Test	File columns (row 1 = titles)	Remarks
Drill hole log (template A)	Depth (m) ; Description ; Recovery (%)	The texture is then chosen in CiviLab.

Test	File columns (row 1 = titles)	Remarks
Drill hole log (template B)	Depth (m) ; Description ; Recovery (%) ; RQD (%)	
Column drill hole log	Depth (m) ; Description or value	For the selected column.
Dynamic penetrometer (DPT)	Number of blows	One row per penetration step; depth, rd and qd are calculated.
Pressuremeter test (Curves)	P15 (MPa) ; P30 (MPa) ; P60 (MPa) ; V15 (cm^3) ; V30 (cm^3) ; V60 (cm^3)	The calculation (EM, pf, pl) runs after the import.
Pressure or volume calibration	P (MPa) ; V60 (cm^3)	
Pressuremeter profile (manual entry)	Depth Z (m) ; Em (MPa) ; Pf* (MPa) ; Pl* (MPa)	
Cone penetration test (CPT / CPTu)	Z (m) ; Qc (kN) ; Qs (kN) ; u2 (MPa)	qc and fs are calculated.
SPT – measurements	Depth (m) ; N	CN, λ, N60 and (N1)60 are calculated.
SPT – soil layers	Thickness (m) ; Unit weight (kN/m^3)	
Grain size distribution	Partial retained (g)	One row per sieve, in the order of the chosen sieve set (the sieves are not replaced). Enter the total mass before importing.
Hydrometer – ASTM D7928	Time (min) ; Temperature (°C) ; Reading (rm) ; Reading (rd,m)	
Hydrometer – ASTM D422	Time (min) ; Reading (R) ; Temperature (°C)	
Hydrometer – NF P94-057	Time (min) ; Reading (R) ; Temperature (°C) ; Correction (Ct)	
Hydrometer – ISO 17892-4	Time (min) ; Reading (R) ; Temperature (°C) ; Reference reading (R0)	Readings as 1.030 or 30.0.
Atterberg limits	Number of blows (or cone penetration) ; Wet mass (g) ; Dry mass (g) ; Container mass (g)	The water content is calculated.
Sand equivalent	h1 (cm) ; h2 (cm)	SE is calculated.
Los Angeles	Dry mass retained (g)	Enter the sample mass before importing; LA is calculated.
Micro-Deval	Dry mass retained (g)	Enter the sample mass before importing; MDE is calculated.

Test	File columns (row 1 = titles)	Remarks
Proctor test	Mass of mould + soil (g) ; Wet mass (g) ; Dry mass (g) ; Container mass (g)	Enter the mould mass and volume before importing; water content and dry density are calculated.
CBR test	Load (kN) or pressure (MPa) depending on the standard ; Penetration (mm)	The curve and the CBR index are recalculated.
Direct shear (one normal stress)	ΔL ; Area ; T	Units as displayed in the window; τ is calculated.
Triaxial test (one specimen)	ΔH (mm) ; P (N) ; u (kPa) ; ΔV (cm^3)	Readings from the start of shearing; u for consolidated tests, ΔV for drained tests. Enter Hi, Di and σc of the specimen first.
Oedometer test	σv (bars) ; ΔH at each time (mm)…	One ΔH column per chosen time interval; e and the curve are calculated.
Concrete compression	Specimen No. ; Mass (kg) ; Load (kN)	The strength is calculated (kN → MPa / bar / kPa; lbf → psi).
Ultrasonic testing (one series)	Reference ; Distance (cm) ; Time (µs)	Velocity and strength are calculated.
Rebound hammer (one series)	Reference ; Rebound number	The strength is calculated.
SonReb combined method (one series)	Reference ; Rebound number ; Distance (cm) ; Time (µs)	Velocity, strength and mean are calculated.
In-situ compaction	Measurement No. ; Location (chainage) ; Position ; Water content (%) ; Dry density (t/m^3)	Enter γd max before importing; the compaction is calculated.
Oedometer settlement (layers)	ΔH (m) ; σ'v0 (kPa) ; Cc ; Cs ; e0 ; σ'p (kPa)	Columns depend on the chosen method (no Cs for the second method).

6. Layout: layers, texts and drawing

6.1 Layers

Each element of the sheet belongs to a layer. The system layers are **Lines**, **Rectangle**, **Texts**, **images**, **Curves**, **Graphs** and **Grid**; their names follow the interface language. Test graphs are placed on the **Graphs** layer by default.

The **Home > Layer** group lets you:

- choose the active layer;
- open the **Layers editor** (**Name**, **Color**, **Display**, line **Type** and **Thickness**);
- change the line type (**Solid**, **Dash**, **Dash - point**, **Dash - point - point**, **Point**), thickness and colour;
- show or hide a layer;
- add a layer.

A layer in use cannot be deleted (“Impossible to delete this Layer: one or more of elements are using this layer”), nor can the default layer.

> **Tip:** create one layer per type of information (for example a coloured “Proctor curves” layer and an “Annotations” layer) to hide or recolour a whole family of elements in one click.

6.2 Texts

1. Select a sheet (“Before you activate text mode, make sure to pick a sheet”).
2. Click **Home > Text > Text**, then click on the sheet.
3. Type the text; **Shift + Enter** adds a new line.

The **Text** group sets the font, size, alignment (left, centre, right), bold, italic, underline and colour. # 7. Drill hole log

7.1 Purpose

A drill hole log is the schematic vertical representation of the soil layers crossed by a borehole. CiviLab offers two templates:

	Drill hole log (templates A and B)	**Drill hole log (Temp2)**
Ribbon	**in-situ Tests > Drill hole log** (first group)	**in-situ Tests > Drill hole log** (second group)

	Drill hole log (templates A and B)	**Drill hole log (Temp2)**
Content	Lithology, thickness and description of the layers, groundwater, recovery, photos; template B adds RQD, WL, PI, SPT and comments	Log with free columns: you choose the columns, their order, width and type

7.2 Entering the log (templates A and B)

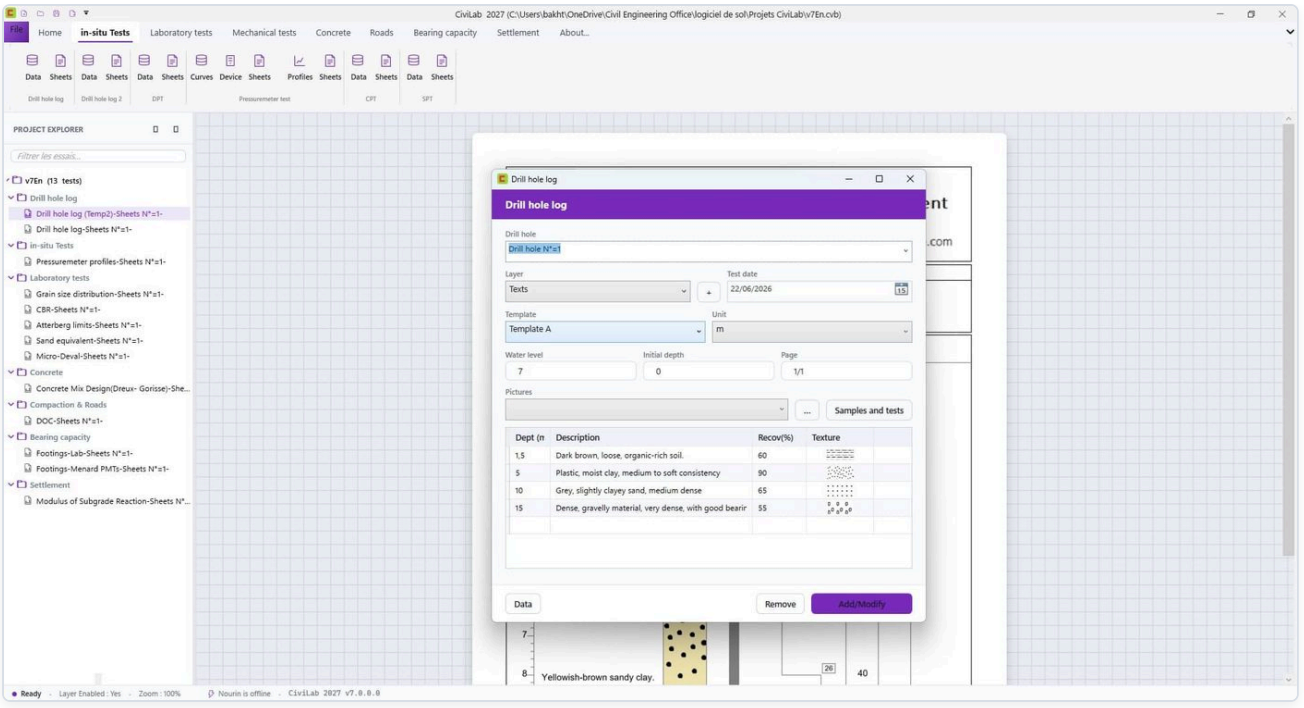
1. **Drill hole**: borehole name (for example BH01).
2. **Layer**, **Test date**, **Template** (**Template A** or **Template B**), **Unit** (m or ft).
3. **Water level**: groundwater depth (leave empty if none); **Initial depth**: top of the log (usually 0); **Page**: page number if the log spans several pages.
4. Layer table, one row per layer:

Column	Content
Depth (m)	Depth of the base of the layer
Description	Geological description (“Plastic clay, moist, medium to soft consistency”)
Recovery (%)	Core recovery of the run
RQD(%)	Rock Quality Designation (template B)
Texture	Lithological pattern, chosen from the library of standard textures

5. **Pictures**: add the photos of the core boxes, with their description (“Box N01”).
6. **Samples and tests** (template B): for each sample, the depth and the test results to show on the log (WL, PI, SPT blow count, comments).

Entry rules checked by CiviLab:

- “The depths must be greater than the initial depth”;
- “Depth values must be entered in ascending order”;
- “Recovery rates must be between 0% and 100%”;
- “RQD values must be between 0% and 100%”.



Data entry window — Drill hole log

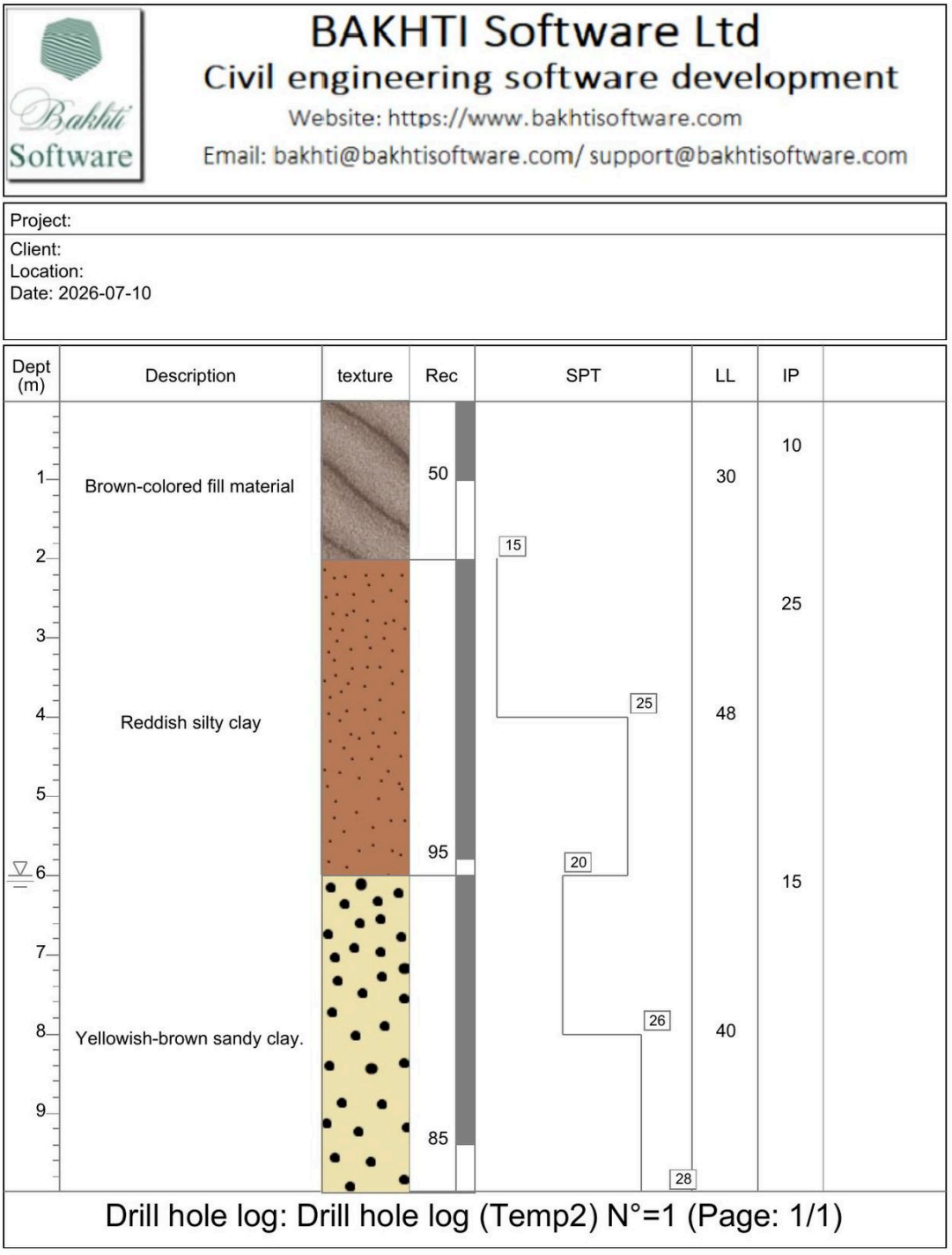
7.3 Column drill hole log (Temp2)

1. Fill in **Drill hole**, **Layer**, **Date**, **Unit**, **Water level**, **Initial depth** and **Final depth**.
2. **Add a column**: choose its **Type** (text, texture, recovery, graph, value…), its **Header**, its **Width** (mm), and whether the header or the text is vertical (**Header is Vertical**, **Text is Vertical**). A graph column can be drawn as a **Step chart**.
3. Enter the data of each column (depth, description, value).
4. **Rearrange** changes the column order (“Input the updated column number”).

Message	Cause
Please insert the header	Column without a header
Please insert the width	Column without a width
Please add column data	Empty column
The list of columns is empty	No column created
Please add measurements and descriptions	Empty layer table

7.4 The sheet

The sheet shows, from left to right: depth, lithology, description, photos (template A) or test columns (template B), groundwater and recovery, with the project header (client, location, date, source, depth, tested by). The borehole location (chapter 5.2) feeds Nourin’s location figure.



Test sheet — Drill hole log

7.5 Geotechnical cross-section (longitudinal profile)

The cross-section places several boreholes side by side, at their real distance and elevation, and connects the layers from one borehole to the next. Ribbon **In-situ tests ▸ Cross-section ▸ Data**, then **Page**.

Borehole coordinates. In the data table of each borehole log (**Descriptions** button), rename three rows **x**, **y** and **z** and enter the coordinates. **z** is the ground elevation. CiviLab also recognises the titles « elevation » and « altitude ». If X and Y are missing, they are calculated from the position placed on the map. Missing coordinates are requested on validation, and all remain editable in the cross-section window.

Dynamic cross-section. The cross-section follows its borehole logs. Each time the sheet is displayed or the cross-section is opened, the layers, depths, descriptions, textures, groundwater level and coordinates are taken again from the logs. What was entered in the cross-section (class, code, connection unit, parameters) is kept for layers whose type is unchanged.

Section tab: - name, layer, date and title (e.g. Section A–A′); - **layer type**: borehole log texture, or list of classes with their colours; - bottom elevation (automatic if blank); - display of the layer parameters, interface elevations and groundwater; - DXF vertical exaggeration.

Boreholes tab: - select the project logs, then **Add to section →**: their layers, groundwater level and coordinates are imported; - the table order is the order along the profile (▲ ▼). The **chainage** is the cumulative distance between successive boreholes; you can enter it; - for the selected borehole, the layer table gives the top, the bottom, the type or class, the code, the **connection unit** and the **parameters**, separated by « ; » (e.g. γ = 19 kN/m³ ; c′ = 12 kPa ; φ′ = 22°).

Soil classes tab: name, code and colour of the classes used in list mode. Click the colour swatch to choose it in the colour picker.

Layer connection

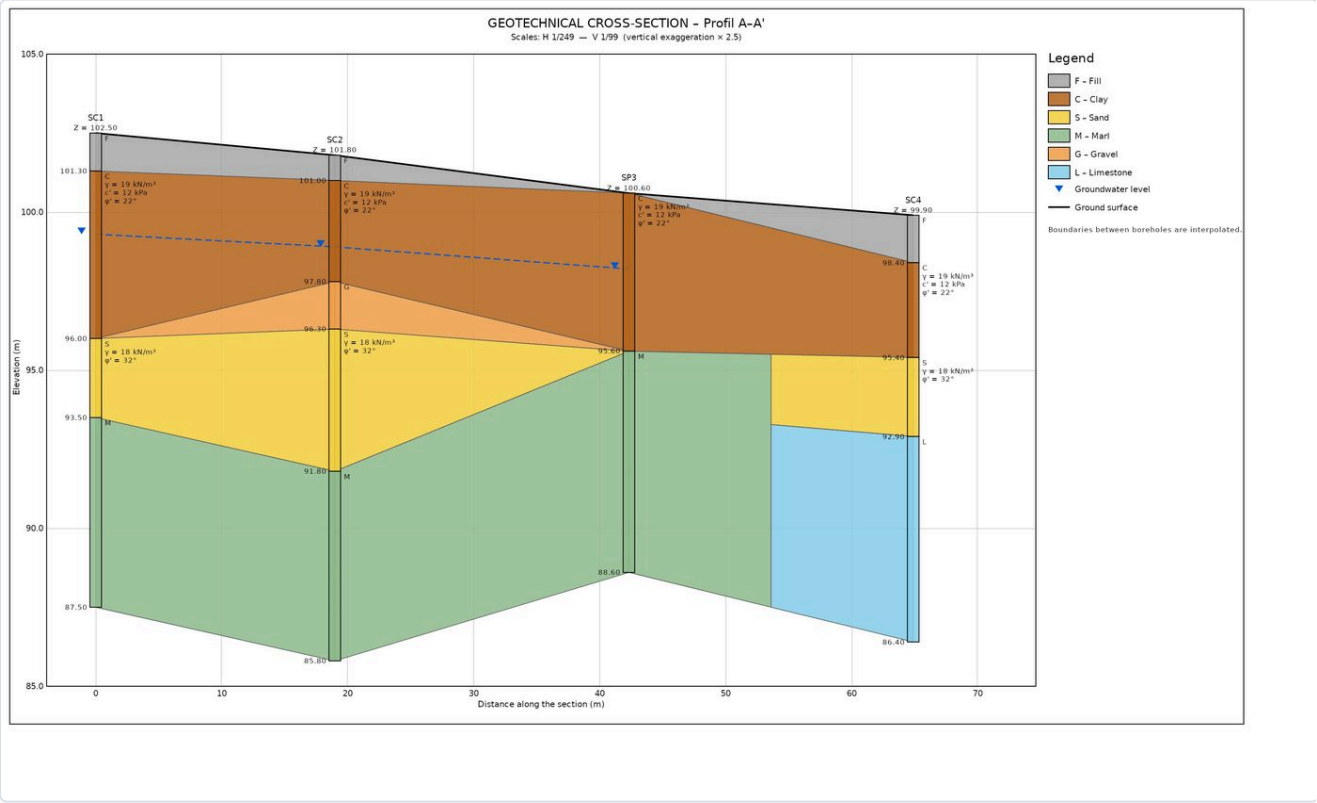
- Layers of the same **unit** are connected from one borehole to the next, in order (longest common sequence).
- A layer without a match ends **in a wedge** at the interface of the neighbouring borehole (lens).
- If both boreholes have unmatched layers at the same level, each one extends them to the middle of the interval.
- By default, the unit is the texture (texture mode) or the class (list mode). To correct the connection, change the unit of a layer. **Automatic connection** restores the default units.

The sheet is **A3 landscape**. It contains: - the layers filled with the texture or the colour; - the borehole columns with their name and ground elevation; - the interface elevations, and the code and parameters of each layer; - the ground surface and the

groundwater level connected between boreholes; - the elevation and distance grid, the horizontal and vertical scales with the exaggeration, and the legend.

Printing switches to landscape, on A3 if the printer offers it.

DXF export (📐 **Export DXF...** button). The file is in AutoCAD R12 format, in real coordinates: x = chainage, y = elevation, multiplied by the requested exaggeration. It contains: - one layer per soil unit, with filled areas; - the CONTOURS, SONDAGES, TERRAIN, NAPPE and TEXTES layers.



Test sheet — Drill hole log

8. Dynamic probing (DPT)

8.1 Purpose and standards

A string of rods fitted with a cone of known section is driven by a hammer falling from a fixed height, and the number of blows needed for each penetration step is counted. The test gives the dynamic resistance of the ground to penetration.

Standards: **NF P 94-114**, **NF P 94-115**, **NF EN ISO 22476-2**, **BS EN ISO 22476-2:2005**, **NA 5204**. Types: **DPL**, **DPM**, **DPH**, **DPSH-A**, **DPSH-B** (or Type A / Type B depending on the standard).

8.2 Declaring the penetrometer (Device)

In the test window, the **+** button next to **Device** opens the list of penetrometers:

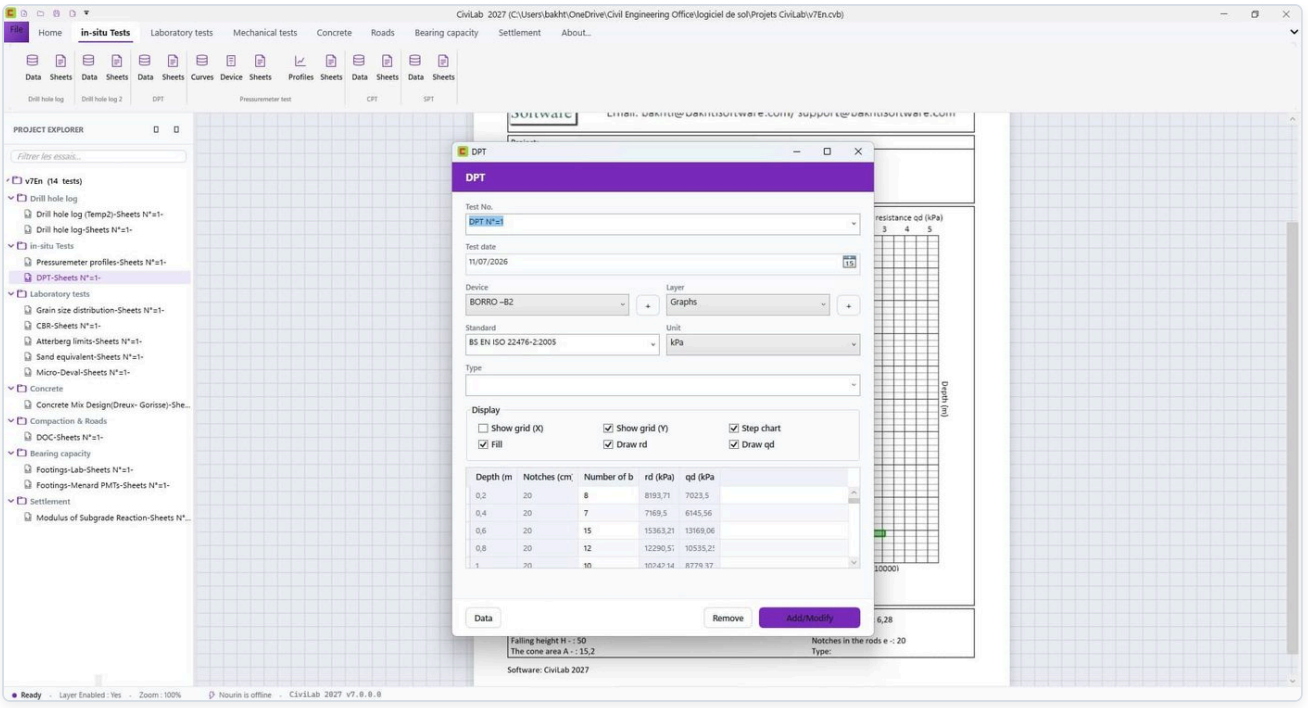
Field	Symbol	SI unit
Device Name	—	—
Hammer Weight	m	kg
Guide + Anvil weight	m′	kg
Rods Weight	m′ rod	kg/m
Falling height	H	cm
The cone area	A	cm²
Rods Length	L	m
Notches in the rods (measurement step)	e	cm

8.3 Entry and calculation

1. **Test No.**, **Test date**, **Device**, **Layer**, **Standard**, result **Unit** (**bar**, **MPa** or **kPa**), **Type**.
2. Enter the **Number of blows** for each step; the **Depth** and **Notches** are calculated from the device step.
3. For each step CiviLab calculates:

- the **unit point resistance**: rd = m · g · H / (A · e / N);
- the **dynamic point resistance** (Dutch formula): qd = rd · m / (m + m′), where m′ is the driven mass (guide, anvil and rods at the depth reached).

4. **Display**: **Show grid** (X and Y), **Step chart**, **Fill**, **Draw rd**, **Draw qd**.



Data entry window — Dynamic probing (DPT)

8.4 The sheet

The sheet shows three penetration logs side by side against depth: **Number of blows**, **Unit point resistance rd** and **Dynamic point resistance qd**, together with the device characteristics.

> **Note:** the DPT feeds the bearing capacity by the dynamic probing method (chapter 28.4) and Nourin.

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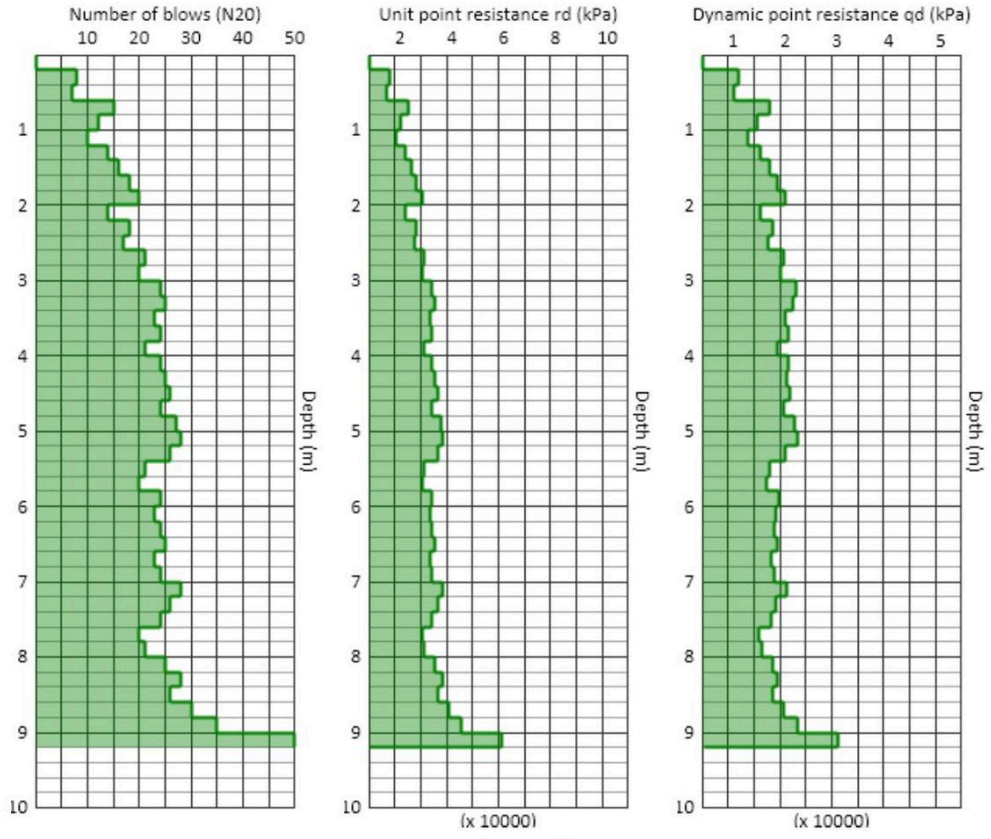
Civil engineering software development

Website: https://www.bakhtisoftware.com

Email: bakhti@bakhtisoftware.com/ support@bakhtisoftware.com

Project:

Client:
Location:
Date: 2026-07-11



Dynamic probing

BS EN ISO 22476-2:2005

Hammer Weight m - : 63,5	Rods Weight m'- : 6,28
Guide + Anvil weight m' - : 4,3	Rods Length -: 1
Falling height H - : 50	Notches in the rods e -: 20
The cone area A - : 15,2	Type:

Software: CiviLab 2027

Test sheet — Dynamic probing (DPT)

9. Menard pressuremeter test

9.1 Purpose and standards

The pressuremeter test measures the deformation and failure of the soil with a probe expanded in a borehole. For each depth it gives:

- the **pressuremeter modulus EM** (pseudo-elastic behaviour);
- the **creep pressure pf** (limit between the pseudo-elastic and the plastic range);
- the **limit pressure pl** (soil failure).

Standards: **ASTM D4719-87**, **NF P 94-110-1** and **NF EN ISO 22476-4** (ISO 22476-4:2012).

The test is handled in four steps, all in the **in-situ Tests > Pressuremeter test** group: **Device** (probe and calibrations), **Curves** (tests), **Profiles**, **Sheets**.

9.2 The probe

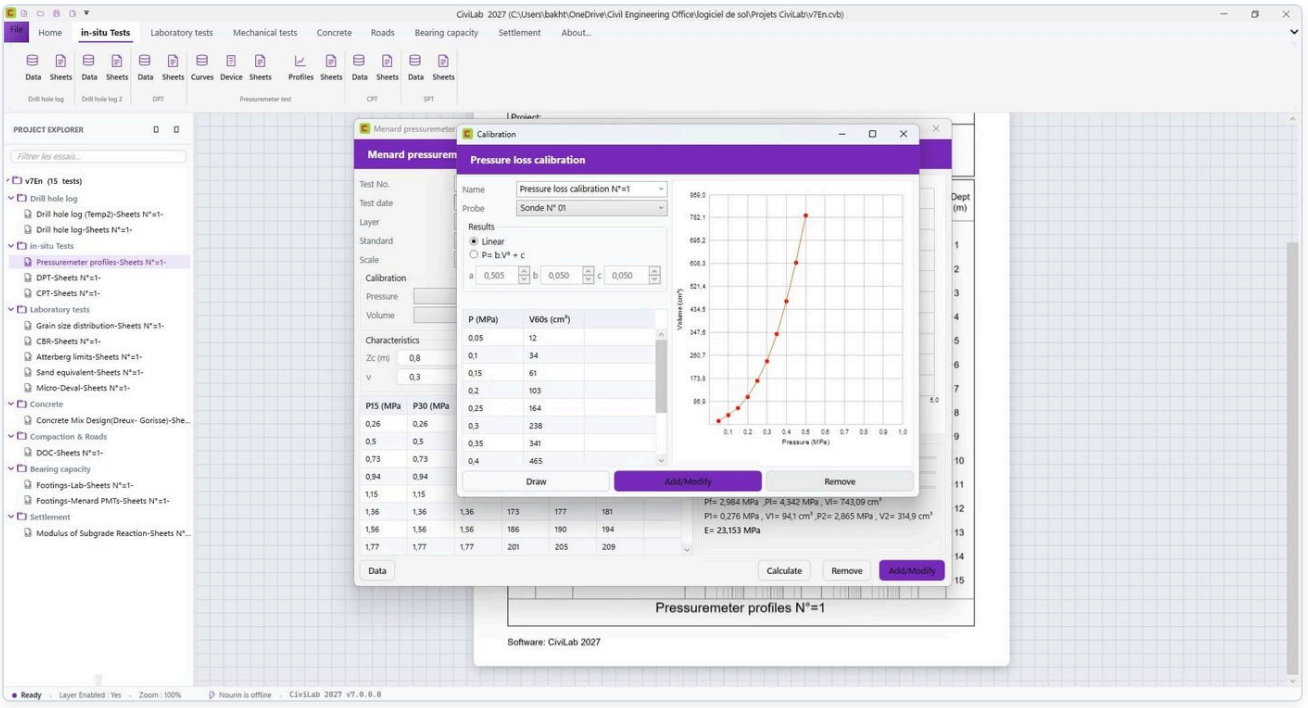
Device > Probe: **Name**, **Central cell length of the probe** (lss), **Guard cell length of the probe** (lg), **Diameter of the probe** (De). CiviLab calculates the volume of the central cell **Vc**.

9.3 Calibrations

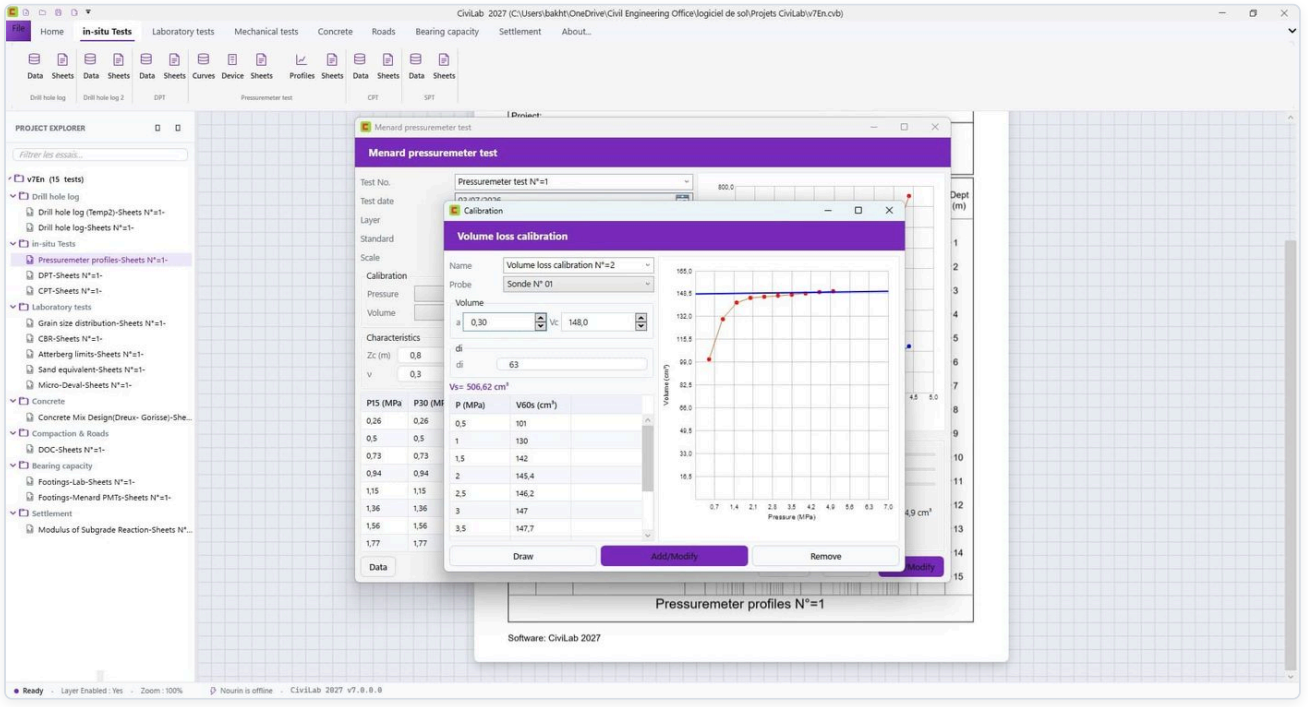
Pressure loss calibration (inherent pressure loss, probe inflated in open air): enter the pressure P (MPa) - volume V60 (cm^3) pairs and choose the model:

- **Linear**;
- non-linear: $\mathbf{P = b \cdot V^a + c}$ (CiviLab fits a, b and c).

Volume loss calibration (probe inflated inside a rigid tube): enter the P - V60 pairs and the **Calibration tube diameter**; CiviLab fits the line $\mathbf{V(P) = a \cdot P + Vc}$ and derives the expansion coefficient a of the equipment.



Data entry window — Menard pressuremeter test (pressure calibration)



Data entry window — Menard pressuremeter test (volume calibration)

9.4 Entering a test (Curves)

1. **Test No.**, **Test date**, **Layer**, **Standard**, **Creep pressure scale** (scale factor of the V60 - V30 creep curve).
2. **Calibration**: choose the **Pressure** calibration and the **Volume** calibration.
3. **Characteristics**:

Field	Meaning
Zc (m)	Control unit elevation: difference in altitude between natural ground and the control unit
Zw (m)	Groundwater depth
Zs (m)	Probe depth
ν	Poisson's ratio (usually 0.33)
K0	Coefficient of earth pressure at rest
σv (kPa)	Total vertical stress at probe level

4. Pressure step table: **P15**, **P30**, **P60** (MPa) and **V15**, **V30**, **V60** (cm^3).
5. Click **Calculate**.

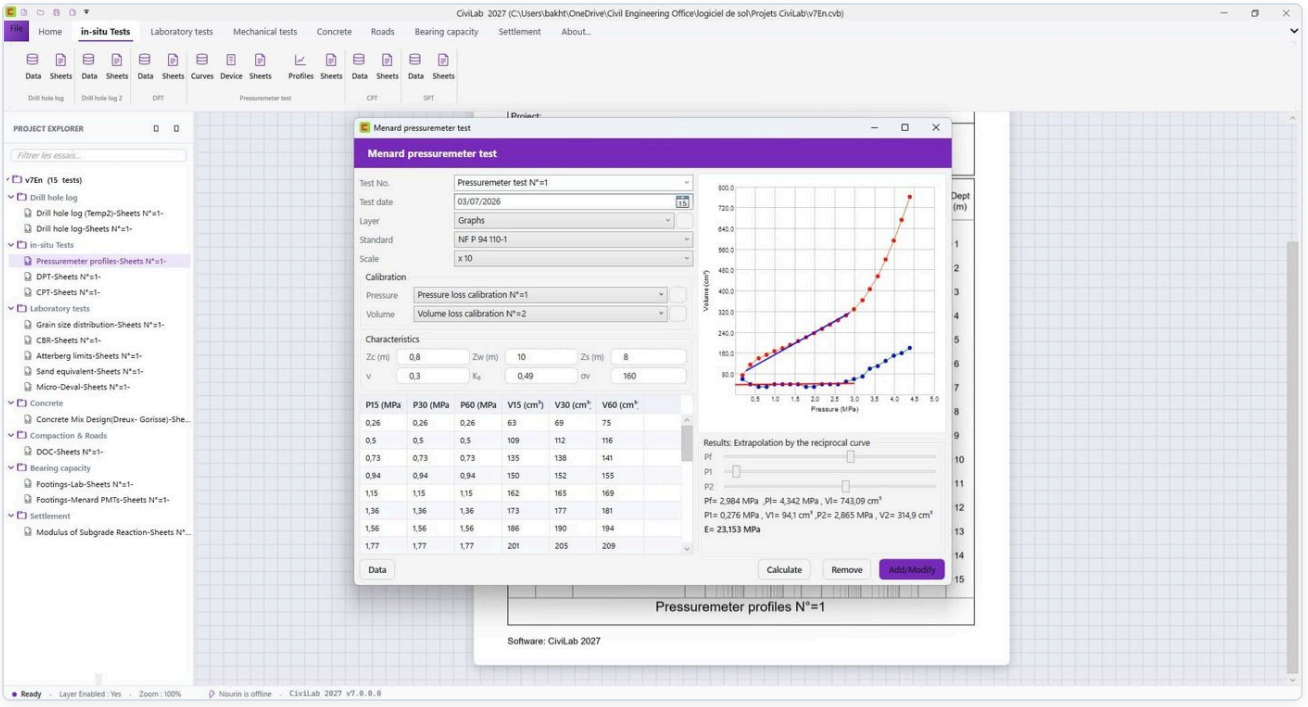
CiviLab corrects each step:

- corrected pressure: P = P60 − Pcalibration(V60) + (Zs + Zc) · γw;
- corrected volume: V = V60 − a · P60;
- creep: V60 − V30 (multiplied by the chosen scale).

It then calculates:

- **EM = 2 (1 + ν) (Vc + Vm) · (P2 − P1) / (V2 − V1)**, with Vm = (V1 + V2) / 2, between the points P1-V1 and P2-V2 bounding the pseudo-elastic phase;
- **pl**: pressure corresponding to the volume VL = Vc + 2 V1. If the test does not reach it: **ASTM D4719-87**, extrapolation by the inverse curve; **NF EN ISO 22476-4**, application of Annex D:
  - direct reading (linear interpolation) when VL is reached (D.4.2);
  - fewer than two steps after pf: result "pLM > p", equal to the last pressure (D.4.3.1);
  - otherwise CiviLab computes the inverse curve on the last three readings (D.4.3.2) and the double hyperbola (D.4.3.3), and keeps the one with the lowest mean deviation from the measured volumes (D.4.4); pLM is never lower than the last corrected pressure (D.6). The selected method is shown below the results;
- **pf**: pressure at the end of the pseudo-elastic phase, read on the creep curve;
- the net values **pl* = pl − σh** and **pf* = pf − σh**, with σh = K0 (σv − u) + u, and u = γw (Zs − Zw) below groundwater.

> **Warning:** if, for the same volume, the calibration pressure is higher than the pressure read during the test, CiviLab shows “Illogical value, the calibration pressure value is greater than the pressure value read from the test”. The **Details** button gives Pcalib and Pcor for each step, with the explanation: during the test the pressure must overcome the resistance of the probe **and** of the soil, so it cannot be lower than during calibration (standard NF P 94-110-1, section D.3.3).



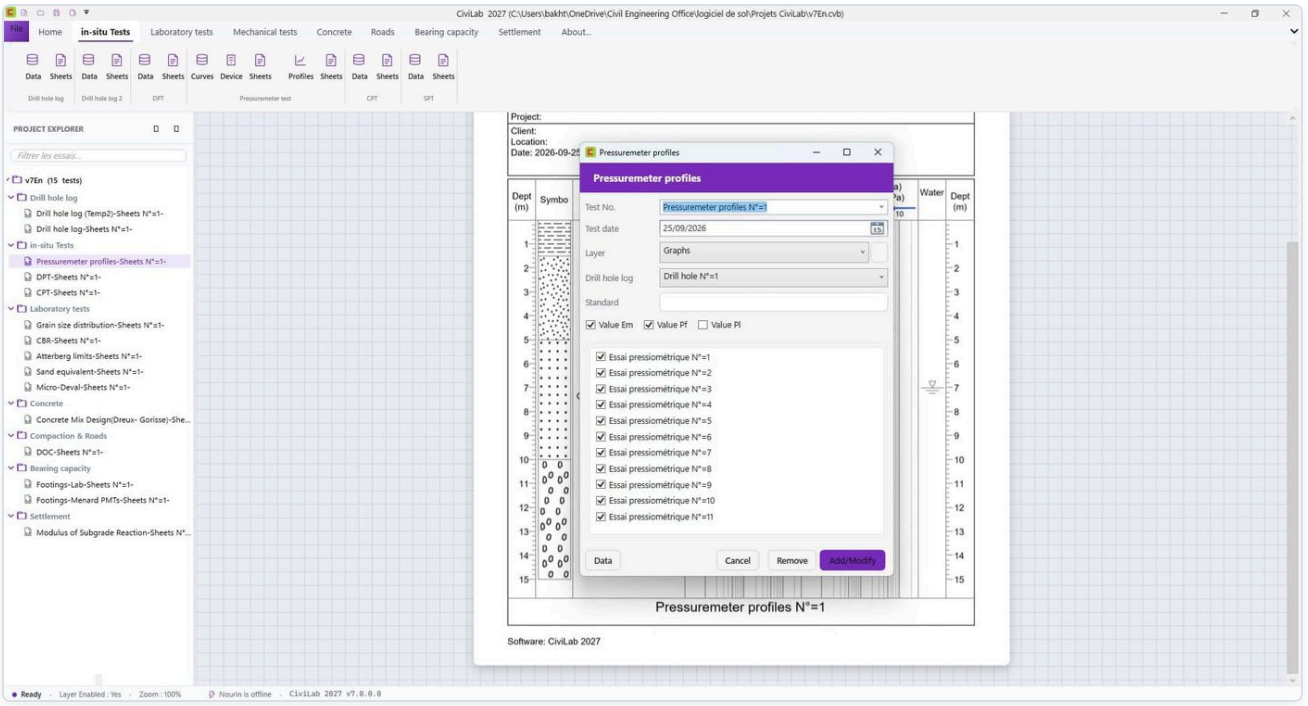
Data entry window — Menard pressuremeter test

9.5 The pressuremeter profile

Profiles groups the tests of a borehole into a profile of EM, pf* and pl* against depth.

1. **Test No.** (profile name), **Date**, **Layer**, associated **Drill hole log** (shown next to the profile), **Standard**.
2. **Em**, **Pf**, **Pl** value options: values shown on the profile.
3. Profile source:
   - **From pressuremeter tests**: tick at least two tests;
   - **Manual entry (Em, Pf*, Pl* table)** (CiviLab 7.1): fill in one row per depth — **Depth Z (m)**, **Em (MPa)**, **Pf* (MPa)**, **Pl* (MPa)**; comma or point accepted; at least two rows.
4. **Add/Modify**.

A manual profile is used like a profile built from tests: sheet, bearing capacity, settlement, modulus of subgrade reaction and Nourin.



Data entry window — Menard pressuremeter test (pressuremeter profile)

9.6 The sheets

- **Curve sheet**: corrected pressuremeter curve, creep curve, calibration curves, probe characteristics and result table (EM, pf, pl, P1, P2, V1, V2, scale).
- **Profile sheet**: drill hole log, EM, pf* and pl* against depth.

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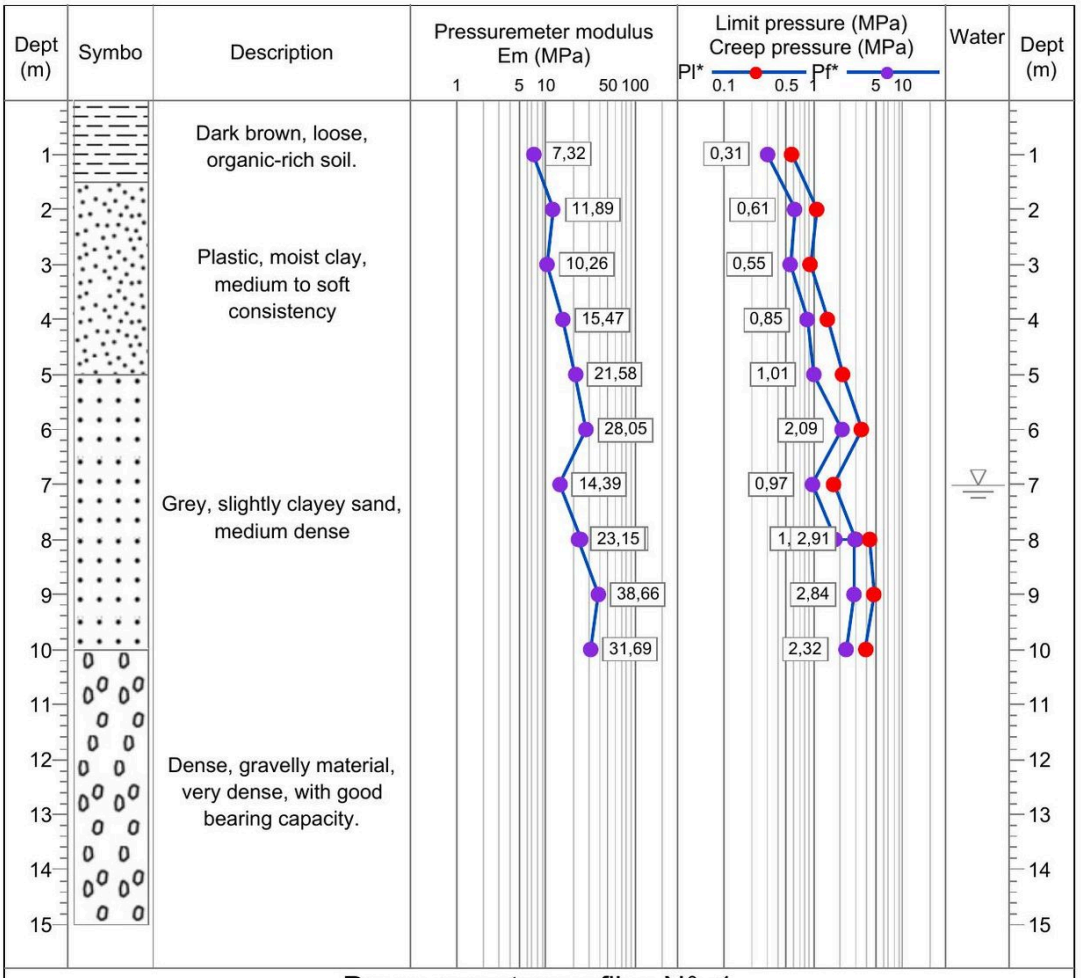
Civil engineering software development

Website: https://www.bakhtisoftware.com

Email: bakhti@bakhtisoftware.com/ support@bakhtisoftware.com

Project:

Client:
Location:
Date: 2026-09-25



Pressuremeter profiles N°=1

Software: CiviLab 2027

Test sheet — Menard pressuremeter test

10. Cone penetration test (CPT / CPTu)

10.1 Purpose and standards

A cone is pushed into the ground at constant speed; the cone resistance qc, the local sleeve friction fs and, for the CPTu, the pore water pressure u2 are measured.

Standards: **ASTM D5778–20**, **NF EN ISO 22476-1**, **BS EN ISO 22476-1**, **NF P 94-113**.

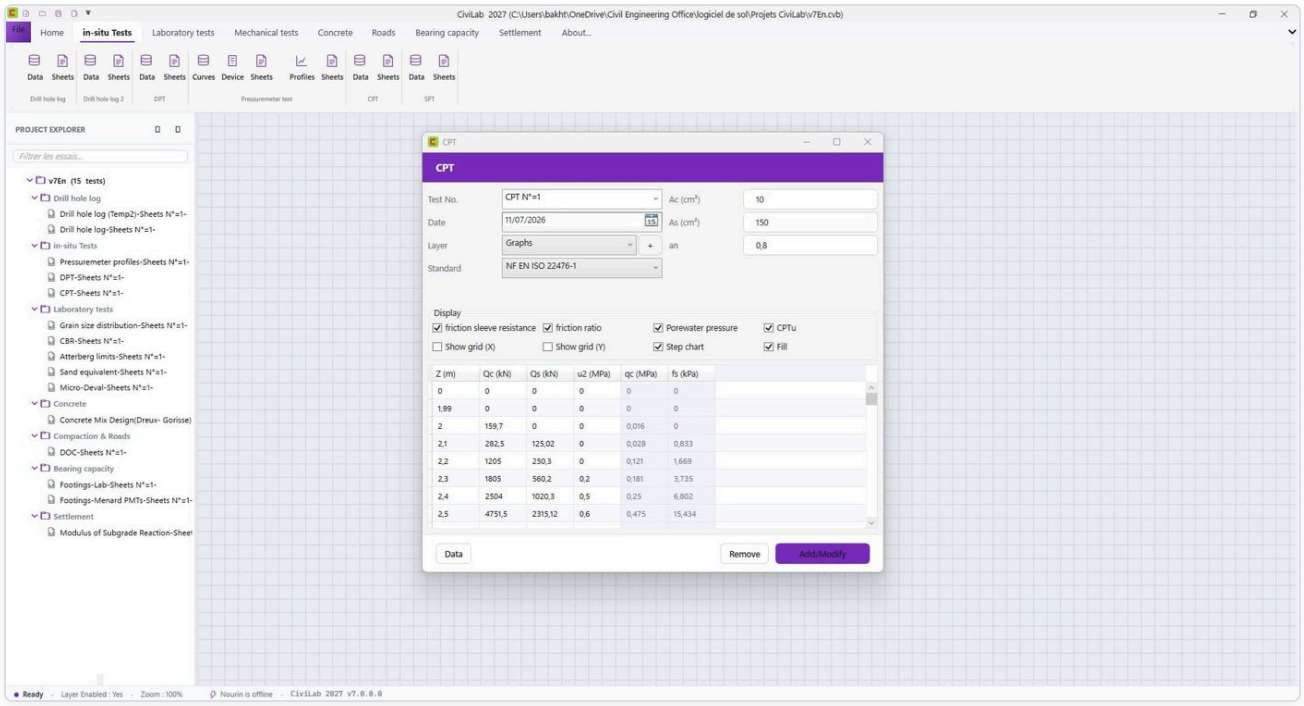
10.2 Entry and calculation

1. **Test No.**, **Test date**, **Layer**, **Standard**.
2. Cone characteristics: **Cone base area** Ac, **Net area ratio** a, **Area of friction sleeve** As.
3. Table, one row per depth: **Depth**, **Force on cone Qc** (kN), **Force on friction sleeve Qs** (kN), **Porewater pressure** u2 (MPa, ASTM D5778) or **Total force Qt**, **tip tilt**. Calculation (SI): qc (MPa) = 10·Qc (kN) / Ac (cm²); fs (kPa) = 10,000·Qs (kN) / As (cm²). If Qc or Qs is empty (or zero), the **qc** and **fs** columns can be typed directly or imported from Excel (📥); CiviLab does not recalculate them. qc and fs are no longer calculated automatically: use the « ▶ Calculate » button. Rf = 100·fs/qc is still calculated on the sheet.

CiviLab calculates:

- the **cone resistance** qc = Qc / Ac;
- the **friction sleeve resistance** fs = Qs / As;
- the **corrected total cone resistance** qt = qc + u2 (1 − a) (CPTu);
- the **friction ratio** Rf = fs / qt (in %).

4. **Display**: **Show grid**, **Step chart**, **Fill**, and choice of the profiles drawn (qc or qt, fs, Rf, u2).



Data entry window — Cone penetration test (CPT / CPTu)

10.3 The sheet

Side-by-side profiles of qc (or qt), fs, Rf and u2 against depth.

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Civil engineering software development

Website: https://www.bakhtisoftware.com

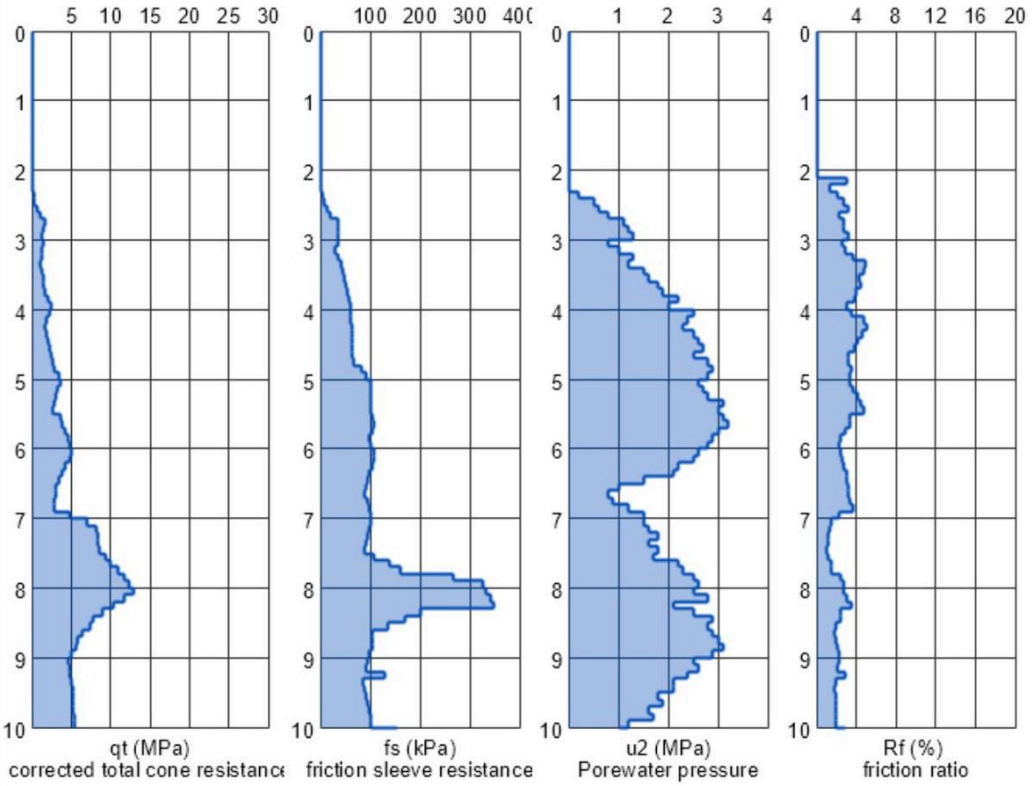
Email: bakhti@bakhtisoftware.com/ support@bakhtisoftware.com

Project:

Client:
Location:
Date: 2026-07-11

Static penetrometer: CPTu

Standard: NF EN ISO 22476-1



Cone base area, Ac = 10cm²
Area of friction sleeve, As = 150cm²
Net area ratio, an = 0,8

Software: CiviLab 2027

Test sheet — Cone penetration test (CPT / CPTu)

11. Standard penetration test (SPT)

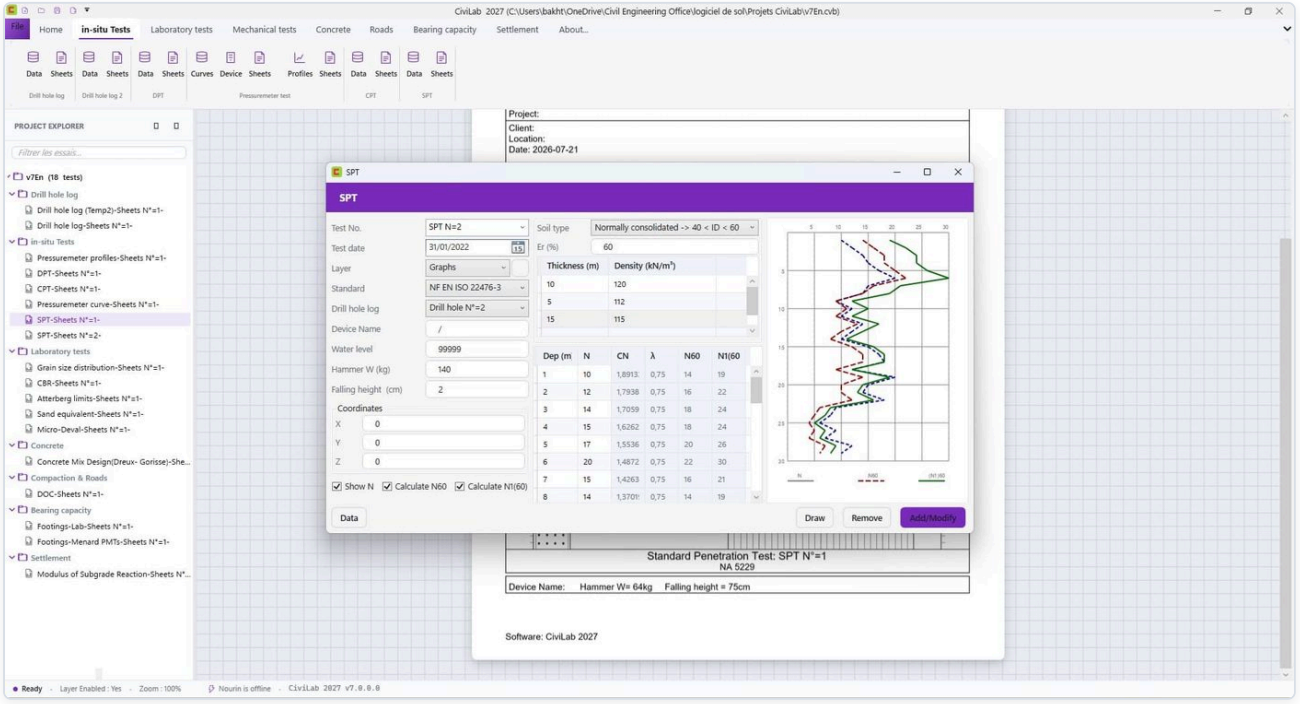
11.1 Purpose and standards

A standard split-spoon sampler is driven by a 63.5 kg hammer falling 76 cm; the result N is the number of blows needed for 0.30 m (1 ft) of penetration.

Standards: **NF EN ISO 22476-3**, **BS EN ISO 22476-3**, **NF P 94-116**, **NA 5229**.

11.2 Entry

1. **Test No.**, associated **Drill hole log**, **Layer**, **Test date**, **Water level**, **Standard**, **Coordinates**.
2. Device: **Device Name**, **Hammer Weight m** (kg), **Falling height H** (cm), energy ratio **Er** (%).
3. **Soil type** (for CN): **Normally consolidated → 40 < ID < 60**, **Normally consolidated -> 60 < ID < 80**, **Overconsolidated**, **Normally consolidated sand**, **FHWA (1998)**, **Peck (1974)**.
4. Soil layer table: **Thickness** and **Density** (unit weight), to calculate the effective stress σ'v.
5. Measurement table: **Depth** and **N**; CN and λ are suggested automatically and remain editable.



Data entry window — Standard penetration test (SPT)

11.3 Calculation

- Effective stress σ′v at the test depth, from the layers and groundwater;
- coefficient **CN** (effect of earth pressure in sands), capped at 2:

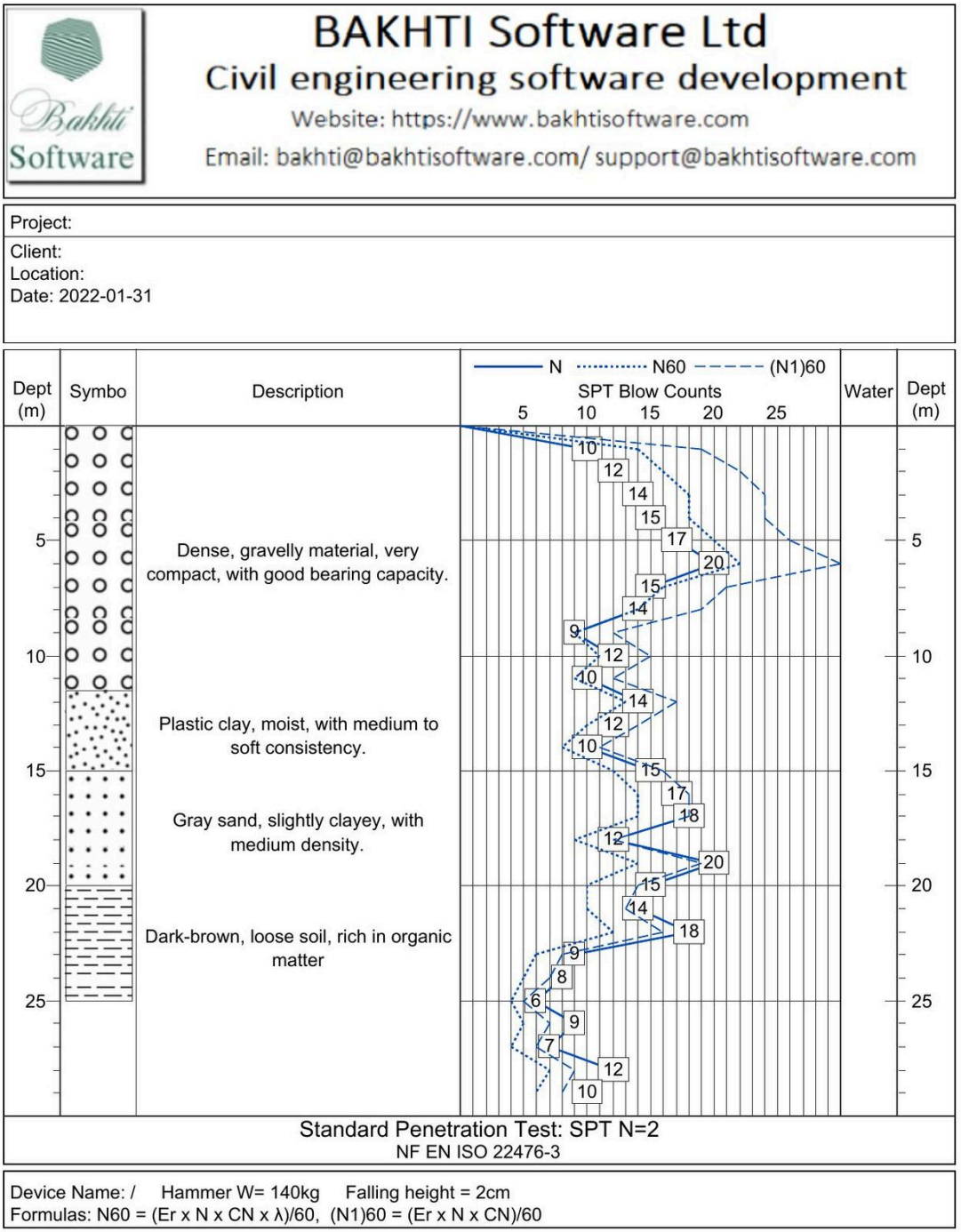
Soil type	CN
Normally consolidated, 40 < ID < 60	200 / (100 + σ′v)
Normally consolidated, 60 < ID < 80	300 / (200 + σ′v)
Overconsolidated	170 / (70 + σ′v)
Normally consolidated sand	√(98 / σ′v)
FHWA (1998), Peck (1974)	(100 / σ′v)^0.4

- coefficient **λ** (energy losses due to rod length): 0.75 up to 4 m; 0.85 from 4 to 6 m; 0.95 from 6 to 10 m; 1 beyond;
- **(N1)60 = Er · N · CN / 60** and **N60 = (N1)60 · λ**.

> **Note:** if the unit weights do not allow σ′v to be calculated, CiviLab shows “Unable to calculate CN: Unable to calculate stress from density weight table”.

11.4 The sheet

Profile of N, N60 and (N1)60 against depth (**Show** options), with the formulas N60 = (Er x N x CN x λ)/60 and (N1)60 = (Er x N x CN)/60.



Test sheet — Standard penetration test (SPT)

12. Grain size distribution

12.1 Purpose and standards

Grain size analysis determines the distribution of particle sizes in a sample: by **sieving** (stack of nested sieves) and, for the fine fraction, by **hydrometer** sedimentation (Stokes' law).

	Standards
Sieving	**ASTM D 6913**, **ASTM D 422**, **AASHTO T 88**, **BS 1377-2:2022**, **NF P 94-056**, **NA 5232**, **NF EN ISO 17892-4**
Hydrometer	**ASTM D7928**, **ASTM D422**, **NF P 94-057**, **ISO 17892-4**
Sieve series	**ASTM E11**, **ISO 565 / 3310-1**
Fineness modulus	**NF EN 12620**, **ASTM C 136**, **XP P 18-540**

12.2 Sieves (Device)

Device opens the list of sieve series: give the series a **Name**, choose the **Standard**, then tick the **sieves used** (from 112 mm to 0.036 mm, with their inch equivalent); **Check all** / **Uncheck all** speed up the selection. A saved series is reusable in every test ("The sieve list is empty" if no sieve is ticked).

12.3 Entering the sieving

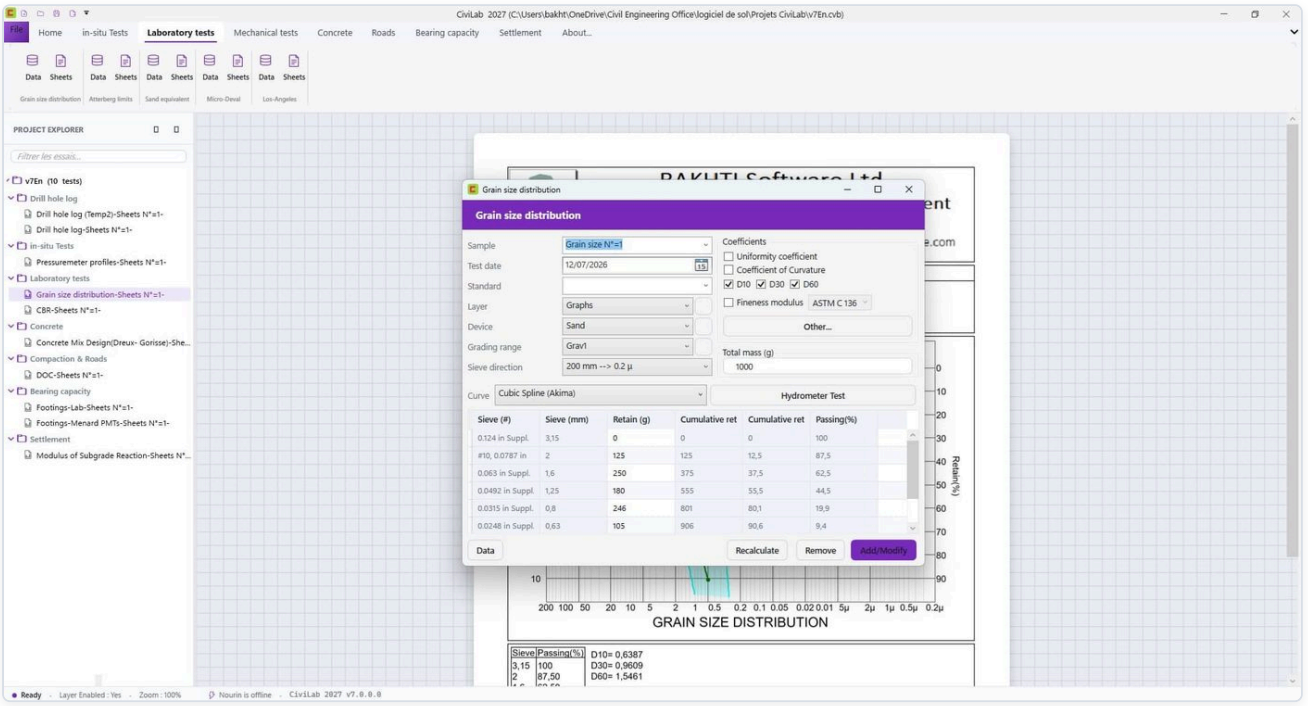
1. **Sample**, **Test date**, **Standard**, **Layer**, **Device** (sieve series).
2. **Grading range**: reference envelope overlaid on the curve (chapter 12.5).
3. **Sieve direction**: display order of the diameter axis (for example 200 mm → 0.2 µm).
4. **Curve**: plotting method — **Linear**, **Cubic Spline**, **Cubic Spline (Akima)**, **Cubic Spline (Pchip)**, **B-Spline**, **Least squares method**.
5. **Total mass of the sample** ("Insert the total mass of the sample" if missing).
6. Table: for each sieve, the **Retain** mass; CiviLab calculates the **Cumulative retain** and the **Passing** (%).
7. **Coefficients** to display: **Uniformity coefficient** Cu, **Coefficient of Curvature** Cc, **D10**, **D30**, **D60**, **Fineness modulus** (according to the chosen standard) and, with **Other...**, any diameter **Dx** (diameter at x % passing).

Calculations:

- Cu = D60 / D10; Cc = $D30^2$ / (D10 · D60);

- fineness modulus: sum of the cumulative retained percentages on the standard sieves of the chosen standard, divided by 100.

> **Note: Recalculate** reruns the calculation after a change; “Check the sieve: …” flags a sieve with an inconsistent retained mass (increasing passing, negative mass).



Data entry window — Grain size distribution

12.4 Hydrometer analysis

The **Hydrometer Test** button opens the hydrometer window:

1. Tick **Activate**, choose the **Standard** and the **Hydrometer**.
2. Characteristics: **Mass of soil**, **Specific gravity of soil** Gs, **Volume of suspension** Vsp, **cross-sectional area** A of the cylinder, **volume of the hydrometer bulb** Vhb, distance between the 100 ml and 1000 ml marks, corrections (**Dispering agent** Rcp, reading correction RcL, **Correction of Temperature**).
3. Reading table: **Time** (min), **Temp**, **Reading**; CiviLab calculates the **Particle Diameter** D (Stokes’ law) and the **Percent Finer < D (%)**.

The fine part is joined to the sieving curve on the same sheet.

12.5 Grading ranges

Grading range opens the list of envelopes: give a **Name** and a **Color**, then enter the **minimum curve** and the **maximum curve** (sieve and passing %). The envelope is drawn behind the test curve to check the compliance of a material.

12.6 The sheet

The sheet plots one or more grading curves (several samples on the same sheet), with the classes **Cobble**, **Gravel**, **Coarse sand**, **Fine sand**, **Silt**, **Clay** above the graph, and below it the sieve - passing table and the chosen coefficients.

> **Note:** Nourin classifies the soil according to LCPC and GTR (NF P 11-300) from this sheet (Nourin manual).

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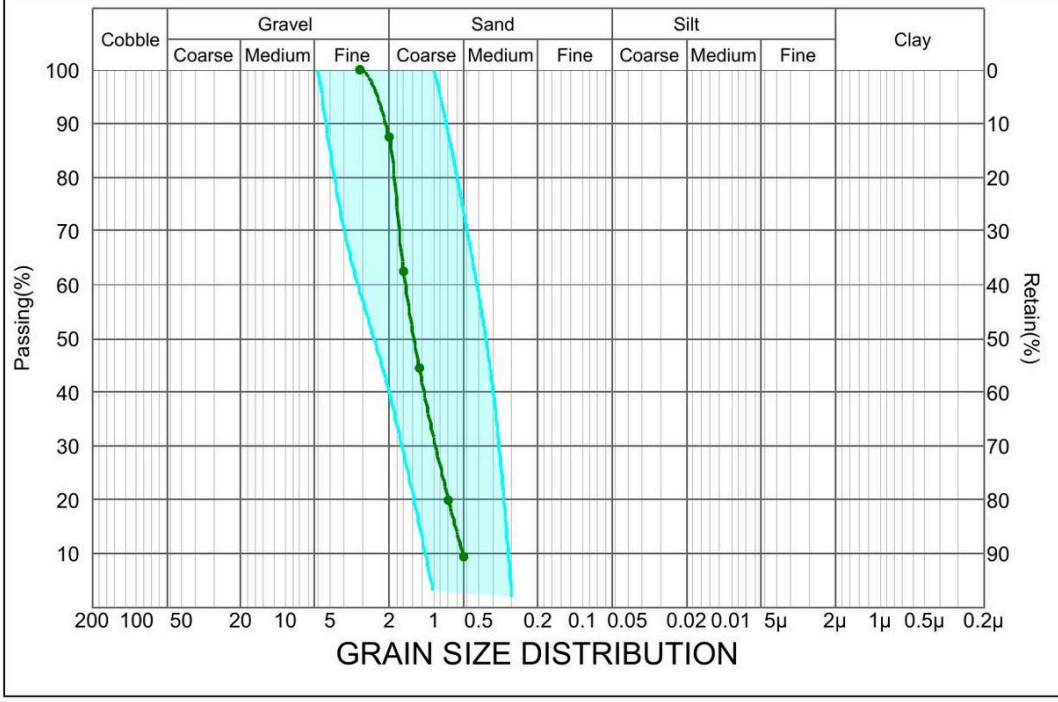
Website: https://www.bakhtisoftware.com

Email: bakhti@bakhtisoftware.com/ support@bakhtisoftware.com

Project:

Client:
Location:
Date: 2026-07-12
Source of sample: BR01

Depth: 10 m



Sieve	Passing(%)
3,15	100
2	87,50
1,6	62,50
1,25	44,50
0,8	19,90
0,63	9,40

Grain size N°=1

D10= 0,6387
D30= 0,9609
D60= 1,5461

Software: CiviLab 2027

Test sheet — Grain size distribution

13. Atterberg limits

13.1 Purpose and standards

The Atterberg limits are the conventional water contents at which a fine soil passes from the liquid to the plastic state (**liquid limit WL**) and from the plastic to the solid state (**plastic limit WP**).

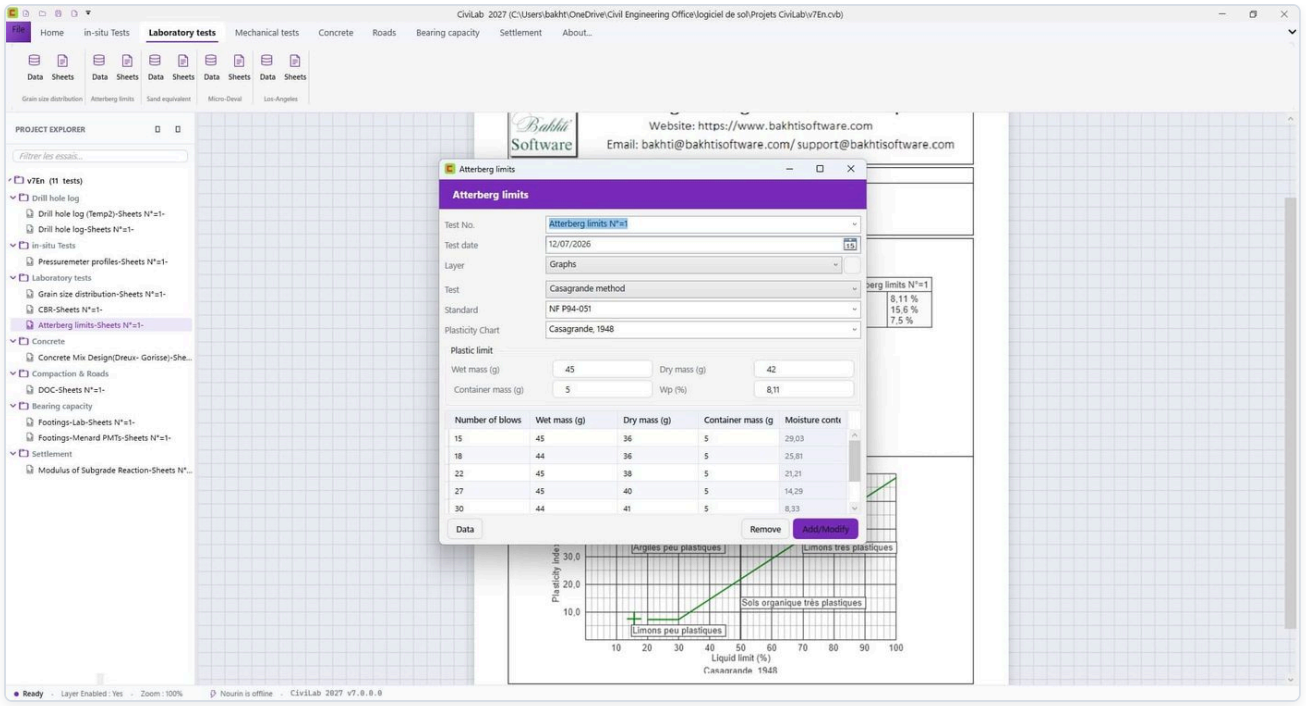
Method	Standards
Casagrande method (cup)	**ASTM D4318-17E01**, **NF P 94-051**, **BS 1377-2:2022**
Cone penetrometer	**NA 16213**, **NF P 94-052-1**, **BS 1377-2:2022**
Classification	**Casagrande, 1948**, **BS 5930:2015**, **ASTM D2487–17**

13.2 Entry

1. **Test No.**, **Test date**, **Standard**, **Layer**, **Casagrande method** or **Cone penetrometer** method.
2. Liquid limit table, one test per row: **Number of blows** (cup) or **Penetration** (cone), **Wet mass**, **Dry mass**, **Container mass**; CiviLab calculates the **Moisture content** w = (Mw − Md) / (Md − Mc) × 100.
3. **Plastic limit**: same masses for the threads; CiviLab calculates **Wp** (average).
4. **Plasticity Chart**: choose the classification chart.

Calculations:

- cup: line of moisture content against log(number of blows); **WL** = moisture content at 25 blows;
- cone: line of moisture content against penetration; **WL** = moisture content at the reference penetration of the standard;
- **PI = WL − WP**, then position of the soil on the chart (CL, CH, ML, MH, OL, OH, CL-ML).



Data entry window — Atterberg limits

13.3 The sheet

Liquid limit curve, WP / WL / PI table and plasticity chart with the soil point.

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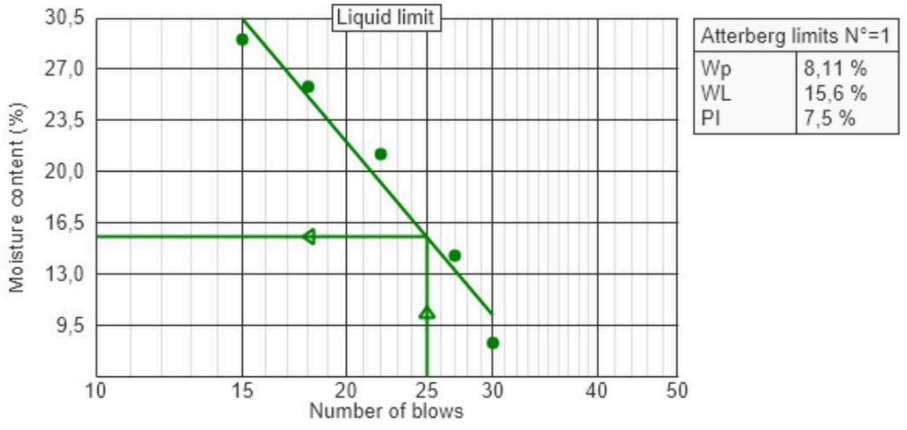
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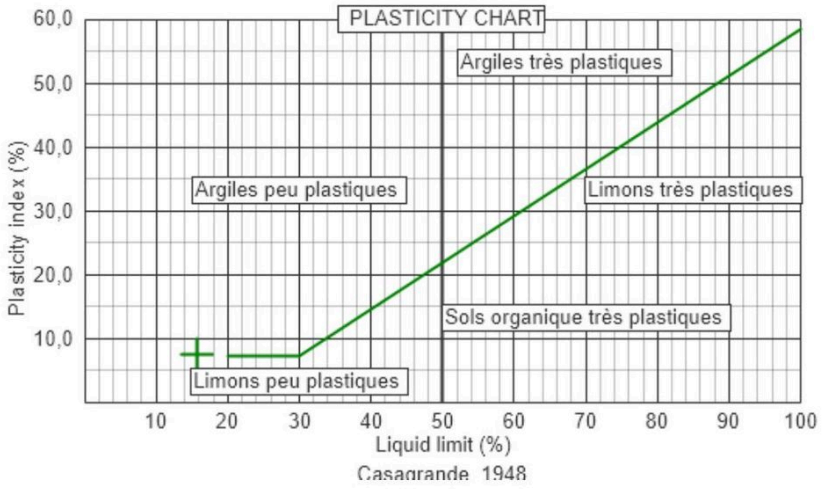
Project:	
Client: Location: Date: 2026-07-12 Source of sample: BR01	Depth: 6 m

ATTERBERG LIMITS

NF P94-051



Atterberg limits N°=1	
Wp	8,11 %
WL	15,6 %
PI	7,5 %



Software: CiviLab 2027

Test sheet — Atterberg limits

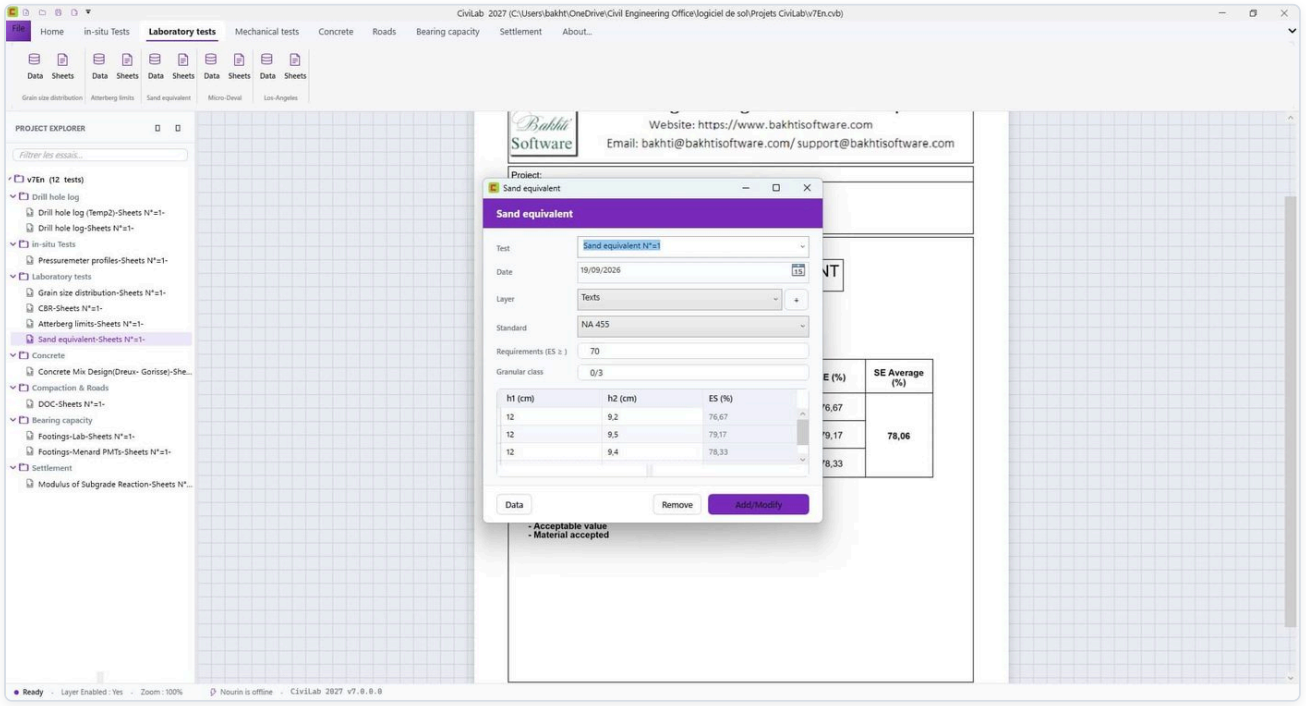
14. Sand equivalent

14.1 Purpose and standards

The sand equivalent describes the cleanliness of a sand: after shaking in a washing solution, the height of the flocculate and the height of the sand are measured. Standards: **ASTM D2419**, **BS EN 933-8**, **NA 455**, **NF EN 933-8**.

14.2 Entry and calculation

1. **Test**, **Date**, **Standard**, **Layer**, **Granular class**, **Requirements** (minimum value allowed).
2. For each cylinder: h1 (total height, sand + flocculate) and h2 (sand height).
3. CiviLab calculates **SE = 100 · h2 / h1** for each cylinder and the average, then compares the average with the requirements.



Data entry window — Sand equivalent

14.3 The sheet

Measurement table, SE of each cylinder, average SE and conclusion.

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Project:

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TEST SAND EQUIVALENT

Standard: NA 455

Test: Sand equivalent N°=1
Granular class: 0/3

N° Sample	h1 (cm)	h2 (cm)	SE (%)	SE Average (%)
1	12,00	9,20	76,67	
2	12,00	9,50	79,17	**78,06**
3	12,00	9,40	78,33	

Requirements: SE ≥ 70,00

Results:
- Acceptable value
- Material accepted

Software: CiviLab 2027

Test sheet — Sand equivalent

15. Micro-Deval

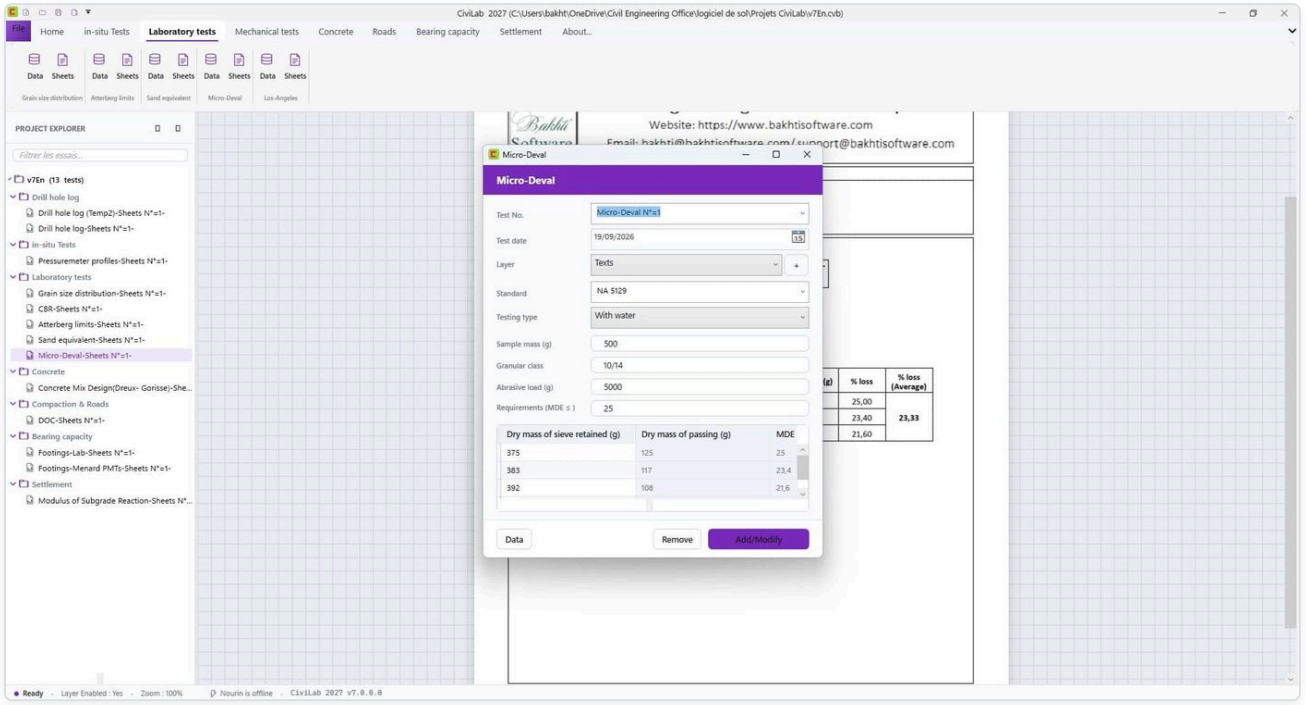
15.1 Purpose and standards

The Micro-Deval test measures the resistance of aggregate to wear by mutual friction, **dry** (MDS) or **with water** (MDE). Granular classes: 4/6.3; 6.3/10; 10/14; 25/50 mm. Standards: **ASTM D6928-17**, **BS EN 1097-1**, **NA 5129**, **NF EN 1097-1**, **NF P 18-572**.

15.2 Entry and calculation

1. **Test No.**, **Test date**, **Standard**, **Layer**, **Testing type** (**Dry** or **With water**).
2. **Sample mass** (usually 500 g), **Granular class**, **Abrasive load** (mass of balls), **Requirements** (MDS ≤ ... or MDE ≤ ...).
3. For each test: the **Dry mass of sieve retained** on the 1.6 mm sieve; CiviLab calculates the **Dry mass of passing**.
4. Coefficient: **MDE (or MDS) = 100 · m / M**, where m is the mass of particles finer than 1.6 mm and M the sample mass.

CiviLab compares the result with the requirements: **Material accepted** or **Material not accepted**.



Data entry window — Micro-Deval

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MICRO - DEVAL ABRASION TEST

Standard: NA 5129

Test: Micro-Deval N°=1
Sample mass: 500 g
Testing type: With water

Granular class	Abrasive load (g)	Dry mass of sieve retained (g)	Dry mass of passing (g)	% loss	% loss (Average)
10/14	5000	375,00	125,00	25,00	**23,33**
		383,00	117,00	23,40	
		392,00	108,00	21,60	

Requirements: M.D. abrasion loss ≤ 25,00 %

Results:
- Acceptable value
- Material accepted

Software: CiviLab 2027

Test sheet — Micro-Deval

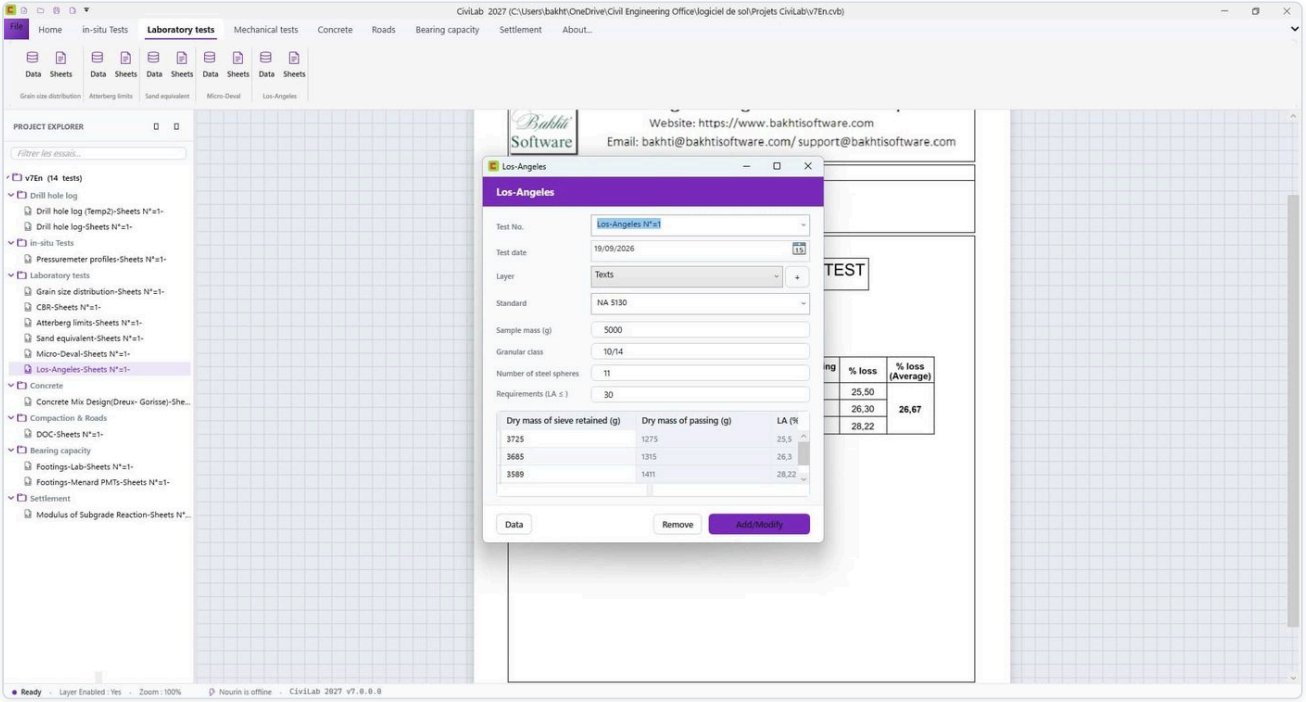
16. Los Angeles

16.1 Purpose and standards

The Los Angeles test measures the combined resistance to impact and wear, by subjecting the aggregate to steel balls in the Los Angeles machine. Granular classes: 4/6.3; 6.3/10; 10/14; 10/25; 16/31.5; 25/50 mm. Standards: **ASTM C131**, **BS EN 1097-2**, **NA 5130**, **NF EN 1097-2**, **NF P 18-573**.

16.2 Entry and calculation

1. **Test No.**, **Test date**, **Standard**, **Layer**.
2. **Sample mass** (usually 5000 g), **Granular class**, **Number of steel spheres**, **Requirements** (LA ≤ ...).
3. For each test: the **Dry mass of sieve retained** on the 1.6 mm sieve; CiviLab calculates the **Dry mass of passing**.
4. Coefficient: **LA = 100 · m / M**, where m is the mass of particles finer than 1.6 mm produced during the test and M the sample mass.



Data entry window — Los Angeles

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LOS ANGELES ABRASION TEST

Standard: NA 5130

Test: Los-Angeles N°=1
Sample mass: 5000 g

Granular class	Number of steel spheres	Dry mass of sieve retained (g)	Dry mass of passing (g)	% loss	% loss (Average)
10/14	11	3725,00	1275,00	25,50	**26,67**
		3685,00	1315,00	26,30	
		3589,00	1411,00	28,22	

Requirements: L.A. abrasion loss ≤ 30,00 %

Results:
- Acceptable value
- Material accepted

Software: CiviLab 2027

Test sheet — Los Angeles

17. Proctor test

17.1 Purpose and standards

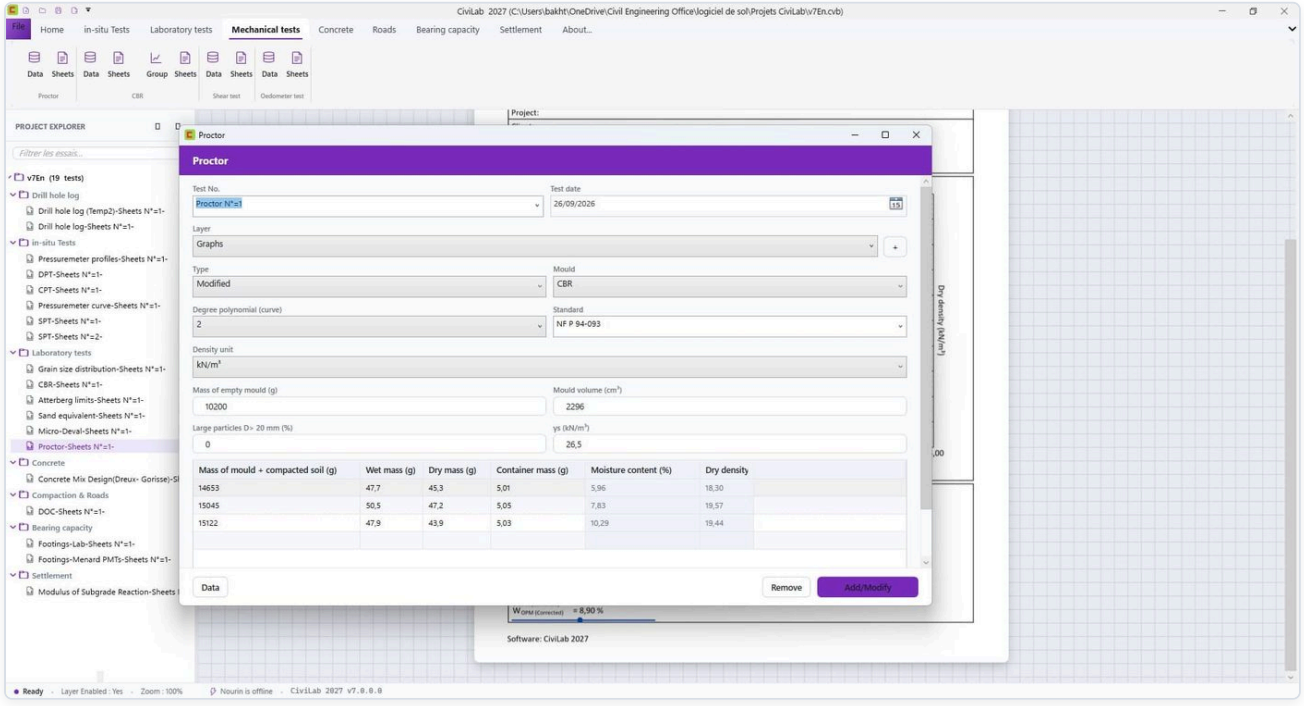
The Proctor test determines the optimum moisture content giving the maximum dry density of a soil compacted with a standardised energy:

- **Standard Proctor** (capping layers, embankments): optimum **WOPN**, **γOPN**;
- **Modified Proctor** (base layers): optimum **WOPM**, **γOPM**.

Two moulds: **Proctor** and **CBR**, depending on the soil grading. Standards: **ASTM D698**, **ASTM D1557-91**, **BS 1377-2:2022**, **NA 5262**, **NF P 94-093**.

17.2 Entry

1. **Test No.**, **Test date**, **Standard**, **Layer**.
2. **Mould** (**Proctor** or **CBR**), **Type** (**Standard** or **Modified**), **Mass of empty mould**, **Mould volume**.
3. **Density unit**: **Dry density** γd (kN/m³) or dry density ρd (t/m³).
4. **Degree polynomial (curve)**: degree of the polynomial fitted to the Proctor curve.
5. **Large particles**: percentage of particles D > 20 mm (density correction).
6. Table, one row per point: **Mass of mould + compacted soil**, **Wet mass**, **Dry mass** and **Container mass** of the moisture content sample.



Data entry window — Proctor test

17.3 Calculation

For each point:

- moisture content w = (Mw − Md) / (Md − Mc);
- wet density ρh = (Mass of mould + soil − Mass of mould) / Mould volume;
- dry density ρd = ρh / (1 + w) (or γd = ρd · g).

CiviLab fits a polynomial of the chosen degree to the (w, ρd) points and derives the optimum: **optimum moisture content** and **maximum dry density**.

> **Warning:** if the percentage of large particles (D > 20 mm) exceeds 25 %, the Proctor test is not representative: “Proctor’s test cannot be done. Reason: percentage of large particles (D> 20mm) is > 25%”.

17.4 The sheet

Compaction curve(s) (several tests on the same sheet), table of points, optimum and mould characteristics.

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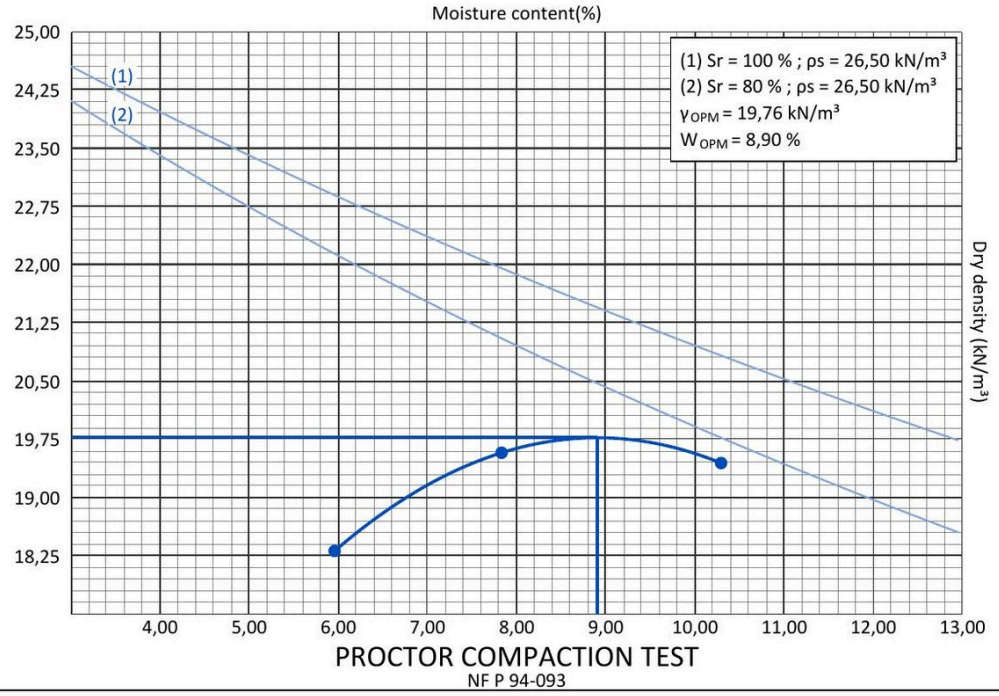
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Client:
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Test	Proctor N°=1
Type	Modified
Mould	CBR
Rammer mass (kg)	4.540
Blows height (cm)	45.70
Number of layers	5
Number of blows / layer	55
Large particles	0 %

γ_{OPM} = 19,76 kN/m³
W_{OPM} = 8,90 %
$\gamma_{OPM\ (Corrected)}$ = 19,76 kN/m³
$W_{OPM\ (Corrected)}$ = 8,90 %

Software: CiviLab 2027

Test sheet — Proctor test

18. CBR test

18.1 Purpose and standards

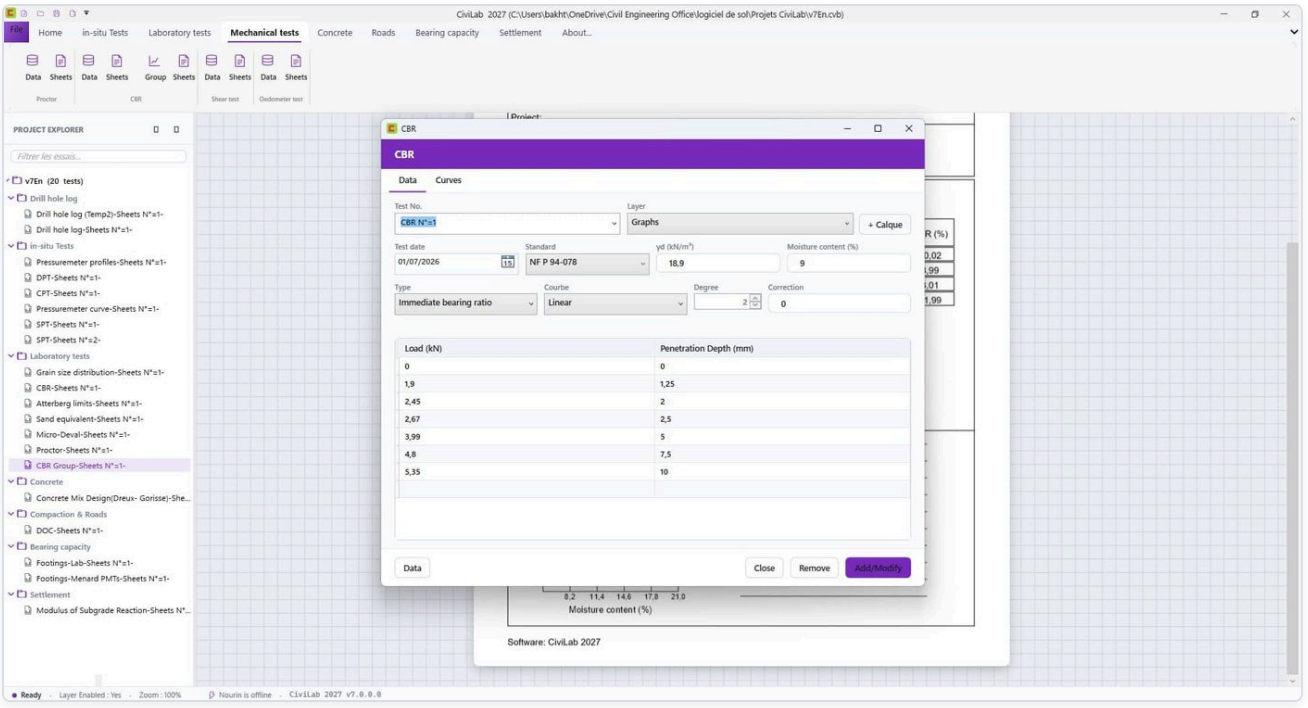
The CBR (California Bearing Ratio) test measures the force needed to push a cylindrical plunger into a specimen at constant speed, and compares it with that of a reference material at two conventional penetrations (2.5 and 5 mm).

Standards: **ASTM D1883-99**, **AASHTO T 193**, **VTM-8**, **NF P 94-078**, **BS 1377-9:1990**, **NA 5252**.

18.2 Entering a test

1. **Test No.**, **Test date**, **Standard**, **Layer** (**+ Layer** button).
2. Index **Type**: **Immediate bearing ratio (IPI)**, **Immediate CBR** or **CBR after 4 days of immersion**.
3. **Moisture content** and dry density of the specimen (for the group study).
4. Table: **Penetration** (mm) and **Load** (kN) — or **Pressure** (MPa).
5. **Curve**: **Linear**, **Cubic Spline**, **Cubic Spline (Akima)**, **Cubic Spline (Pchip)**, **B-Spline** (with its **Degree**), **Least squares method**.
6. **Correction**: origin shift when the curve shows an initial concavity (seating of the plunger).
7. ↻ **Refresh** redraws the curve.

CiviLab calculates the CBR at 2.5 mm and 5 mm penetration (loads compared with the reference loads of the standard) and keeps the higher value.



Data entry window — CBR test

18.3 CBR study on a group of tests (Group)

Mechanical tests > CBR > Group brings together several CBR tests made at different energies or moisture contents:

1. Group **Test No.**, **Standard**, **Layer**, curve **Degree**.
2. Tick the CBR tests of the group.
3. **Curves**: **CBR-Molded Density curve** and/or **CBR-Moisture Content curve**, with the plotting method.

The group gives the CBR corresponding to a given density or moisture content (for example 95 % of the OPM).

18.4 The sheets

- Test sheet: load - penetration curve (corrected), indices at 2.5 and 5 mm, retained index.
- Group sheet: CBR - dry density and CBR - moisture content curves.

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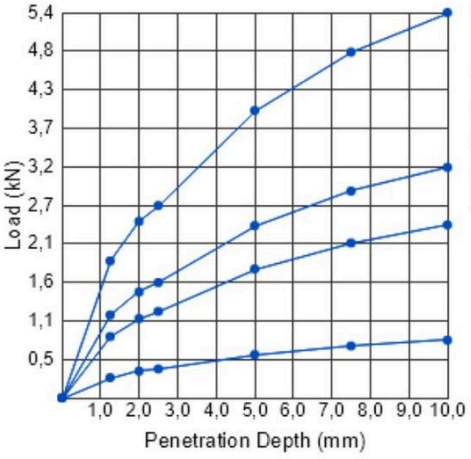
Email: bakhti@bakhtisoftware.com/ support@bakhtisoftware.com

Project:

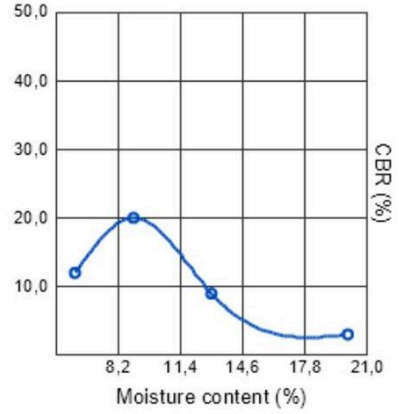
Client:
Location:
Date: 2026-09-26

TEST REPORT

CBR Test NF P 94-078



γd (kN/m³)	ω (%)	Penetration		CBR (%)
		2.5 mm	5 mm	
18,90	9,00	2,67	3,99	20,02
17,80	13,00	1,20	1,79	8,99
14,50	20,00	0,40	0,60	3,01
17,90	6,00	1,60	2,39	11,99



Software: CiviLab 2027

Test sheet — CBR test

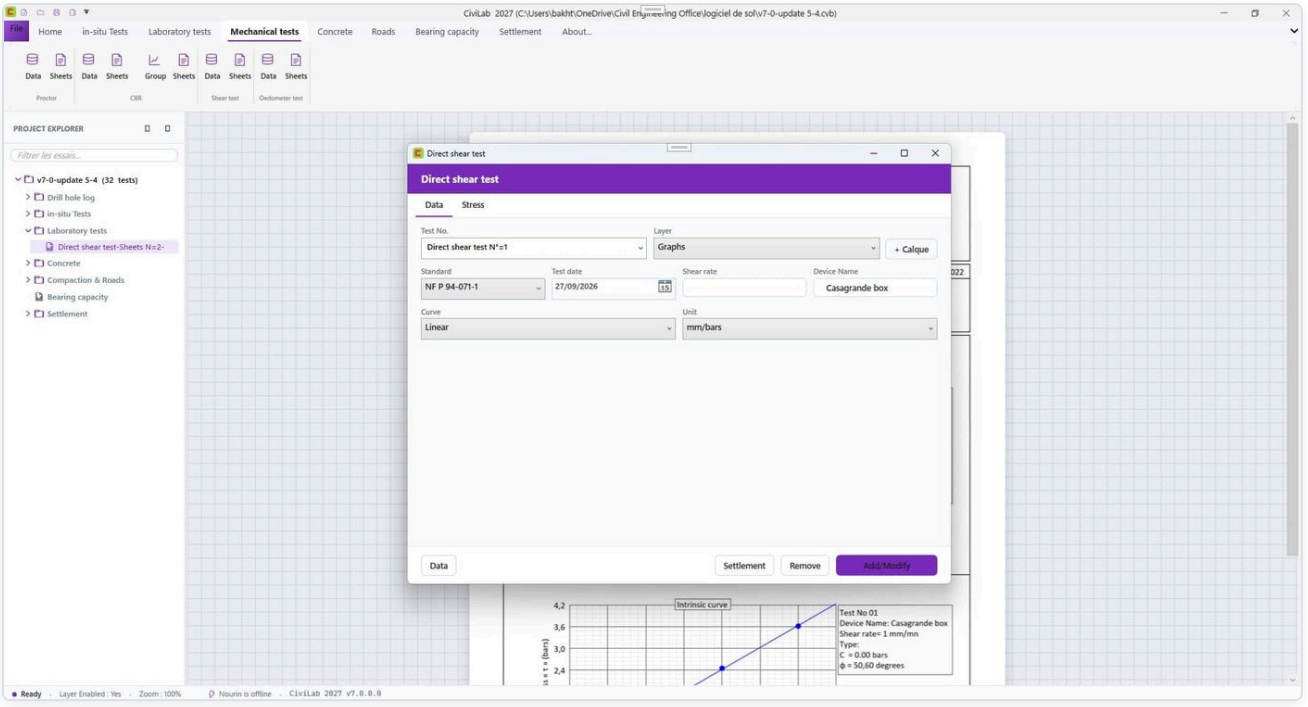
19. Direct shear

19.1 Purpose and standards

The shear box test (Casagrande box) measures the failure characteristics of a specimen sheared along an imposed plane at constant speed. Under drained conditions and at slow speed, it gives the effective friction angle φ′ and the effective cohesion c′. Standards: **ASTM D3080-04**, **NF P 94-071-1**, **NA 16218**.

19.2 Entry

1. **Test No.**, **Test date**, **Standard**, **Layer**, **Device Name**, **Shear rate**.
2. Test type: **Unconsolidated Undrained (UU)**, **Consolidated Undrained (CU)** or **Consolidated Drained (CD)**.
3. **Casagrande box**: dimensions and **Area** of the specimen; reading **Unit** (mm/bars, mm/kPa, in/lbf/in²).
4. For each **Normal stress** σn: table of **Horizontal displacement** ΔL, corrected **Area**, **T** (shear force: T = 9.81 × K × proving ring reading) and **Settlement** (vertical displacement).
5. **Curve**: plotting method of the stress - displacement curve.



Data entry window — Direct shear

19.3 Calculation

- **Shear stress τ = T / S** for each reading;
- maximum (peak) τ for each normal stress;
- **Intrinsic curve** τ = c′ + σn · tan φ′ fitted to the (σn, τmax) points: **cohesion C** and **friction angle φ**.

> **Note:** “Unable to find the provided normal stress” flags a normal stress without a measurement table; “Error C<0 !” indicates an intrinsic line crossing the axis below the origin.

19.4 The sheet

τ - displacement curves for each σn, σn - τ intrinsic line, C and φ.

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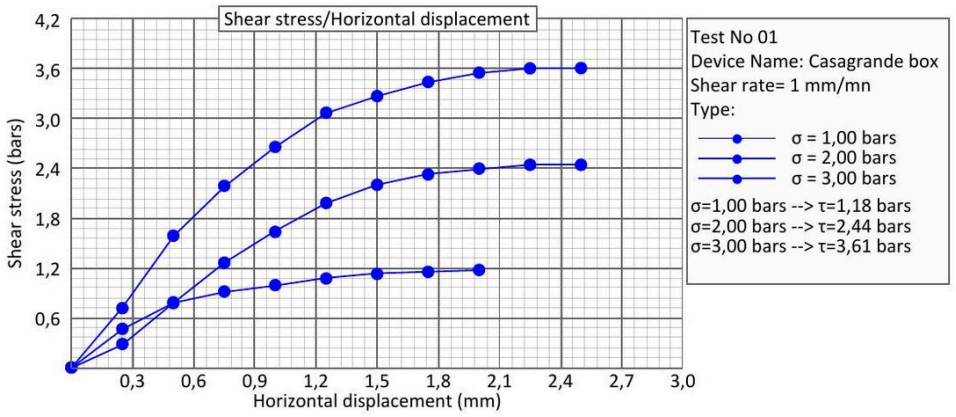
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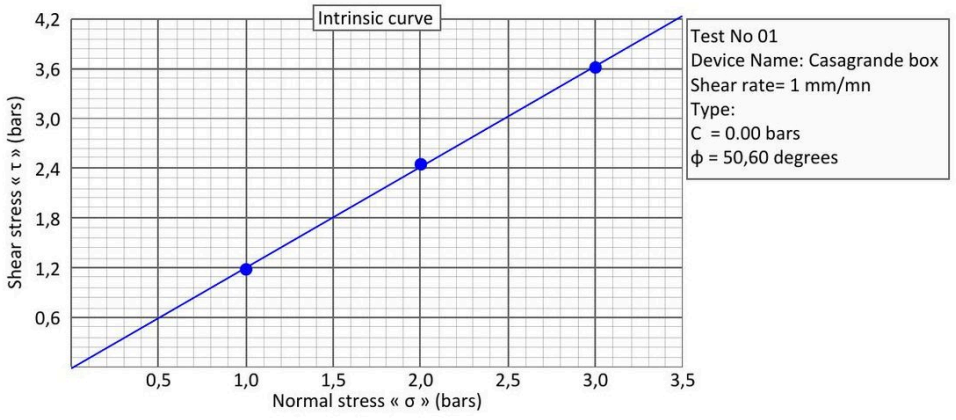
Email: bakhti@bakhtisoftware.com/ support@bakhtisoftware.com

Project: RN 18 Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2020-02-12

DIRECT SHEAR TEST
Standard: NF P 94-071-1





Software: CiviLab 2027

Test sheet — Direct shear

20. Triaxial test

20.1 Purpose and standards

The triaxial test measures the shear strength of a cylindrical specimen enclosed in a membrane, placed in a cell under a confining pressure σc and loaded axially at a constant rate until failure. CiviLab handles:

Type	Description	Standard
UU	unconsolidated undrained	**EN ISO 17892-8:2018**
CU / CIU	isotropically consolidated undrained, with pore pressure measurement (CU+u); without u: **CU** test interpreted in total stresses	**EN ISO 17892-9:2018**; NF P 94-070
CAU	anisotropically consolidated undrained	EN ISO 17892-9:2018
CD / CID	isotropically consolidated drained	EN ISO 17892-9:2018
CAD	anisotropically consolidated drained	EN ISO 17892-9:2018

Definitions and interpretation (s, t, s′, Mohr circles, Mohr–Coulomb line, cuu and φuu, cu = cuo + λcu·σ′c) follow **NF P 94-070**.

20.2 Data entry

Ribbon **Mechanical tests ▸ Triaxial ▸ Data**. The window has three tabs.

Test tab: name, layer, date, **test type**, **failure criterion**, **failure strain** (%), apparatus, then the apparatus and corrections:

- **Membrane correction**: thickness tm, diameter Dm (blank = specimen diameter), modulus Em (1,400 kPa for latex, value given by the standard);
- **f** (1/3 by default);
- **piston area a** and **K = W − (Acor − a)·h·γ** for a load cell outside the cell (a = 0 and K = 0 for an internal load cell);
- consolidated tests: **filter paper strip correction** (Pfp, Kfp = 0.19 kN/m);
- UU: **Saturated soil** box (φu = 0).

Specimens tab: one specimen per cell pressure (at least 3 for c′, φ′). For each one:

- Hi, Di, initial mass, water content w, cell pressure σc;

- UU: **ΔHi**, height change before shearing (ISO 17892-8 formula 1);
- consolidated tests: back pressure uB, saturation check (Δσc and Δu → **B**), consolidation **ΔVc**, measured **ΔHc** (blank: Hc is calculated with ISO 17892-9 formula 3).

The **readings** table takes the measurements **from the start of shearing**: **ΔH** (shortening), **P** (axial force), **u** (consolidated tests) and **ΔV** (drained tests, volume decrease positive). The grey columns (εsv, σv − σh, σ′1, σ′3) are calculated. The 📥 **Import Excel…**, 📤 **Export Excel…** and ▶ **Calculate** buttons are above the table (section 5.6).

Results tab: - summary cards: c′ and φ′ (or cu), cu = cuo + λcu·σ′c, test type and standard, failure criterion, warnings (orange) or « no warning » (green); - a table of the values at failure for each specimen, with its colour; - the charts in a 2 × 2 grid, identical to those of the sheet: deviator stress – strain, Δu or εsvol – strain, Mohr circles, t – s′ stress paths. Double-click a chart to enlarge it.

20.3 Calculation

Formulae of EN ISO 17892-8 (UU) and EN ISO 17892-9 (consolidated tests):

- **corrected area** Acor = (Vi − ΔV) / (Hi − ΔH), ΔH and ΔV counted from set-up (before shearing + shearing);
- **strain** εsv = ΔHs / Hs (shortening during shearing / height at the start of shearing);
- **membrane corrections** (Δσv)m = 4·tm·Em/Dm·(εv + εvol/3) and (Δσh)m = 4·tm·Em/Dm·εvol/3 (UU: (Δσv)m = 4·tm·Em/Dm·εv);
- **stresses** σv = [P + K + σc·(Acor − a)] / Acor − (Δσv)m − (Δσv)fp; σh = σc − (Δσh)m; σ′ = σ − u; Δu = u − uB;
- **failure** by the chosen criterion: peak deviator stress, peak σ′v/σ′h ratio, or specified strain. Without a peak, failure is taken at the failure strain (15 % by default);
- **cu = (σv − σh)f / 2**;
- **c′, φ′** by regression of the failure path t = k + s′·tan α′ (ISO 17892-9 Annex B): sin φ′ = tan α′, c′ = k / cos φ′. CU test without u: ccu, φcu in total stresses (σ − uB). Unsaturated UU: cuu, φuu. CU tests: cu = cuo + λcu·σ′c (NF P 94-070).

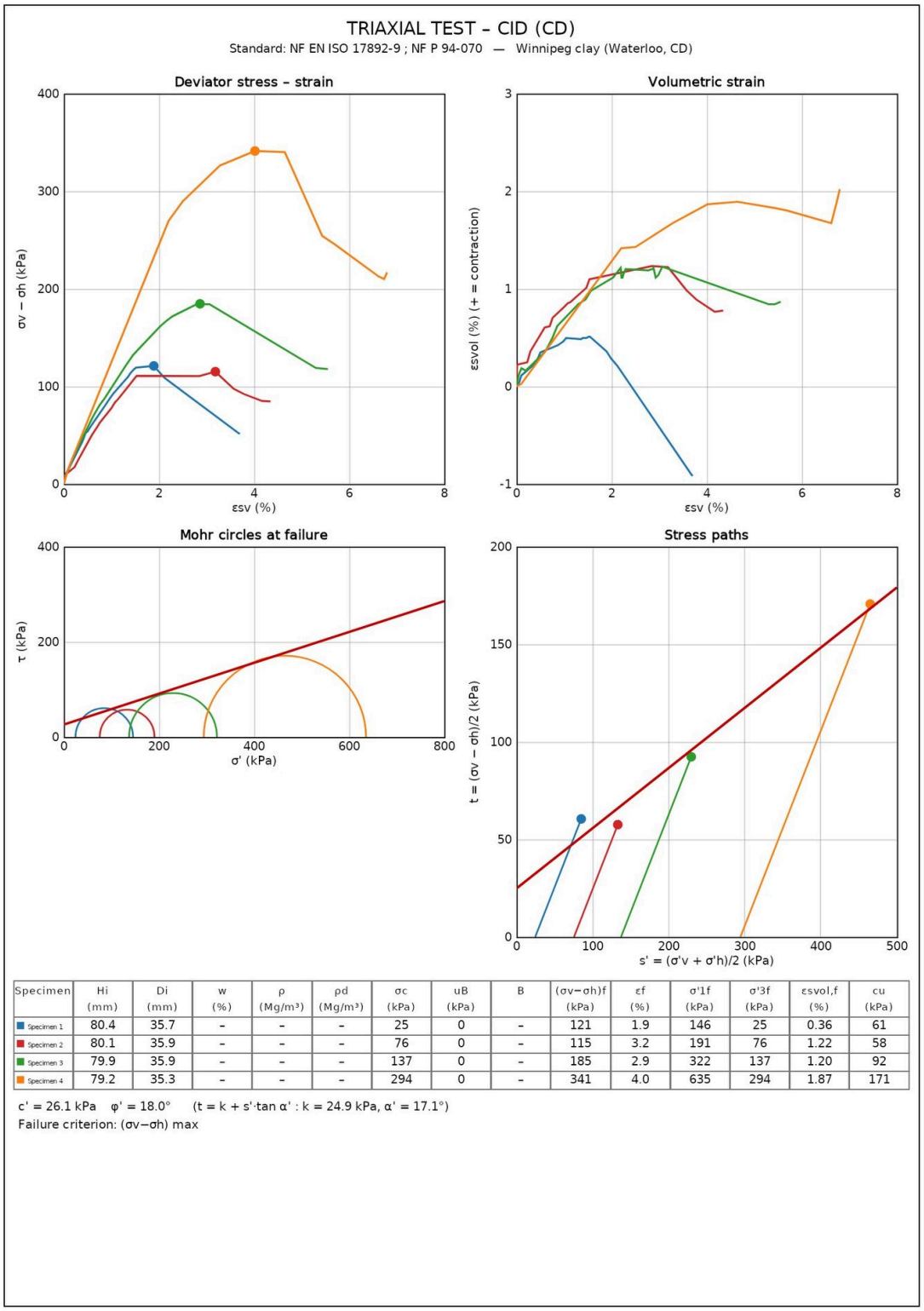
CiviLab reports **B < 0.95** (ISO 17892-9 § 6.3.3.4) and a test stopped too early: before 15 %, before peak + 5 % and before a 20 % drop of the deviator stress (ISO 17892-8 § 6.4.4, ISO 17892-9 § 6.7.1.4).

> **Validation:** the calculation was compared with published real tests: 4 CD tests on Winnipeg clay (raw readings, University of Waterloo) and 4 series of CIU tests by the British Geological Survey, whose published c′ and φ′ are found to within 0.01. The workbook **docs/verification/Validation-Triaxial-7.1.xlsx** contains these data, the calculations as Excel formulae and sheets ready to import.

20.4 The sheet

Ribbon **Mechanical tests ▸ Triaxial ▸ Page**. The sheet contains:

- the (σv − σh) – εsv curve;
- Δu – εsv (undrained tests with u) or εsvol – εsv (drained tests);
- the Mohr circles at failure with the envelope;
- the t – s′ stress paths with the failure line (consolidated tests);
- the results table (dimensions, w, ρ, ρd, σc, uB, B, (σv − σh)f, εf, σ′1f, σ′3f, Δuf or εsvol,f, cu);
- the parameters c′, φ′ (or cu), the failure criterion and the corrections applied.



Specimen	Hi (mm)	Di (mm)	w (%)	ρ (Mg/m³)	ρd (Mg/m³)	σc (kPa)	uB (kPa)	B	(σv−σh)f (kPa)	εf (%)	σ'1f (kPa)	σ'3f (kPa)	εsvol,f (%)	cu (kPa)
Specimen 1	80.4	35.7	–	–	–	25	0	–	121	1.9	146	25	0.36	61
Specimen 2	80.1	35.9	–	–	–	76	0	–	115	3.2	191	76	1.22	58
Specimen 3	79.9	35.9	–	–	–	137	0	–	185	2.9	322	137	1.20	92
Specimen 4	79.2	35.3	–	–	–	294	0	–	341	4.0	635	294	1.87	171

c' = 26.1 kPa φ' = 18.0° (t = k + s'·tan α' : k = 24.9 kPa, α' = 17.1°)
Failure criterion: (σv−σh) max

Test sheet — Triaxial test

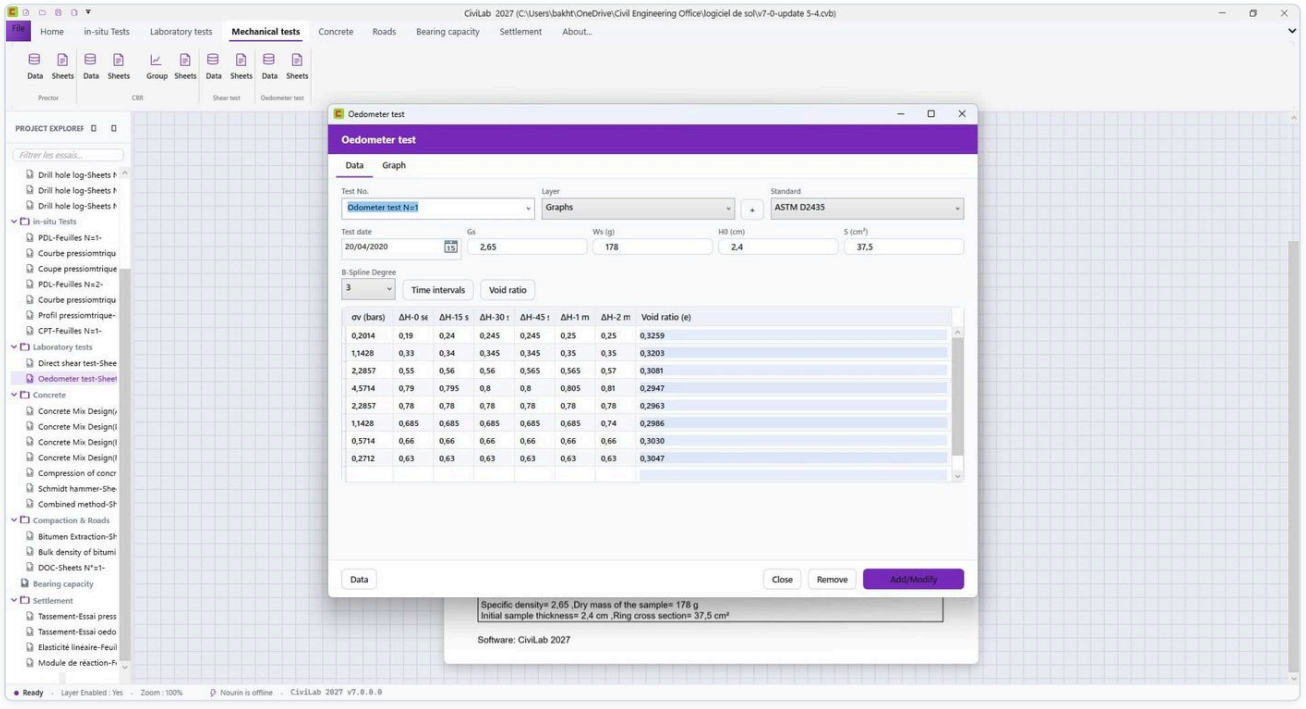
21. Oedometer test

21.1 Purpose and standards

The oedometer test measures the settlement of a specimen under increasing vertical loads, then its swelling on unloading, in timed steps. Standards: **ASTM D2435**, **XP P 94-090-1**.

21.2 Entry

1. **Test No.**, **Test date**, **Standard**, **Layer**.
2. Characteristics: **Specific density** Gs, **Dry mass of the sample** Ws, **Initial sample thickness** H_o, **Ring cross section** S (“Please enter the specific gravity (Gs), dry mass of the sample (Ws), initial height (H_o), and cross-sectional area (S).”).
3. For each **Normal stress** step σv (bars): the dial gauge readings at the **Time intervals** 0 s, 15 s, 30 s, 1, 2, 4, 8, 15, 30 min... until stabilisation.
4. Click **Draw**.



Data entry window — Oedometer test

21.3 Calculation

- height of solids: Hs = Ws / (Gs · ρw · S);
- **Void ratio** at the end of each step: e = (H − Hs) / Hs;
- oedometer curve e - log σ’v;

- **compression index Cc** (slope of the loading branch), **swelling index Cs** (slope of the unloading branch) and **preconsolidation pressure σ'p**.

Plotting options: **B-Spline Degree** (**Degree 2: linear plot**), **Tangent**; values left at 0 are calculated automatically ("For automatic calculation keep the value equal to 0").

Message	Cause
Please calculate the void ratios	Plot requested before the void ratios were calculated
The number of points in the stress list and the void ratio list is not the same	Step without a final reading

21.4 The sheet

Oedometer curve, step table (σv, e) and results Cc, Cs, σ'p.

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Civil engineering software development

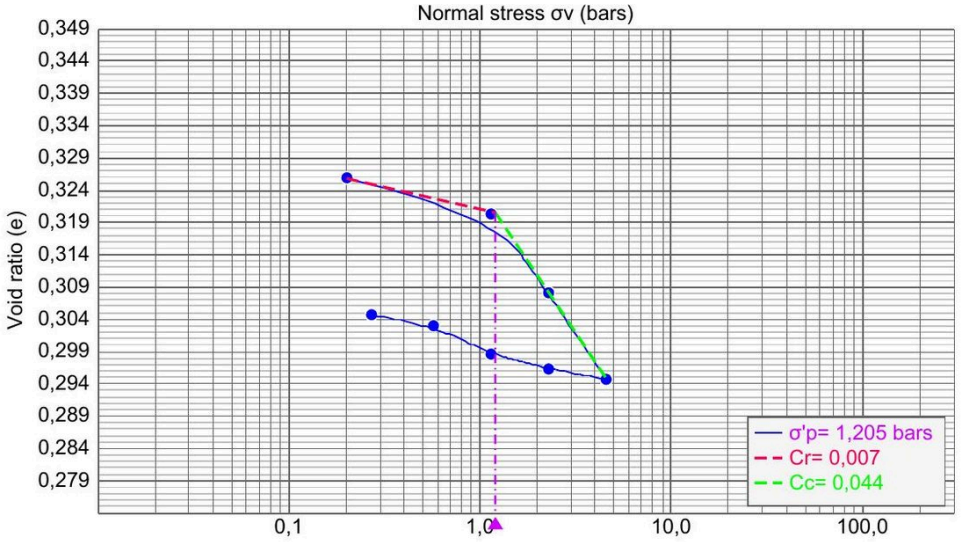
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Project: RN 18 Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2020-04-20

OEDOMETER TEST
ASTM D2435



	1	2	3	4	5	6	7	8	9
σv (bars)	0,201	1,143	2,286	4,571	4,571	2,286	1,143	0,571	0,271
e	0,3259	0,3203	0,3081	0,2947	0,2947	0,2963	0,2986	0,3030	0,3047

Test: Odometer test N=1
Specific density= 2,65 ,Dry mass of the sample= 178 g
Initial sample thickness= 2,4 cm ,Ring cross section= 37,5 cm²

Software: CiviLab 2027

Test sheet — Oedometer test

22. Concrete mix design

22.1 Principle

Mix design selects the concrete components and their proportions to reach the target 28-day strength and the required workability. It has two phases: a **theoretical design** (calculated by CiviLab with one of the methods) then an **experimental adjustment** in the laboratory (trial batches, **Batch Adjustments** button).

CiviLab offers four methods, in the **Concrete** tab: **Dreux-Gorisse**, **Bolomey**, **Faury** and **ACI** (ACI 211.1).

Data common to the Dreux-Gorisse, Bolomey and Faury methods:

- the grading of the **Sands** (one or more, with their proportion: “The sandcomposition must be equal to 100%”) and of the **Gravels** (Gravel No. 01 to No. 03, ticked with **Use**); the **Load** button reuses a grain size analysis of the project;
- the **Relative density** (absolute density) of each component (cement 3.1; sand and gravel 2.65 by default);
- the **mix curve** and the **Display** tab (**Show tables** of the sands and gravels on the sheet).

> **Warning:** the passing values of each aggregate must start at 100 %; Gravel No. 03 can only be used after Gravel No. 02.

22.2 Dreux-Gorisse method

General tab:

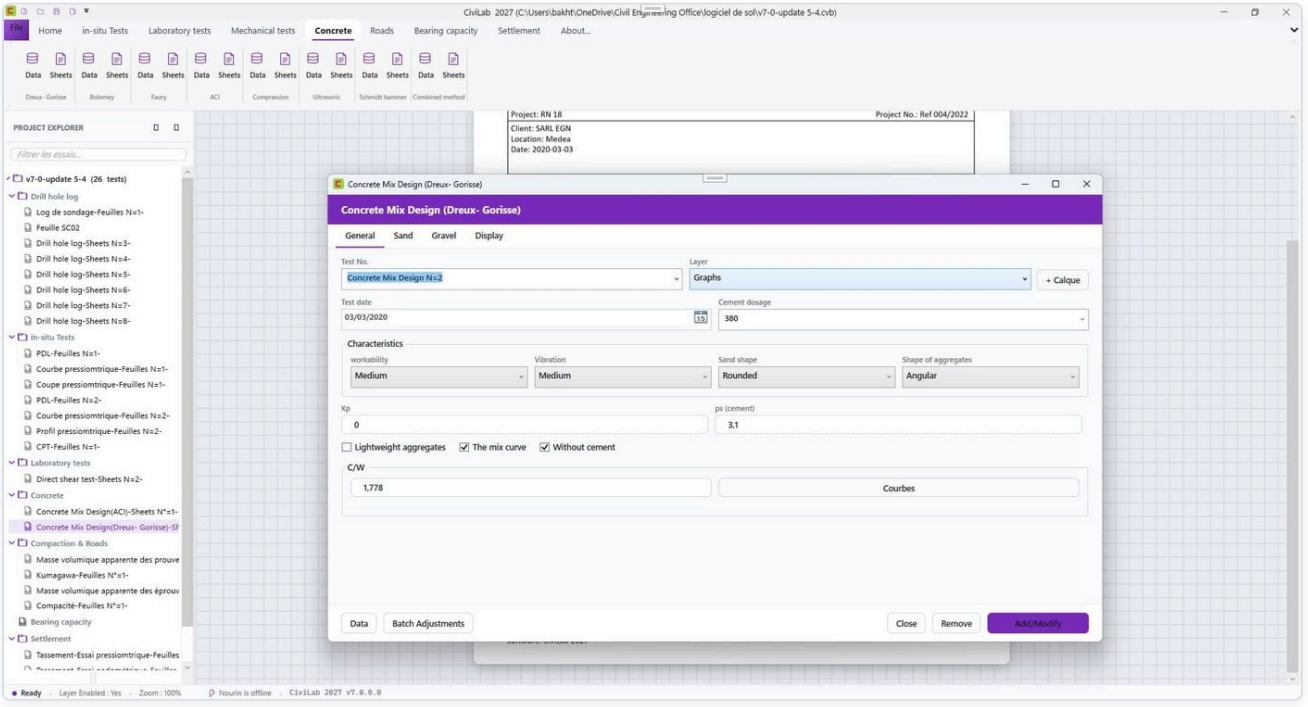
Field	Values
workability	Low, Medium, High (dry, plastic, soft), Fluid
Cement dosage	200, 250, 300, 350, 400 kg/m³, **400 + Fluid**
Vibration	**Low**, **Medium**, **High**, **Hand rodding**
Sand shape / **Shape of aggregates**	**Rounded** or **Angular**
Dmax match	Dmax used for the reference curve
Pumpable correction	Additional correction if the concrete is pumpable (between +5 and +8)
C/W	Cement / water ratio, read on the chart (**Curves** button)

Field	Values
Options	**Lightweight aggregates**, **The mix curve**, **Without cement**

The **Curves** button opens the **C/W** chart: depending on the workability (slump) or depending on the concrete strength (Bolomey formula).

Calculation: CiviLab draws the reference grading curve OAB (break point A depending on Dmax, aggregate shape, vibration and dosage), determines the proportion of each aggregate with the dividing lines, then calculates for 1 m³: water, cement, masses and volumes of sand and gravel, and the theoretical density.

> **Warning:** the method does not apply with a cement dosage below 200 kg/m³ or above 400 kg/m³ (without admixture): “Impossible to use the Dreux-Gorisse mix design with a cement dosage lower than 200 kg/m³ or higher than 400 kg/m³, even with admixtures.”



Data entry window — Dreux-Gorisse method

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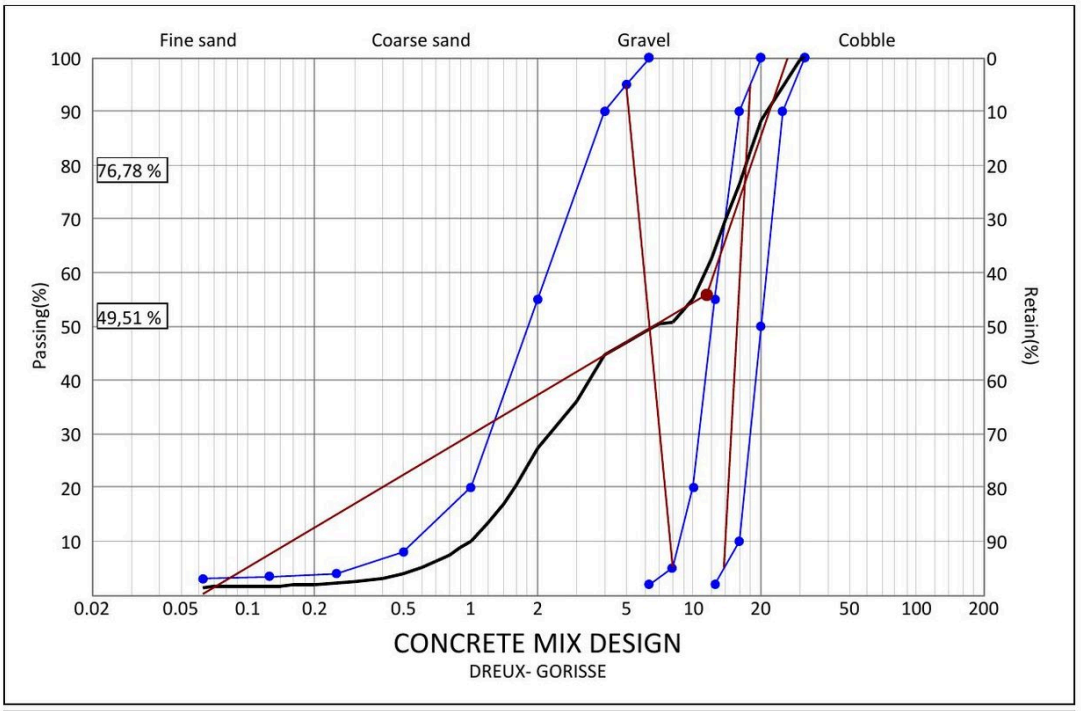
Civil engineering software development

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Project: RN 18 — Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2020-03-03



Sieve	Passing(%)
6,3	100
5	95,00
4	90,00
2	55,00
1	20,00
0,5	8,00
0,25	4,00
0,125	3,50
0,063	3,00

Sable

Sieve	Passing(%)
20	100
16	90,00
12,5	55,00
10	20,00
8	5,00
6,3	2,00

Gravier 08/15

ρs = 2,6 t/m³

Sieve	Passing(%)
31,5	100
25	90,00
20	50,00
16	10,00
12,5	2,00

Gravier 15/25

ρs = 2,6 t/m³
Dmax = 26,18 mm

Designation	Percentage(%)	Volume(L)	Mass(kg)
Sand	49,51	347,13	902,53
Gravel N°1	27,27	191,20	497,12
Gravel N°2	23,22	162,78	423,24
Cement	/	122,58	380,00
Water	/	213,72	213,72

K0 = 0,800 ,Ks = 10,170 ,Kp = 0,000
C0 = 0,828 ,C1 = 0-,010 ,C2 = 0,000 ,C3 = 0,006

Software: CiviLab 2027

Test sheet — Dreux-Gorisse method

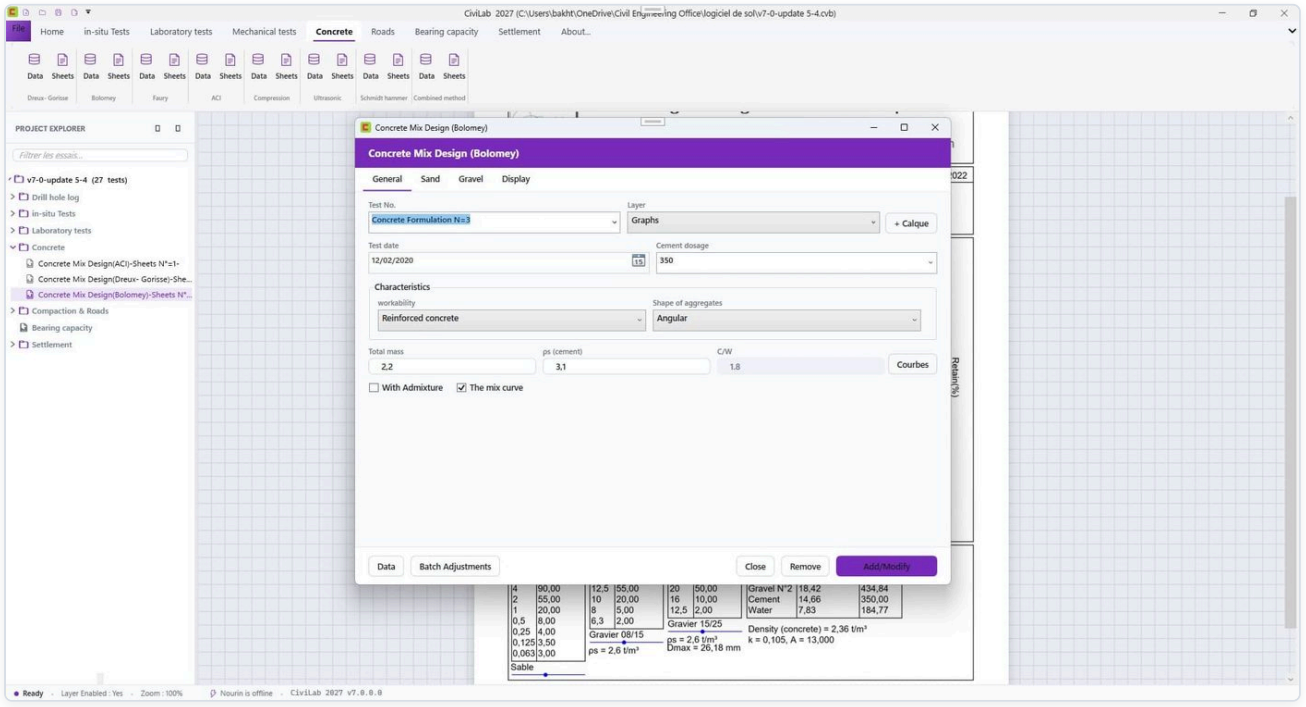
22.3 Bolomey method

General tab: **Shape of aggregates** (**Rounded** / **Angular**), **Cement dosage**, **Dmax match**, **C/W**, **workability** depending on placing (**Groomed concrete**, **Reinforced concrete**, **Concrete poured**), **Weighing concrete in tonnes per cubic meter**, **With**

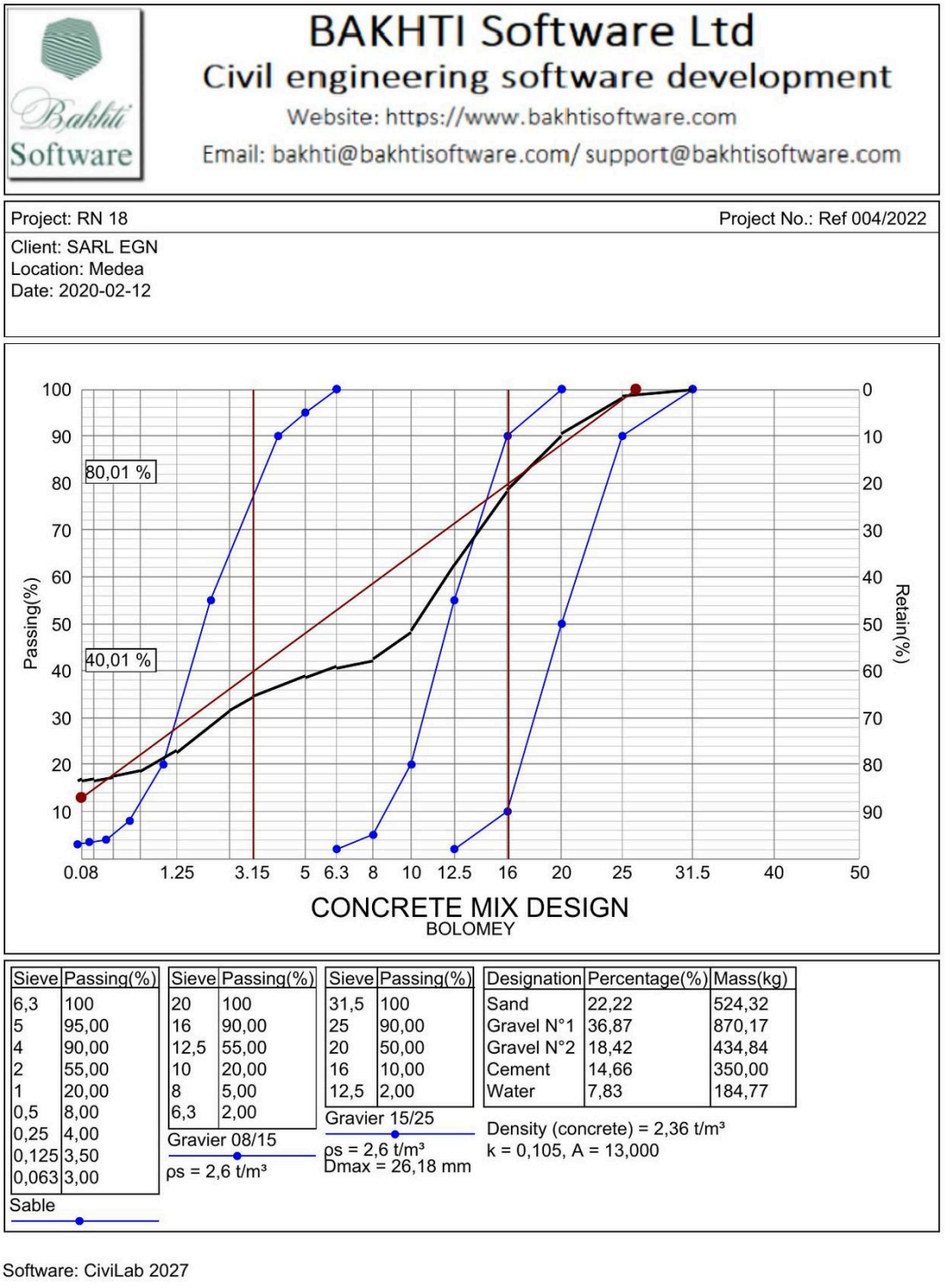
Admixture.

Calculation: the Bolomey reference curve **P = A + (100 − A) · √(d / D)** (A depends on aggregate shape and workability); CiviLab fits the aggregate proportions to this curve, then calculates the quantities for 1 m³.

> **Warning:** the Bolomey method only applies to aggregates with an absolute density between 2.5 and 2.7 t/m³.



Data entry window — Bolomey method



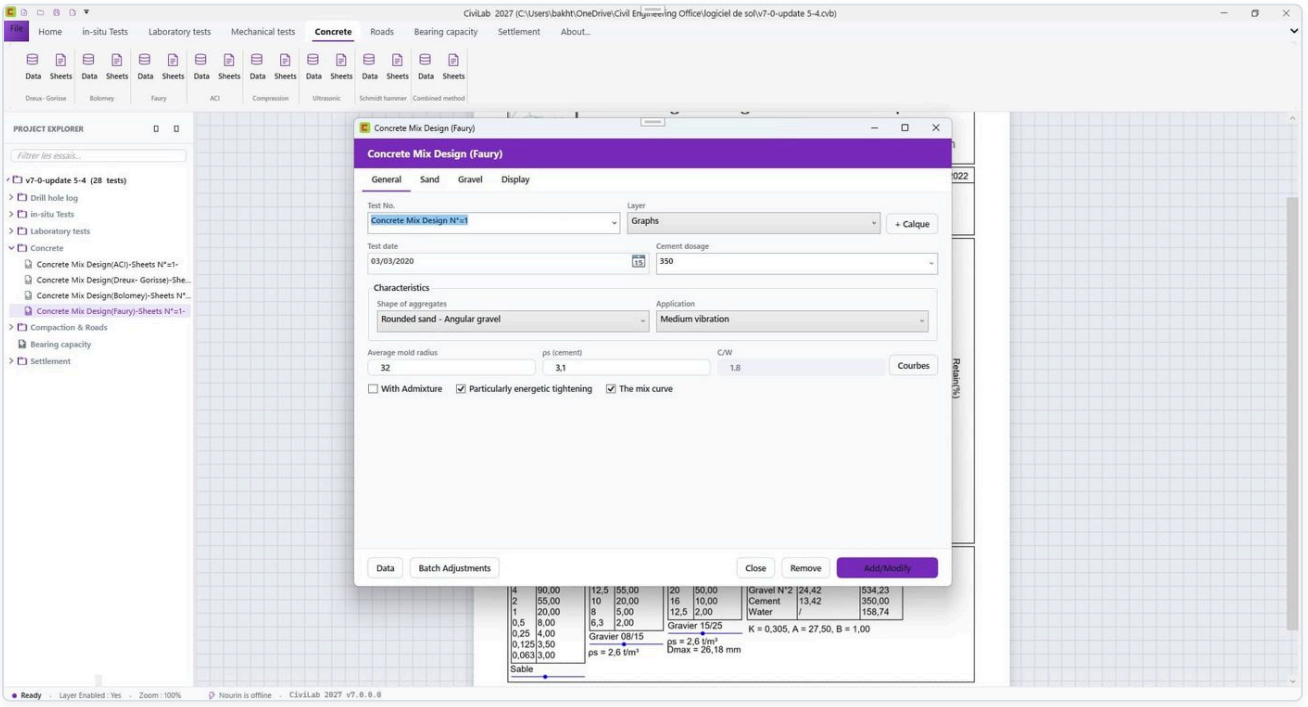
Test sheet — Bolomey method

22.4 Faury method

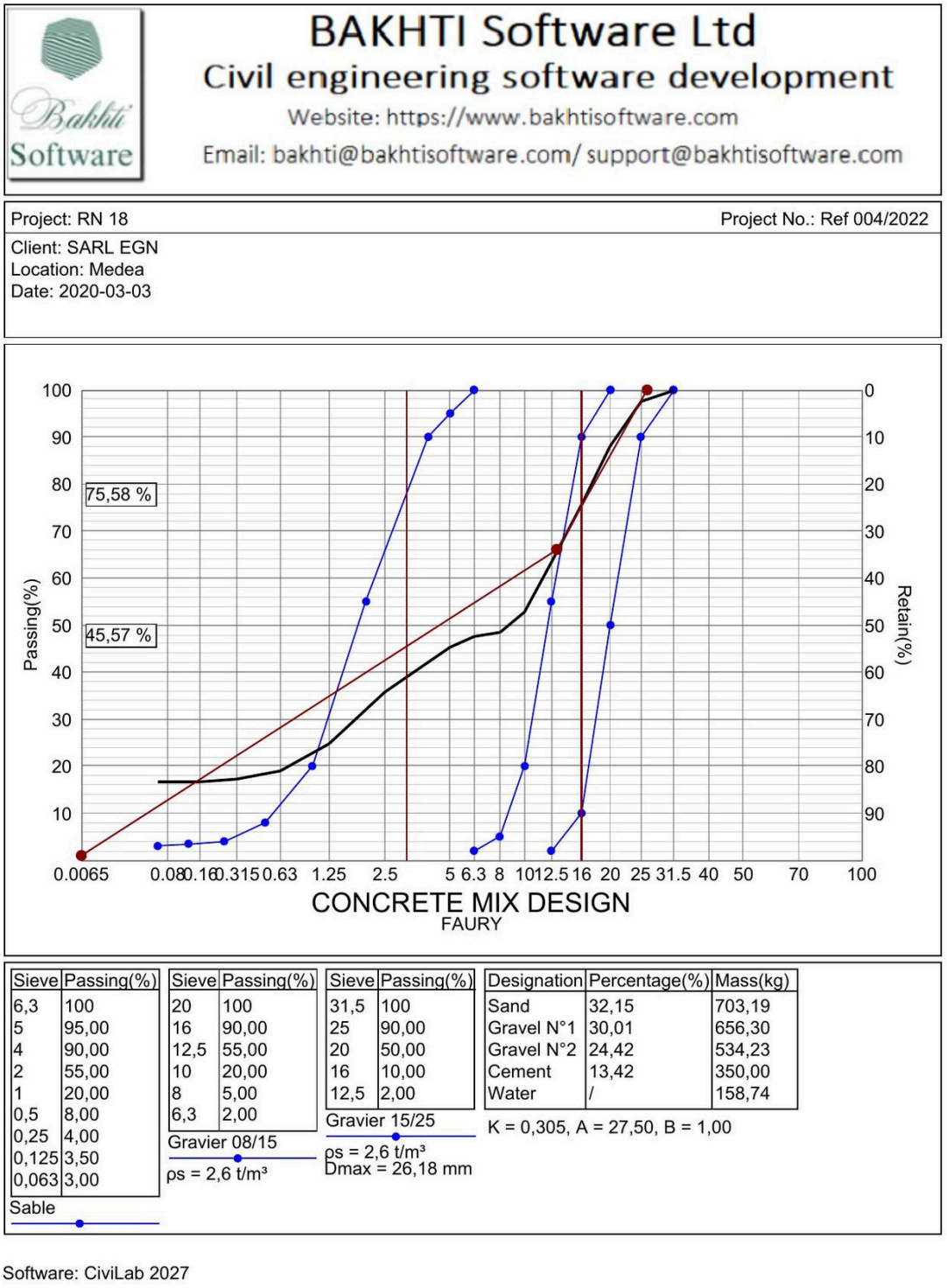
General tab: **Dmax match**, **Cement dosage**, **Shape of aggregates** (**Rounded sand - Rounded gravel**, **Rounded sand - Angular gravel**, **Angular sand - Angular gravel**), **C/W**, **Application** (**Hand rodding**, **Medium vibration**, **High vibration**, **Powerful**

vibration, **Particularly energetic tightening**), **Average mold radius** R, **With Admixture**.

Calculation: the Faury reference curve, a broken line plotted against $\sqrt[5]{d}$, whose break point at D/2 has the ordinate **$y = A + 17.8 \cdot \sqrt[5]{D} + B / (R / (1.25 \cdot D) - 0.75)$** (square-mesh sieves; 17 and R / D with round-hole screens) (A and B depending on aggregate shape and placing); origin at the 0.0065 mm sieve (0 %), end point (D; 100 %). Water = voids index **$n = K / \sqrt[5]{D} + K' / (R / D - 0.75)$** (K′ = 0.004 rodding, 0.003 medium vibration, 0.002 strong vibration); CiviLab derives the proportions and the quantities for 1 m^3.



Data entry window — Faury method



Test sheet — Faury method

22.5 ACI method (ACI 211.1)

The window has three tabs: **General**, **Materials**, **Results**.

General:

Field	Values
Unit	**SI** (metric) or **FPS** (imperial)
Design strength f′c at 28 days	MPa (psi)
Statistical data available	Yes / No; **Standard deviation** if yes (required average strength f′cr)
Exposure condition	Low permeability concrete exposed to water; concrete exposed to freezing and thawing in a moist condition or deicers; corrosion protection of reinforcement against chlorides; not exposed / protected (no limit)
Desired workability (Slump)	25-50 mm, 75-100 mm, 150-175 mm (1-2, 3-4, 6-7 in)
Maximum size of aggregate	mm (in)
Air-entrained concrete	Yes / No; **Level of exposure**: mild, moderate, severe
Sulfate exposure	Negligible, Moderate, Severe, Very severe (sulfate in soil or water)
Type of gravel	Angular, subangular, with some crushed particles, rounded
Underwater concrete	Yes / No
Reduce water by	Water reduction percentage of the water reducer (0 to 30 %)

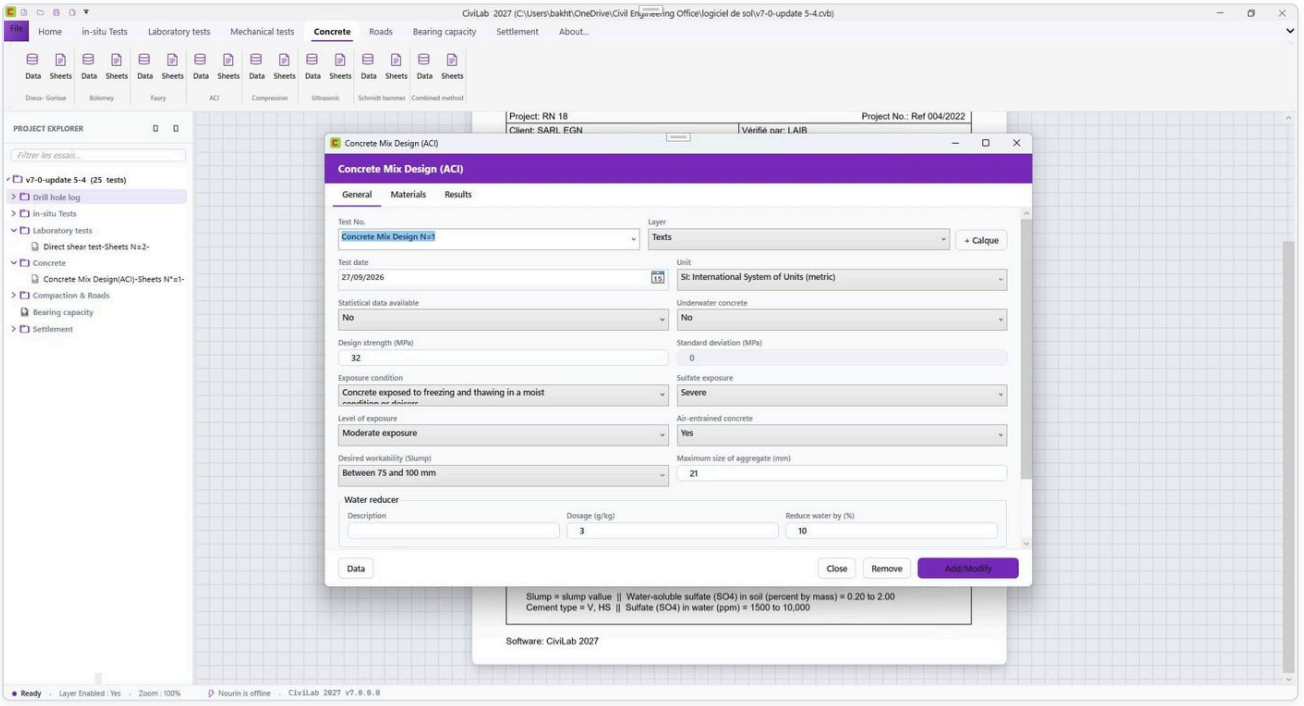
Materials: for cement, sand and gravel, **Description**, **Relative density**, **Density**, **Moisture content**, **Absorption**; **Fineness modulus** of the sand.

Results: for 1 m³, **Water**, **Cement**, **Coarse aggregate**, **Fine aggregate**, **Air-entraining**, **Water reducer**, as **Dry aggregates** and as **Wet aggregates** (corrected for moisture and absorption).

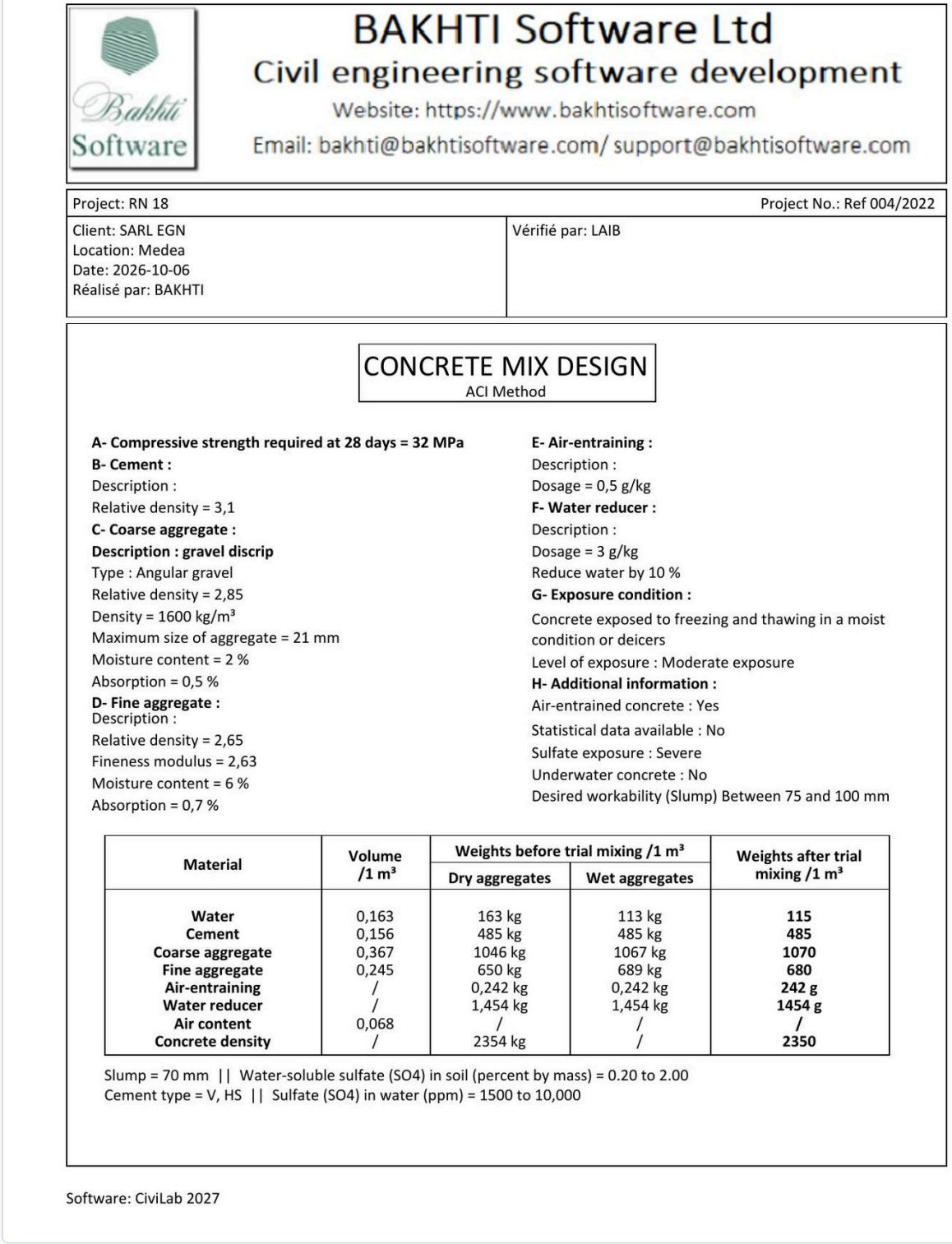
Calculation (ACI 211.1-91 § 6.3, ACI 318): f′cr = f′c + 7 / + 8.5 / 1.10 f′c + 5.0 MPa without standard deviation; w/c from Table 6.3.4(a), limited by exposure and sulfates; water and air from Table 6.3.3 (no allowance added); rounded gravel: −18 kg/m³ (−15 air-entrained); cement = water / (w/c), with underwater and sulfate minimums; coarse aggregate volume from Table 6.3.6 (fineness modulus bounded 2.40–3.00); sand by absolute volumes; moisture corrections § 6.3.9. Admixtures are dosed in **% of cement mass**. Validated on ACI 211.1 Example 1 (water 181, coarse 1136, sand 774, added water 123 kg/m³).

Batch Adjustments: after the trial batch, enter the measured **Slump**, the **Concrete density** and the **Air content**; CiviLab corrects the **Weights before trial mixing** to give the **Weights after trial mixing**.

Message	Cause
The water reduced value must be between 0 and 30	Water reduction out of range
Relative density of coarse (fine) aggregate is less than or equal to 0	Missing relative density



Data entry window — ACI method (ACI 211.1)



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Project: RN 18 — Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2026-10-06
Réalisé par: BAKHTI

Vérifié par: LAIB

CONCRETE MIX DESIGN

ACI Method

A- Compressive strength required at 28 days = 32 MPa
B- Cement :
Description :
Relative density = 3,1
C- Coarse aggregate :
Description : gravel discrip
Type : Angular gravel
Relative density = 2,85
Density = 1600 kg/m³
Maximum size of aggregate = 21 mm
Moisture content = 2 %
Absorption = 0,5 %
D- Fine aggregate :
Description :
Relative density = 2,65
Fineness modulus = 2,63
Moisture content = 6 %
Absorption = 0,7 %

E- Air-entraining :
Description :
Dosage = 0,5 g/kg
F- Water reducer :
Description :
Dosage = 3 g/kg
Reduce water by 10 %
G- Exposure condition :
Concrete exposed to freezing and thawing in a moist condition or deicers
Level of exposure : Moderate exposure
H- Additional information :
Air-entrained concrete : Yes
Statistical data available : No
Sulfate exposure : Severe
Underwater concrete : No
Desired workability (Slump) Between 75 and 100 mm

Material	Volume /1 m³	Weights before trial mixing /1 m³		Weights after trial mixing /1 m³
		Dry aggregates	Wet aggregates	
Water	0,163	163 kg	113 kg	**115**
Cement	0,156	485 kg	485 kg	**485**
Coarse aggregate	0,367	1046 kg	1067 kg	**1070**
Fine aggregate	0,245	650 kg	689 kg	**680**
Air-entraining	/	0,242 kg	0,242 kg	**242 g**
Water reducer	/	1,454 kg	1,454 kg	**1454 g**
Air content	0,068	/	/	**/**
Concrete density	/	2354 kg	/	**2350**

Slump = 70 mm || Water-soluble sulfate (SO4) in soil (percent by mass) = 0.20 to 2.00
Cement type = V, HS || Sulfate (SO4) in water (ppm) = 1500 to 10,000

Software: CiviLab 2027

Test sheet — ACI method (ACI 211.1)

22.6 Mix design sheets

Grading curves of the components, reference curve and mix curve, dosage table for 1 m³ (volumes and masses), C/W ratio and density.

23. Concrete compression

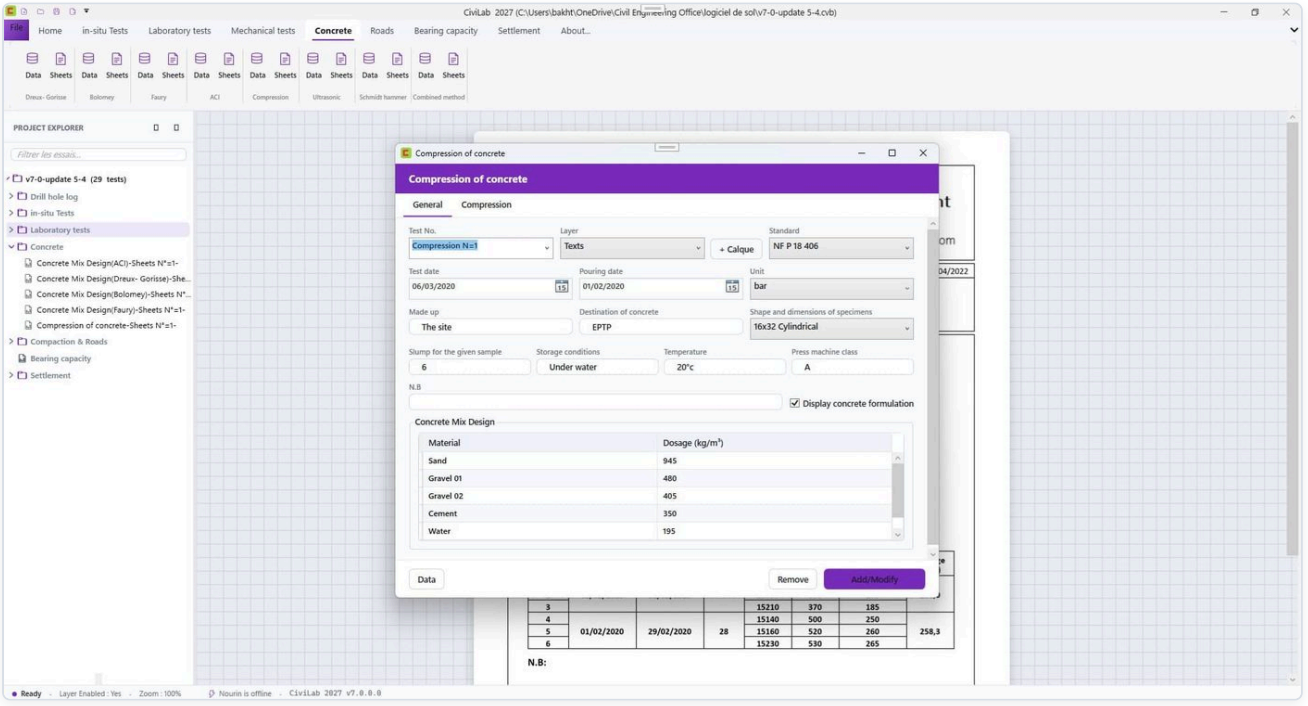
23.1 Purpose and standards

The compression test measures the strength of a specimen (cylinder, cube or core) loaded until failure. Standards: **ASTM C39**, **NF P 18-406**.

23.2 Entry

General tab (test report information): **Test No.**, **Pouring date**, **Test date**, **Standard**, **Layer**, **Made up** (on site, in the laboratory), **Destination of concrete** (posts, beams...), **Shape and dimensions of specimens** (16×32 and 11×22 cylinders; 10, 15, 20 cm cubes; 6×12 and 4×8 inch in FPS), **Slump**, **Storage conditions** (under water...), **Temperature**, **Press machine class**, **N.B**, **Unit**. **Display concrete formulation** shows a project mix design on the sheet (materials and dosages).

Compression tab: for each specimen, **Specimen No.**, age in **Days**, **Mass**, **Failure load**.



Data entry window — Concrete compression

23.3 Calculation and sheet

Compressive strength fc = F / A (A: specimen cross-section), for each specimen, and average per age.

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Project: RN 18 — Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2020-03-06

CONCRETE COMPRESSION TEST

Standard: NF P 18 406

Test: Compression N=1
Made up : The site
Destination of concrete: EPTP

Concrete Mix Design	Material	Dosage (kg/m³)	Material	Dosage (kg/m³)
	Sand	945	Cement	350
	Gravel 01	480	Water	195
	Gravel 02	405	/	/

Shape and dimensions of specimens: 16x32 Cylindrical
Slump for the given sample : 6
Storage conditions: Under water
Temperature: 20°c
Press machine class: A

Specimen	Pouring date	Test date	Age (D)	Mass (kg)	Failure load (kN)	Compressive strength (bars)	Average (bars)
1	01/02/2020	08/02/2020	7	15,12	360	180	180,0
2				15,09	350	175	
3				15,21	370	185	
4	01/02/2020	29/02/2020	28	15,14	500	250	258,3
5				15,16	520	260	
6				15,23	530	265	

N.B:

Software: CiviLab 2027

Test sheet — Concrete compression

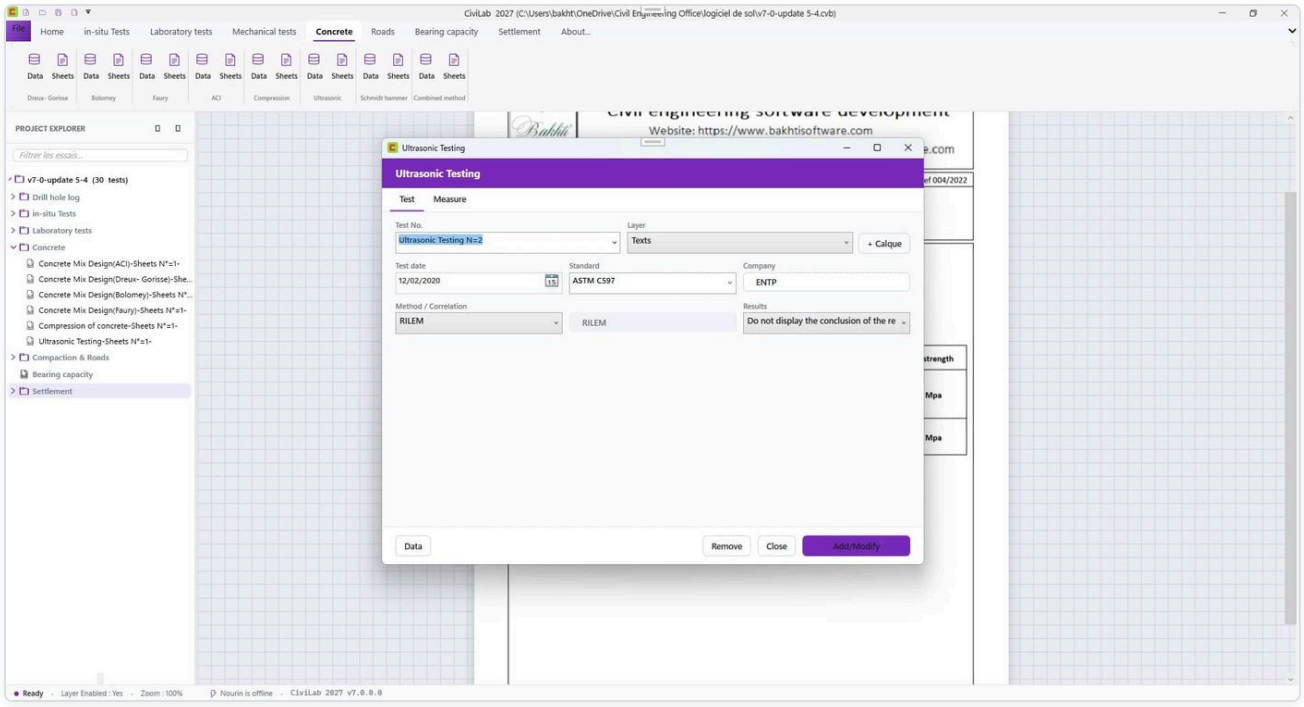
24. Ultrasonic testing

24.1 Purpose and standards

The test measures the transit time of a longitudinal ultrasonic pulse through a concrete element; the pulse velocity depends on concrete quality and, by correlation, on its strength. Standard: **ASTM C597**. Correlations: **RILEM curve**, **Yun et al. (1988)**, **Canadian recommendations**, **CNERIB**, **Other...** (user-defined correlation).

24.2 Entry and calculation

1. **Information** tab: **Test No.**, **Test date**, **Standard**, **Layer**, **Company**, **Method / Correlation**.
2. **Measurements** tab: **Block** > **Level** > **Element** structure; for each measurement, **Ref.**, **Distance** and **Time**.
3. CiviLab calculates the **Speed** V = distance / time, the concrete quality (**Very bad**, **bad**, **Doubtful**, **Good**, **Excellent**) and the **Strength** estimated by the correlation, then the **Average strength** of the element.
4. Sheet conclusion: **Do not display the conclusion of the result**, **Accepted result**, **Result is not accepted**. **Recalculate** reruns the calculation after a change of correlation.



Data entry window — Ultrasonic testing

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Project: RN 18 — Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2020-02-12

ULTRASONIC TESTING

Standard: ASTM C597

Test: Ultrasonic Testing N=2
Company: ENTP
Method / Correlation: RILEM

Block	Level	Element	Ref.	Distance (cm)	Time (µs)	Speed (m/s)	Strength	Average strength
A01	1	P01	1	35	90	3888,89	21,43 Mpa	**22,41 Mpa**
			2	35	89	3932,58	22,34 Mpa	
			3	35	85	4117,65	26,59 Mpa	
			4	35	92	3804,35	19,82 Mpa	
A01	1	P02	1	35	85	4117,65	26,59 Mpa	**30,71 Mpa**
			2	35	79	4430,38	35,51 Mpa	
			3	35	82	4268,29	30,61 Mpa	

Software: CiviLab 2027

Test sheet — Ultrasonic testing

25. Rebound hammer

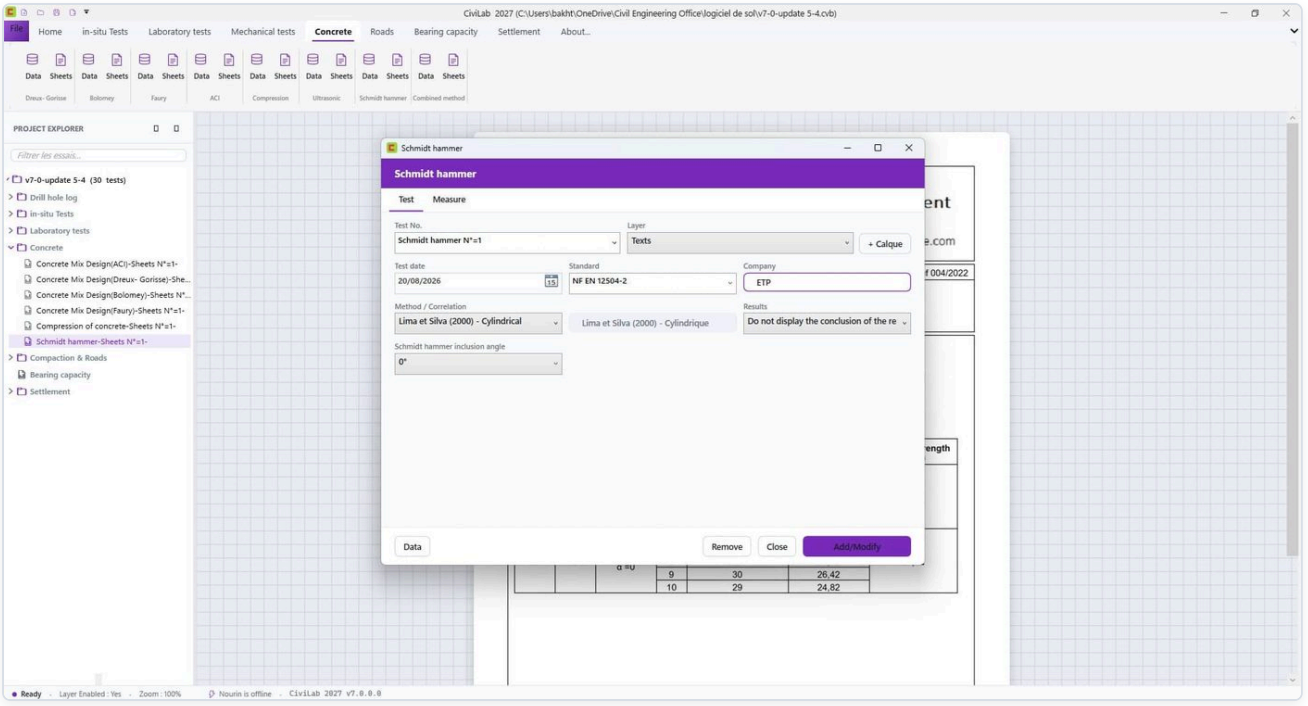
25.1 Purpose and standards

The rebound hammer test measures the rebound index of a mass projected against the concrete surface; this index is converted into strength by a correlation. Standard: **ASTM C805**. Methods: **I²/32**, **Lima et Silva (2000) - Cylindrical**, **Gonçalves (1995) - Cylindrical**, **Boukhelkhal (2015) - Cylindrical**, **Rebound Hammer Test Graph** (single conversion curve), **Other...**

25.2 Entry and calculation

Concrete > Rebound hammer > Data opens the same window as ultrasonic testing, in rebound hammer mode:

1. **Method / Correlation**, **Block** > **Level** > **Element** structure, **Schmidt hammer inclusion angle** α of each element.
2. For each reference: the **Rebound numbers**.
3. CiviLab discards outliers, applies the orientation correction, calculates the average index, the corresponding **Strength** (MPa) and the **Average strength** of the element and level.



Data entry window — Rebound hammer

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Project: RN 18 Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2026-08-20

REBOUND HAMMER TEST
Standard: NF EN 12504-2

Test: Schmidt hammer N°=1
Company:
Correlation: Lima et Silva (2000) - Cylindrique

Block	Level	Element	Ref.	Rebound number	Strength (MPa)	Average strength (MPa)
A1	RDC	P1 α =0	1	25	18,88	**21,27**
			2	24	17,51	
			3	26	20,29	
			4	28	23,26	
			5	30	26,42	
A1	RDC	P2 α =0	6	31	28,06	**27,12**
			7	33	31,49	
			8	29	24,82	
			9	30	26,42	
			10	29	24,82	

Software: CiviLab 2027

Test sheet — Rebound hammer

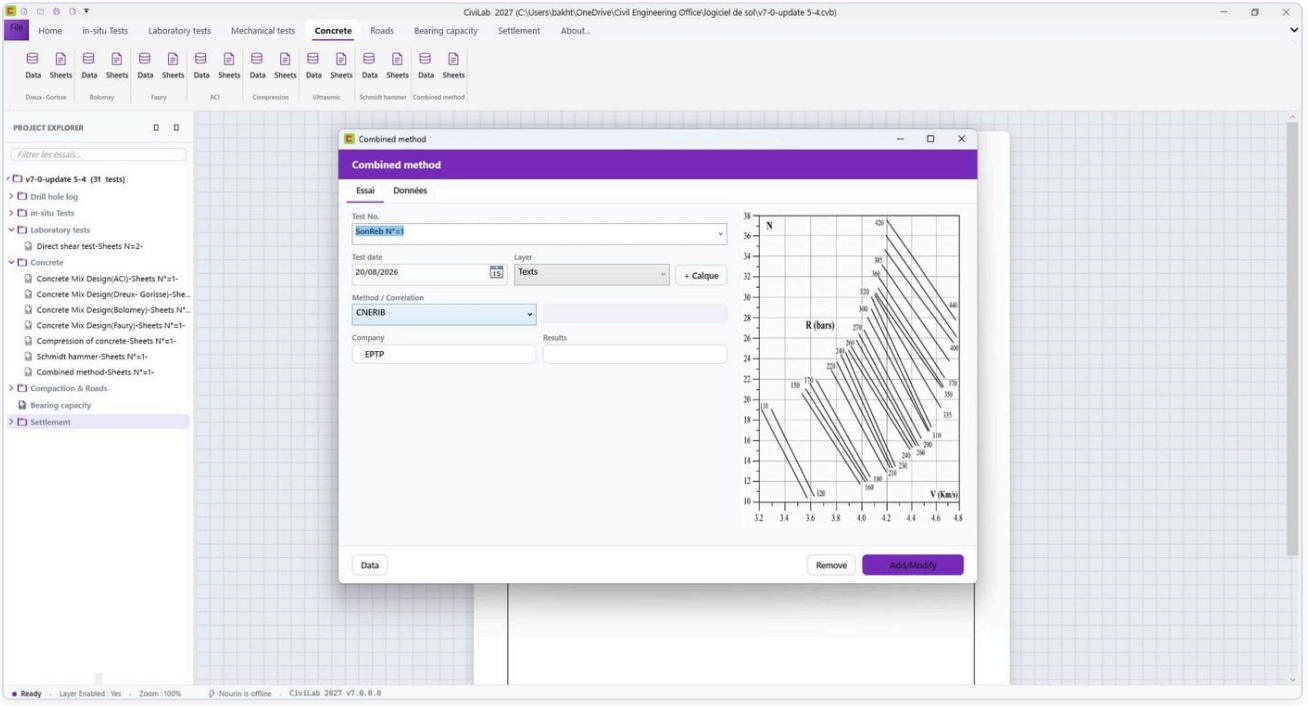
26. Combined method (SonReb)

26.1 Purpose

The SonReb method combines the ultrasonic pulse velocity V and the rebound number R to estimate the strength of ordinary concrete (aggregates up to 25 mm). Correlations: **CNERIB**, **Meynink et al. (1979)**, **Bellander. (1979)**, **Arioglu et al. (1996)**, **Faella et al. (2011)**, **Other...**

26.2 Entry and calculation

1. **Test No.**, **Test date**, **Layer**, **Company**, **Method / Correlation**.
2. For the CNERIB method: **Cement type** (CPA, CPJ, CRS), **Cement dosage** (200 to 400 kg/m³) and **Admixture** (**Water repellent admixtures**, **Superplasticizers / Water-reducing**, **Retarding / Plasticizer**); CiviLab applies the corresponding correction coefficients (cement, dosage, admixture).
3. **Block** > **Level** > **Element** structure; for each **Ref.**: **Rebound value** R, **Distance** and **Time**; CiviLab calculates the **Speed** and the **Strength** (MPa), then the **Average strength**.



Data entry window — Combined method (SonReb)

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Project: RN 18 — Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2026-08-20

COMBINED METHOD

Test: SonReb N°=1
Company: EPTP
Method / Correlation: CNERIB

Cement type: CPA
Cement dosage: 200 Kg/m³
Admixture: Water repellent admixtures

Block	Level	Element	Ref.	Rebound value	Distance (cm)	Time (µs)	Speed (m/s)	Strength	Average strength
A1	RDC	P1	1	26	40	95	4210,53	26,2 MPa	**27,2 MPa**
			2	24	40	94	4255,32	25,5 MPa	
			3	28	40	89	4494,38	32,2 MPa	
			4	25	40	96	4166,67	24,8 MPa	
			5	26	40	94	4255,32	27,1 MPa	

R = Cc x Cd x Cadj x Rab. With : Cc = 1,00 ,Cd = 0,83 ,Cadj = 1,00

Software: CiviLab 2027

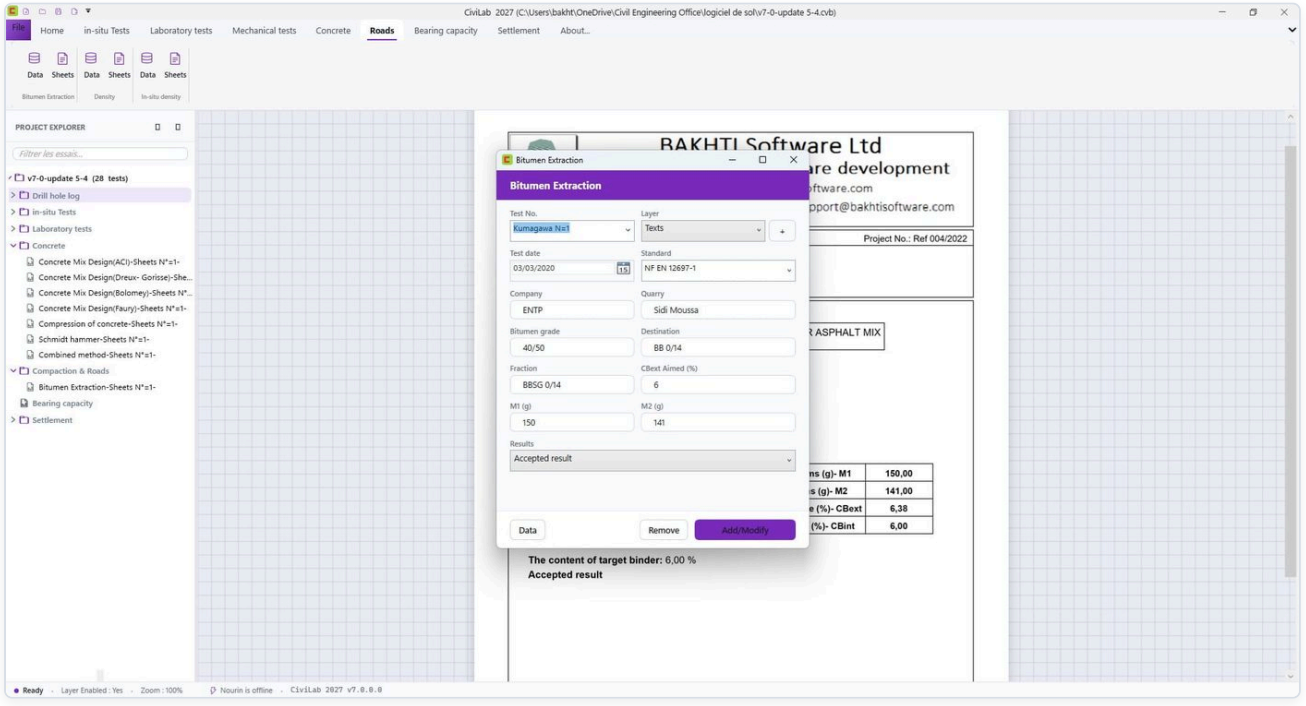
Test sheet — Combined method (SonReb)

27. Road tests

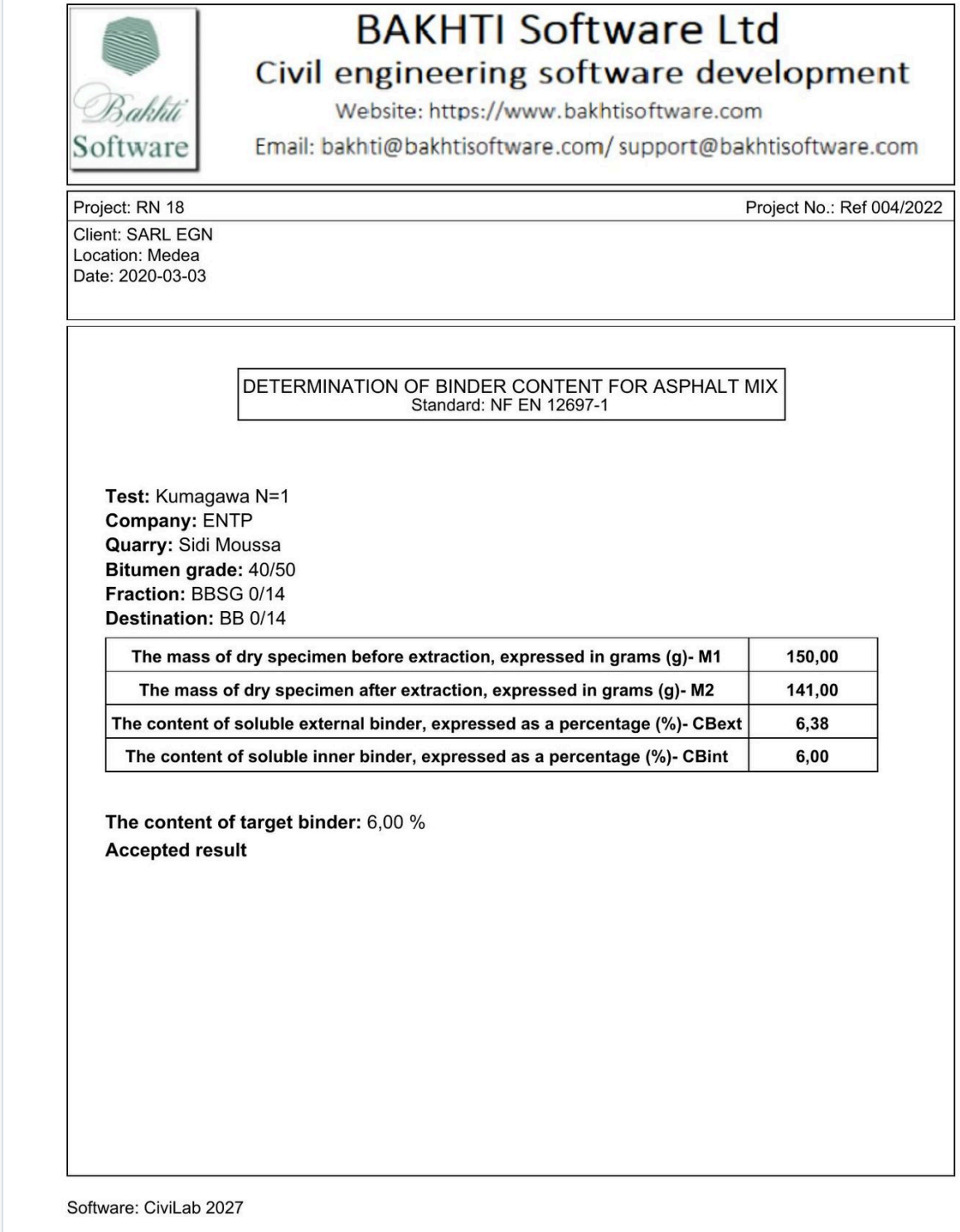
27.1 Bitumen extraction (Kumagawa)

The test determines the binder content of an asphalt mix by hot extraction of the binder with a solvent. Standard: **ASTM D2172**.

1. **Test No.**, **Test date**, **Standard**, **Layer**, **Bitumen grade**, **Destination**, **Fraction**, **Company**, **Quarry**.
2. **M1**: mass of the dry specimen before extraction (g); **M2**: mass after extraction (g); **CBext Aimed**: target external binder content.
3. CiviLab calculates:
   - external binder content **CBext = 100 · (M1 − M2) / M2**;
   - internal binder content **CBint = 100 · (M1 − M2) / M1**;
   - and compares CBext with the target value (**Accepted result** / **Result is not accepted**).



Data entry window — Bitumen extraction (Kumagawa)



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Client: SARL EGN
Location: Medea
Date: 2020-03-03

DETERMINATION OF BINDER CONTENT FOR ASPHALT MIX
Standard: NF EN 12697-1

Test: Kumagawa N=1
Company: ENTP
Quarry: Sidi Moussa
Bitumen grade: 40/50
Fraction: BBSG 0/14
Destination: BB 0/14

The mass of dry specimen before extraction, expressed in grams (g)- M1	**150,00**
The mass of dry specimen after extraction, expressed in grams (g)- M2	**141,00**
The content of soluble external binder, expressed as a percentage (%)- CBext	**6,38**
The content of soluble inner binder, expressed as a percentage (%)- CBint	**6,00**

The content of target binder: 6,00 %
Accepted result

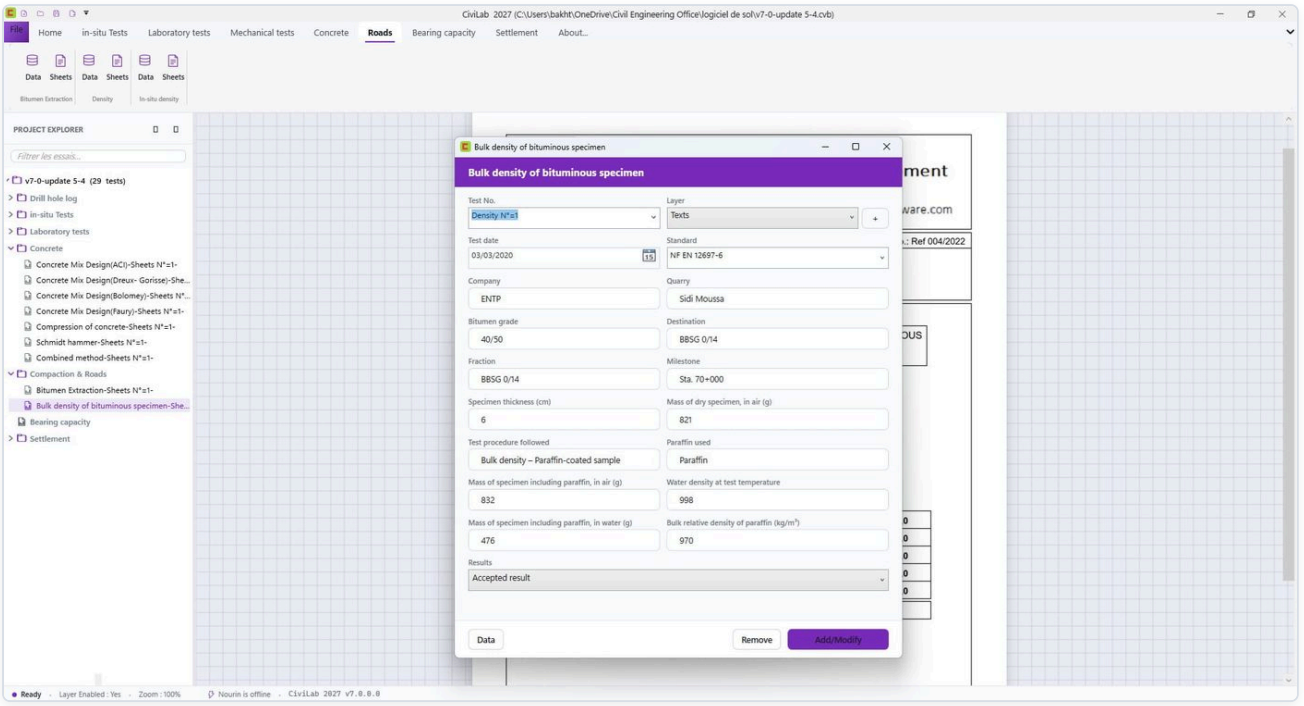
Software: CiviLab 2027

Test sheet — Bitumen extraction (Kumagawa)

27.2 Bulk density of bituminous specimens

Compaction control of asphalt is based on the bulk density of specimens.

1. Identification: **Standard**, **Bitumen grade**, **Destination**, **Fraction**, **Company**, **Quarry**, **Milestone**, **Specimen thickness**, **Test procedure followed**, **Paraffin used**.
2. Measurements: **Mass of dry specimen, in air** m1 (g), **Mass of specimen including paraffin, in air** m2 (g), **Mass of specimen including paraffin, in water** m3 (g), **Water density at test temperature** ρw, **Bulk relative density of paraffin** ρp.
3. Result: **bulk density** of the specimen (kg/m³), compared with the expected value.



Data entry window — Bulk density of bituminous specimens

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Project: RN 18 Project No.: Ref 004/2022

Client: SARL EGN
Location: Medea
Date: 2020-03-03

DETERMINATION OF BULK RELATIVE DENSITY OF COMPACTED BITUMINOUS MIXTURES USING PARAFFIN COATED SPECIMENS
Standard: NF EN 12697-6

Test: Density N°=1
Company: ENTP
Quarry: Sidi Moussa
Bitumen grade: 40/50
Fraction: BBSG 0/14
Destination: BBSG 0/14
Test procedure followed: Bulk density – Paraffin-coated sample
Paraffin used: Paraffin
Milestone: Sta. 70+000
Specimen thickness: 6,00 cm

Mass of dry specimen, in air (g)- M1 (g)	**821,0**
Mass of specimen including paraffin, in air (g)- M2 (g)	**832,0**
Mass of specimen including paraffin, in water (g)- M3 (g)	**476,0**
Water density at test temperature- qw (kg/m³)	**998,0**
Bulk relative density of paraffin- qsm (kg/m³)	**970,0**

Bulk density (qbsea), in kilograms per cubic meter= 2301,56

Accepted result

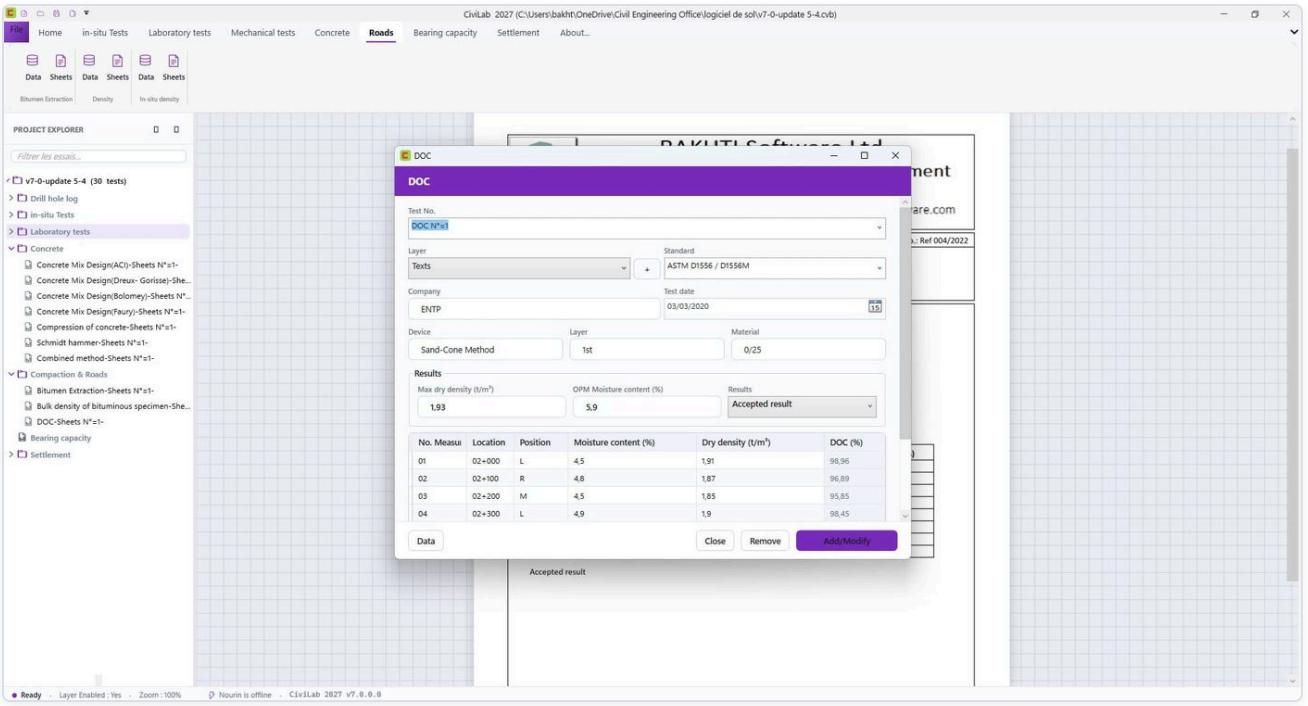
Software: CiviLab 2027

Test sheet — Bulk density of bituminous specimens

27.3 In-situ density

The degree of compaction is the ratio between the dry density measured in place (sand cone, rubber balloon densometer, nuclear gauge...) and the Proctor reference density. Standards: **ASTM D1556 / D1556M**, **NF P 94-061-1**.

1. **Standard**, **Layer**, **Material**, **Max dry density** and **OPM Moisture content** of the Proctor reference, **Device**, **Company**.
2. For each measurement: **No. Measure**, **Location**, **Position**, **Moisture content**, in-place **Dry density**.
3. CiviLab calculates the **degree of compaction = 100 · γd / γd max** of each measurement and concludes (**Accepted result** / **Result is not accepted**).



Data entry window — In-situ density

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Client: SARL EGN
Location: Medea
Date: 2020-03-03

IN-SITU DENSITY MEASUREMENT

Standard: ASTM D1556 / D1556M

Test: DOC N°=1
Company: ENTP
Device: Sand-Cone Method
Layer: 1st
Material: 0/25
Max dry density= 1,93 t/m³
OPM Moisture content= 5,9 %

No. Measure	Location	Position	Dry density	Moisture content	DOC (%)
01	02+000	L	1,91	4,50	98,96
02	02+100	R	1,87	4,80	96,89
03	02+200	M	1,85	4,50	95,85
04	02+300	L	1,90	4,90	98,45
05	02+400	R	1,88	5,10	97,41
06	02+500	M	1,89	5,20	97,93
07	02+600	R	1,84	5,50	95,34
08	02+700	R	1,86	5,10	96,37

Accepted result

Software: CiviLab 2027

Test sheet — In-situ density

28. Bearing capacity of shallow foundations

28.1 Common principle

The **Bearing capacity** tab calculates the allowable stress of a shallow footing (isolated, strip or raft) from the project's tests:

Ribbon group	Method	Test used	Standards
Laboratory tests	c-φ method	Shear parameters	Eurocode 7 (NF P 94-261), DTR BC 2.331, DTU 13.12
Pressuremeter test	Pressuremeter method	Pressuremeter profile	Eurocode 7 (NF P 94-261), DTR BC 2.331, DTU 13.12
Dynamic probing	Penetrometer method	DPT test	DTR BC 2.331, DTU 13.12
CPT	Static penetrometer method	CPT test	Eurocode 7 (NF P 94-261), DTR BC 2.331, DTU 13.12
SPT	Meyerhof, Meyerhof-Bowles, Terzaghi-Peck	SPT test	—

Each calculation has a **Name**, a **Date**, a **Layer** and a **Method** (standard). The sheet recalls the formulas, the data, the **Detailed Calculations** and the result at the **Ultimate Limit State (ULS)** and the **Serviceability Limit State (SLS)** (or with a **Safety factor ≥ 3** under the DTR and DTU), with a sketch of the footing.

Geometric properties (common button): type of footing (**Strip footing**, rectangular, square or circular **Isolated Footings**, **Mat (Raft) Foundations**), width **B**, length **L**, embedment depth **D**, base inclination α, **Embankment** (angle, distance to the edge), **Inclined load** (angle or components H and V), **Eccentric load** (eccentricities eB, eL). The **Sketch** tab illustrates each parameter.

28.2 c-φ method (laboratory tests)

Soil tab: **Method** (**Eurocode 7 (NF P 94-261)**, **DTR BC 2.331**, **DTU 13.12**), **Undrained behaviour** (check box), **Friction angle** φ′, cohesion **C** (kPa), unit weights **γ1** (above the base) and **γ2** (below the base), surcharge **q**; **The average density** calculates γ from layers.

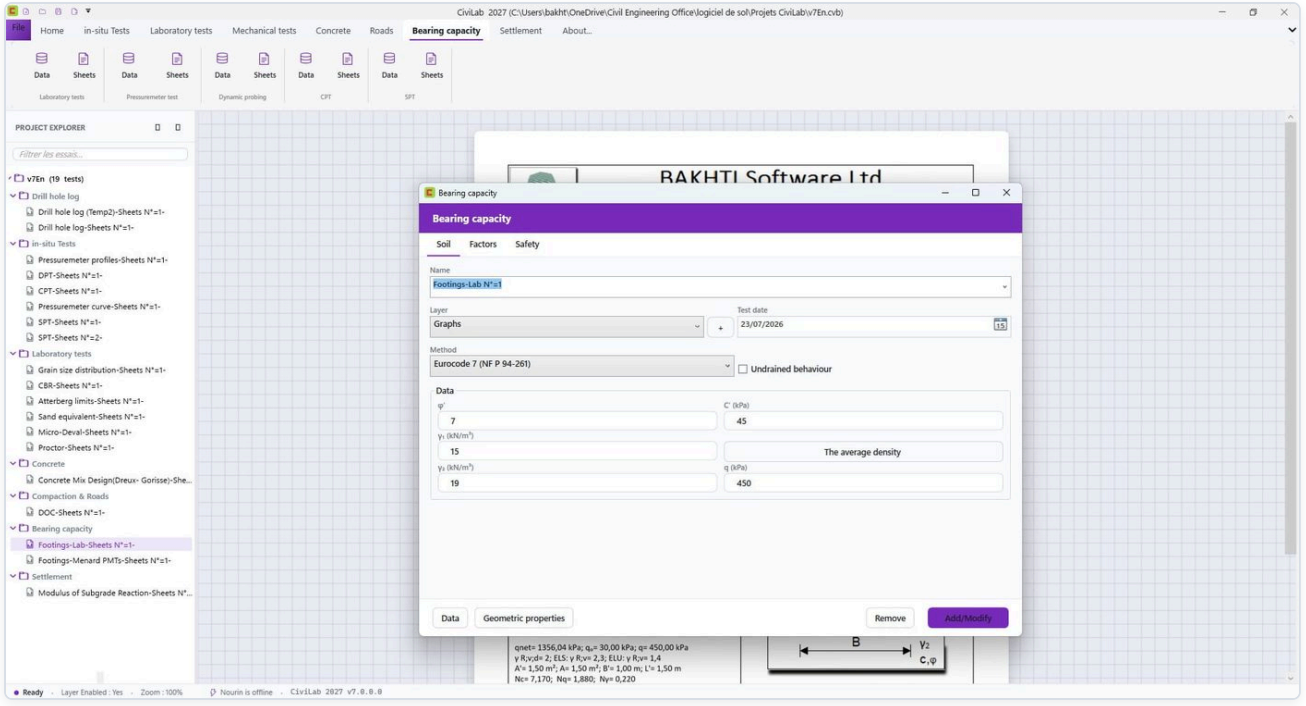
Factors tab: CiviLab automatically determines the **bearing capacity factors Nc, Nq, Nγ**, the **base inclination factors** bc, bq, bγ, the **shape factors** sc, sq, sγ and the **load inclination factors** ic, iq, iγ. They remain editable.

Safety tab: partial factors **γR;v (ULS)** (1.4), **γR;v (SLS)** (2.3) and model factor **γR;d;v**.

Formulas (Eurocode 7):

- drained conditions: **qnet = c′ · Nc · bc · sc · ic + q′0 · Nq · bq · sq · iq + 0.5 · γ′ · B′ · Nγ · bγ · sγ · iγ − q0**;
- undrained conditions: **qnet = (π + 2) · cu · bc · sc · ic**;
- check: **σv;d ≤ qnet / (γR;v · γR;d;v) + q0**.

Under DTR BC 2.331 and DTU 13.12, CiviLab calculates the ultimate stress qu (Terzaghi formula with the effective width B′) and the allowable stress with a safety factor of 3.



Data entry window — c-φ method (laboratory tests)

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Project:

Client:
Location:
Date: 2026-07-23

Bearing capacity: Method C-ϕ

Standard: Eurocode 7 (NF P 94-261)

For drained conditions, the general bearing capacity equation recommended by Eurocode 7:

$$q_{net} = c' N_c b_c s_c i_c + q'_0 N_q b_q s_q i_q + q N_q b_q s_q i_q + 0{,}5\gamma' B' N_\gamma b_\gamma s_\gamma i_\gamma - q'_0$$

With:

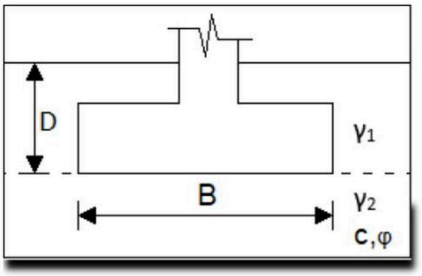
- c': The undrained cohesion of the subgrade of the foundation;
- Nc, Nq et Nγ: Bearing capacity factors;
- γ': The effective density of the soil under the base of the foundation;
- q and q'0 are the overload stress and the effective stress at the foundation base
- bc, bq et bγ: Base inclination correction factors;
- sc, sq et sγ: Shape correction factor;
- ic, iq et iγ: Loads inclination correction factors.

Results

$$\sigma_{V;d} \leq \frac{q_{net}}{\gamma_{R;v}\,\gamma_{R;d;v}} + q_0$$

ELU: σ V;d ≤ 514,30 kPa; ELS: σ V;d ≤ 324,79 kPa

qnet= 1356,04 kPa; q_o= 30,00 kPa; q= 450,00 kPa
γ R;v;d= 2; ELS: γ R;v= 2,3; ELU: γ R;v= 1,4
A'= 1,50 m²; A= 1,50 m²; B'= 1,00 m; L'= 1,50 m
Nc= 7,170; Nq= 1,880; Nγ= 0,220
sc= 1,174; sq= 1,081; sγ= 0,800



Isolated Footings-Rectangular : B= 1 m; L= 1,5 m; D= 2 m
q= 450 kPa; Hw= 9999 m; α(Base angle)= 0°
γ1= 15 kN/m³; γ2= 19 kN/m³; C= 45 kPa

Software: CiviLab 2027

Test sheet — c-φ method (laboratory tests)

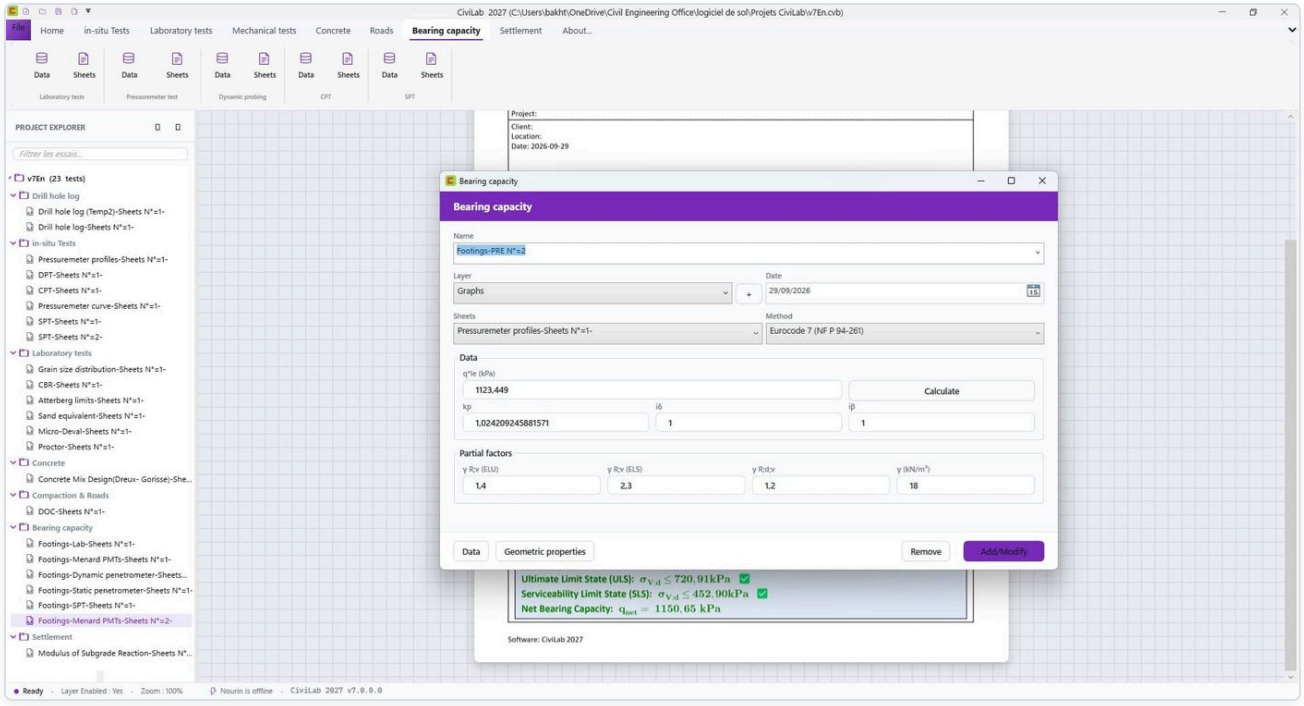
28.3 Pressuremeter method

Bearing capacity > Pressuremeter test > Data:

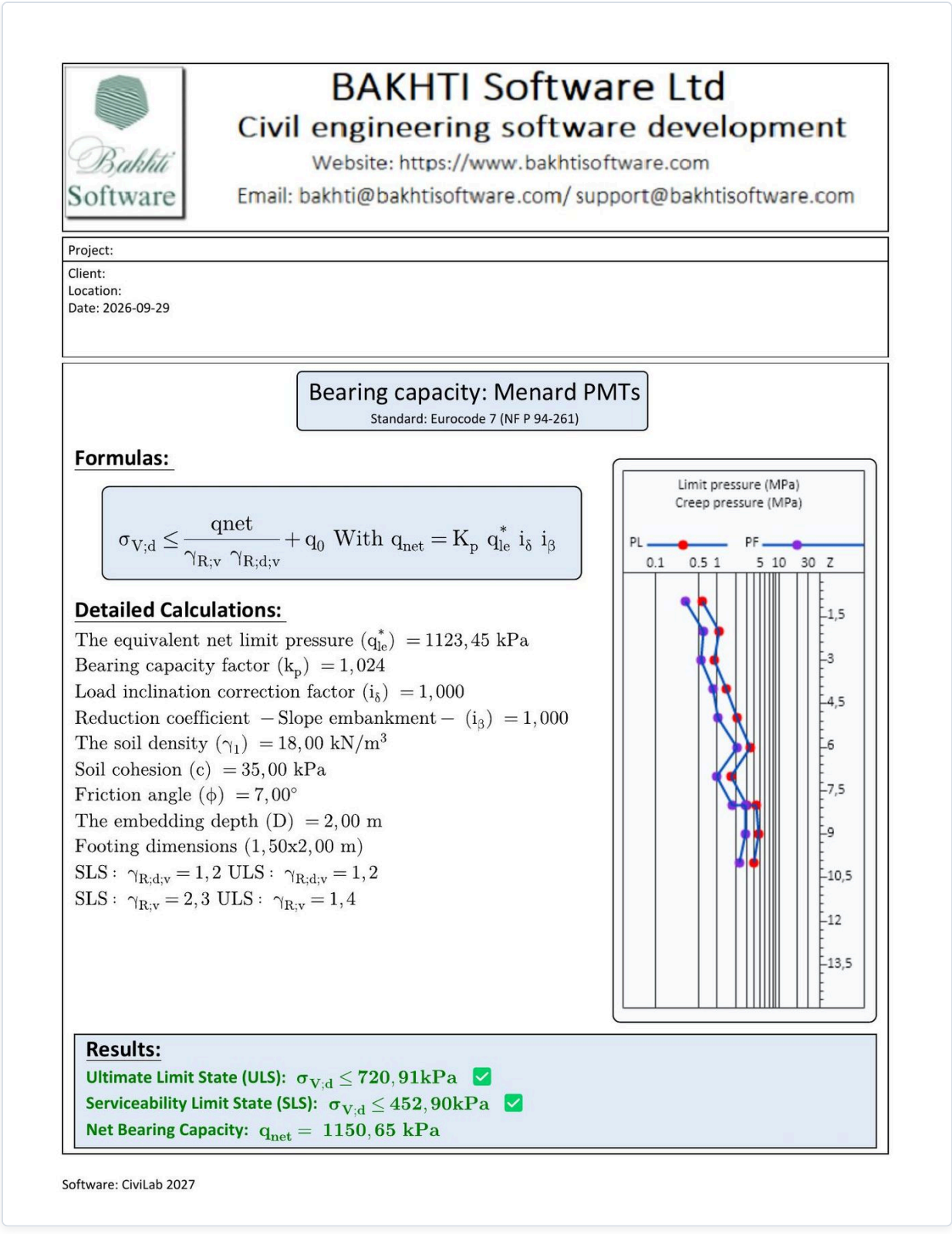
1. Choose the **pressuremeter profile** (“Please select a pressuremeter profile”) and the **Method**.
2. The **Calculate** button asks for “B D” (width and embedment depth, separated by a space) then reads the profile: CiviLab calculates the **equivalent net limit pressure ple*** over the useful height below the base (geometric mean of pl* from D to D + 1.5 B).
3. Enter the **pressuremeter bearing capacity factor kp** (suggested from the soil category, shape and embedment), the **load inclination correction factor** and the **slope reduction coefficient** iδβ, the unit weight γ1 and the partial factors.

Formula: **qnet = kp · ple* · iδβ**, then ULS and SLS checks (Eurocode 7) or allowable stress with a safety factor of 3 (DTR, DTU).

> **Note:** manually entered profiles (Em, Pf*, Pl* table) are used in the same way.



Data entry window — Pressuremeter method



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Project:

Client:
Location:
Date: 2026-09-29

Bearing capacity: Menard PMTs

Standard: Eurocode 7 (NF P 94-261)

Formulas:

$$\sigma_{V;d} \leq \frac{qnet}{\gamma_{R;v}\ \gamma_{R;d;v}} + q_0 \text{ With } q_{net} = K_p\ q^*_{le}\ i_\delta\ i_\beta$$

Detailed Calculations:

The equivalent net limit pressure (q^*_{le}) $= 1123,45$ kPa
Bearing capacity factor (k_p) $= 1,024$
Load inclination correction factor (i_δ) $= 1,000$
Reduction coefficient $-$ Slope embankment $-$ (i_β) $= 1,000$
The soil density (γ_1) $= 18,00$ kN/m^3
Soil cohesion (c) $= 35,00$ kPa
Friction angle (ϕ) $= 7,00°$
The embedding depth (D) $= 2,00$ m
Footing dimensions (1,50x2,00 m)
SLS : $\gamma_{R;d;v} = 1,2$ ULS : $\gamma_{R;d;v} = 1,2$
SLS : $\gamma_{R;v} = 2,3$ ULS : $\gamma_{R;v} = 1,4$

Results:

Ultimate Limit State (ULS): $\sigma_{V;d} \leq 720,91$kPa ✓
Serviceability Limit State (SLS): $\sigma_{V;d} \leq 452,90$kPa ✓
Net Bearing Capacity: $q_{net} = 1150,65$ kPa

Software: CiviLab 2027

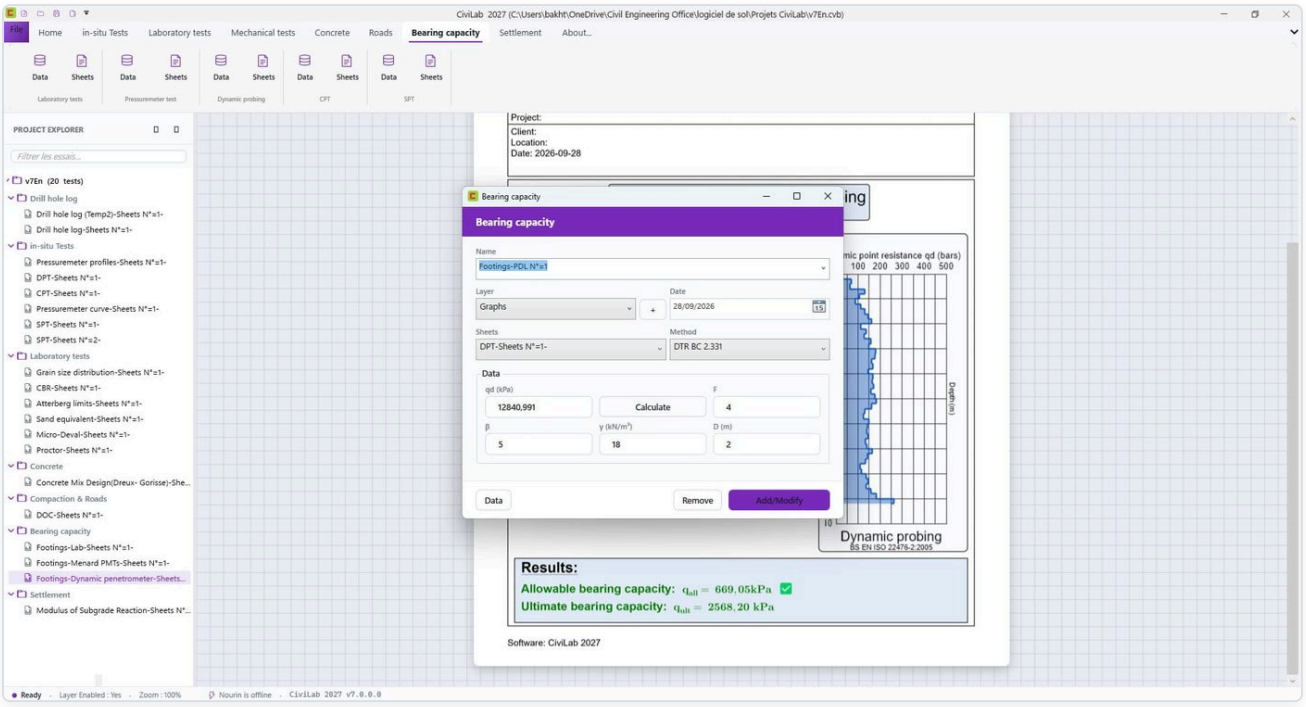
Test sheet — Pressuremeter method

28.4 Dynamic probing method

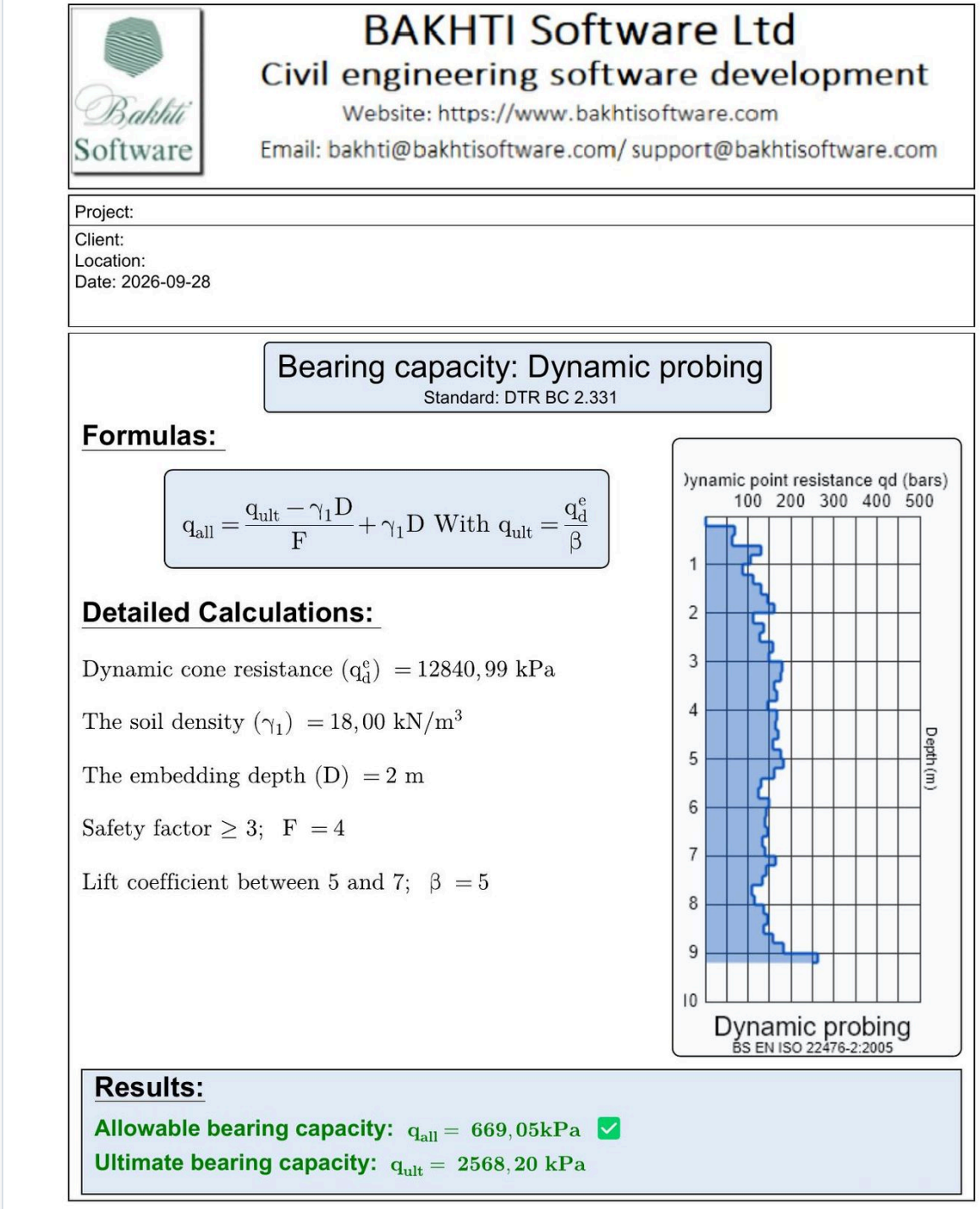
1. Choose the **DPT profile** (“Please select a DPT profile”) and the **Method** (DTR BC 2.331 or DTU 13.12).

2. **Calculate** asks for “B D Max”: width, embedment depth and ceiling value of qd (qd Max); CiviLab calculates the equivalent dynamic resistance qd below the footing.
3. Enter **The soil density** γ1, the **lift coefficient β** (between 5 and 7) and the **safety factor F** (≥ 3).

Formulas: **qu = qd / β**; **qadm = (qu – γ1 · D) / F + γ1 · D**.



Data entry window — Dynamic probing method



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Project:

Client:
Location:
Date: 2026-09-28

Bearing capacity: Dynamic probing

Standard: DTR BC 2.331

Formulas:

$$q_{all} = \frac{q_{ult} - \gamma_1 D}{F} + \gamma_1 D \text{ With } q_{ult} = \frac{q_d^e}{\beta}$$

Detailed Calculations:

Dynamic cone resistance $(q_d^e) = 12840,99$ kPa

The soil density $(\gamma_1) = 18,00$ kN/m^3

The embedding depth $(D) = 2$ m

Safety factor ≥ 3; $F = 4$

Lift coefficient between 5 and 7; $\beta = 5$

Results:

Allowable bearing capacity: $q_{all} = 669,05$kPa

Ultimate bearing capacity: $q_{ult} = 2568,20$ kPa

Software: CiviLab 2027

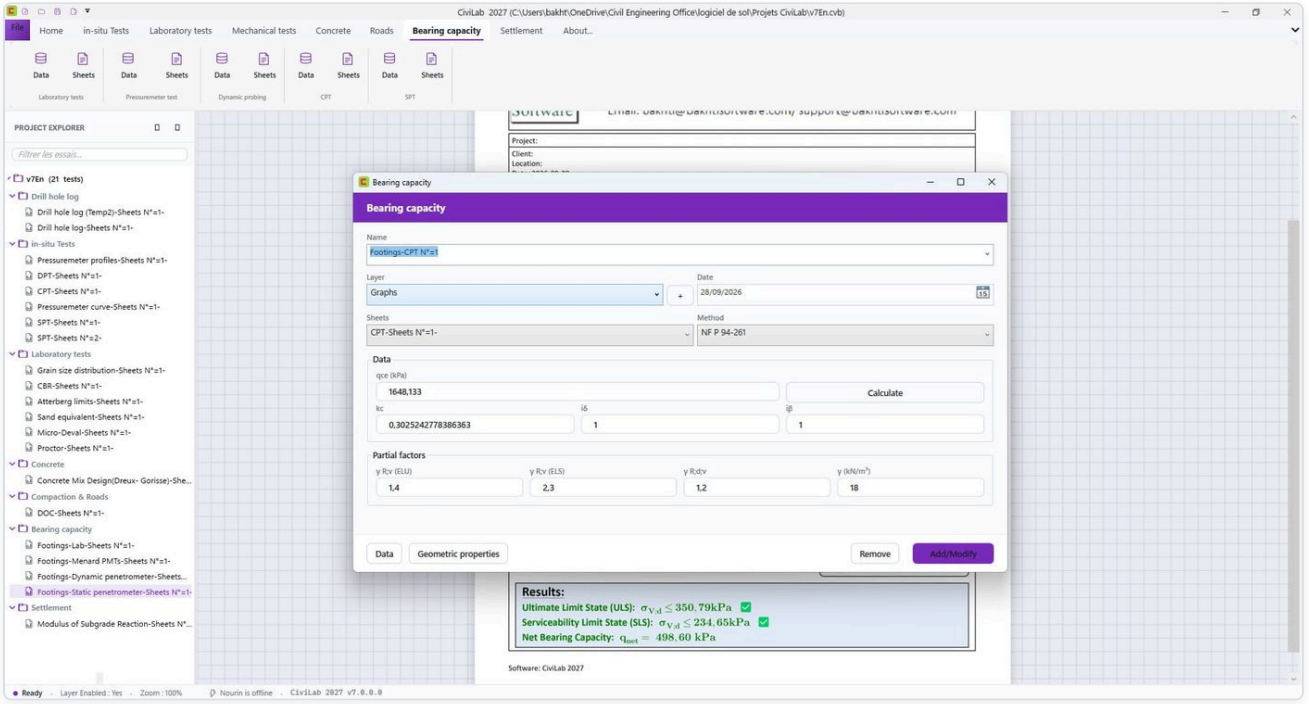
Test sheet — Dynamic probing method

28.5 Static penetrometer method (CPT)

1. Choose the **CPT test** (“Please choose a CPT test”) and the **Method**.
2. **Calculate** asks for “B D”; CiviLab calculates the **equivalent cone resistance qce** (average of the clipped cone resistances over the useful height).

3. Enter the **bearing capacity factor kc**, the inclination and slope coefficients, and the partial factors.

Formula: **qnet = kc · qce · iδβ**, then ULS / SLS check or safety factor.



Data entry window — Static penetrometer method (CPT)

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Project:

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Location:
Date: 2026-09-28

Bearing capacity: Static penetrometer

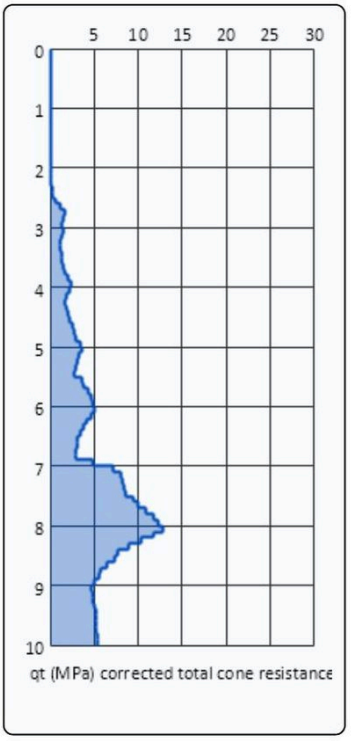
Standard: NF P 94-261

Formulas:

$$\sigma_{V;d} \leq \frac{qnet}{\gamma_{R;v}\ \gamma_{R;d;v}} + q_0 \text{ With } q_{net} = K_c\ q_{ce}\ i_\delta\ i_\beta$$

Detailed Calculations:

Equivalent cone resistance (q_{ce}) $= 1648,13$ kPa
Bearing capacity factor (k_c) $= 0,303$
Load inclination correction factor (i_δ) $= 1,000$
Reduction coefficient $-$ Slope embankment $-$ (i_β) $= 1,000$
The soil density (γ_1) $= 18,00$ kN/m^3
Soil cohesion (c) $= 35,00$ kPa
Friction angle (ϕ) $= 7,00°$
The embedding depth (D) $= 3,00$ m
Footing dimensions $(1,50x2,00$ m$)$
SLS : $\gamma_{R;d;v} = 1,2$ ULS : $\gamma_{R;d;v} = 1,2$
SLS : $\gamma_{R;v} = 2,3$ ULS : $\gamma_{R;v} = 1,4$



Results:

Ultimate Limit State (ULS): $\sigma_{V;d} \leq 350,79$kPa ✓
Serviceability Limit State (SLS): $\sigma_{V;d} \leq 234,65$kPa ✓
Net Bearing Capacity: $q_{net} = 498,60$ kPa

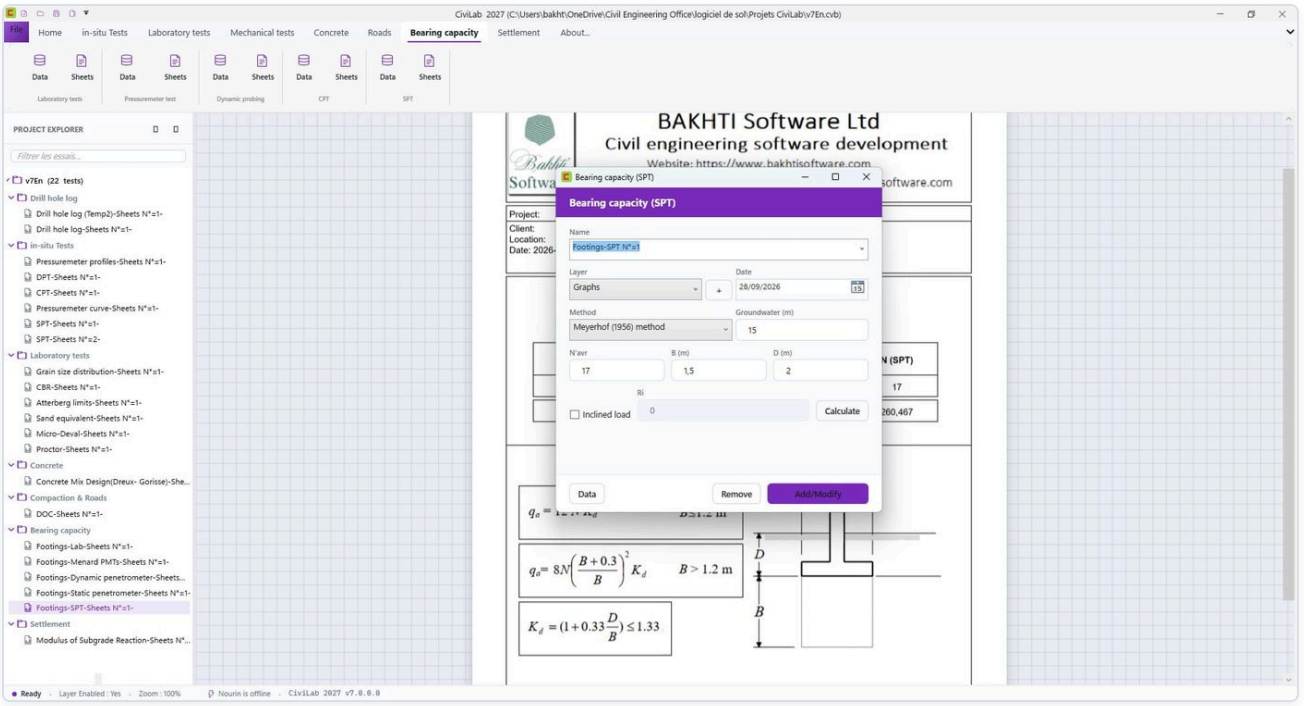
Software: CiviLab 2027

Test sheet — Static penetrometer method (CPT)

28.6 SPT method

1. **Method: Meyerhof (1956) method, Meyerhof method modified by Bowles (1977)** or **Terzaghi & Peck (1948) Method.**

2. Data: **N'avr**, average SPT blow count from the footing base to 1.5 · B′ below the base (corrected to 15 + 0.5 (N − 15) in saturated fine sands), **The effective width of the foundation** B′, **The embedding depth** D, **Groundwater**, **Inclined load** (H/V value: "Please insert H/V value").
3. CiviLab calculates the **bearing pressure for a maximum settlement of 25 mm or 1-inch**, corrected for embedment, groundwater and **load inclination**.



Data entry window — SPT method

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Project:

Client:
Location:
Date: 2026-09-28

Bearing capacity: Standard Penetration Test

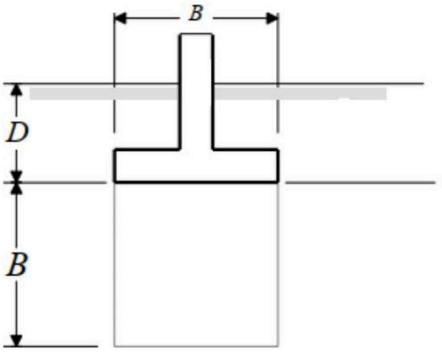
Meyerhof (1956) method

Groundwater(m)	Ri	B (m)	D (m)	N (SPT)
15,00	/	1,50	2,00	17
Bearing pressure for a maximum settlement of 25 mm or 1-inch (kPa)				260,467

$$q_a = 12\,N\,K_d \qquad B \le 1.2 \text{ m}$$

$$q_a = 8N\left(\frac{B+0.3}{B}\right)^2 K_d \qquad B > 1.2 \text{ m}$$

$$K_d = (1+0.33\frac{D}{B}) \le 1.33$$



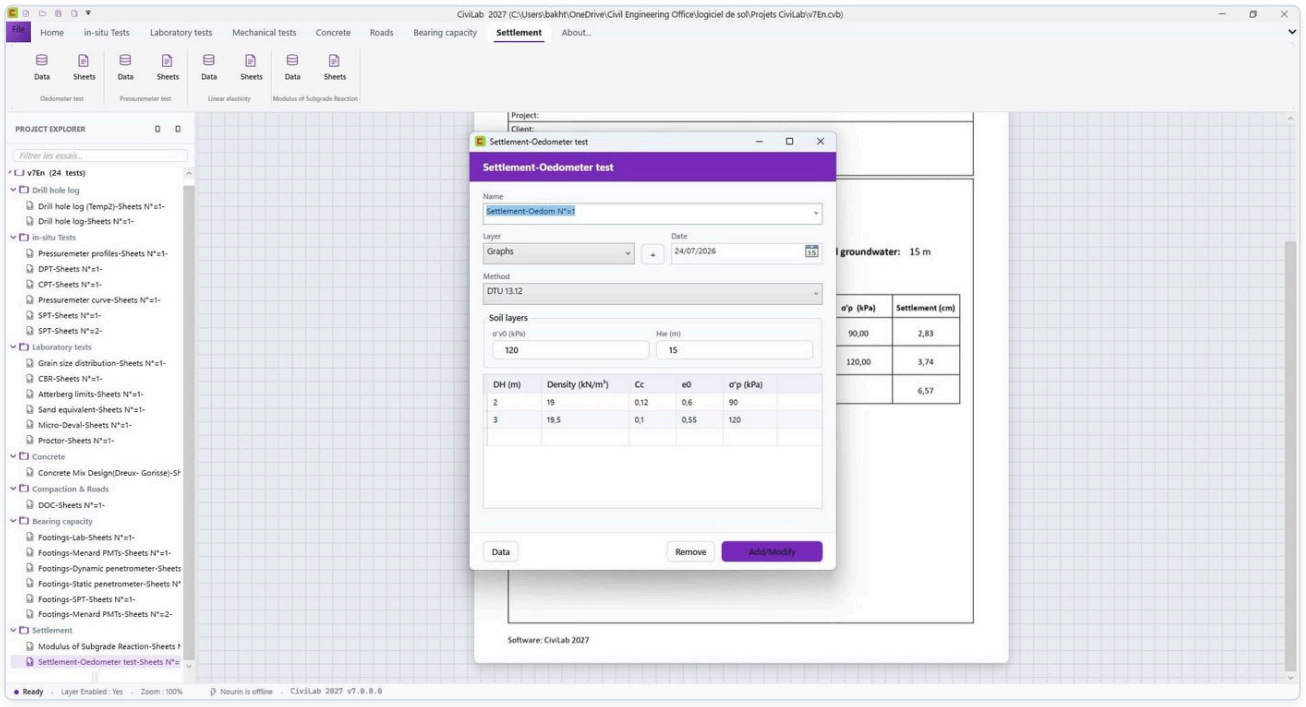
Test sheet — SPT method

29. Settlement of shallow foundations

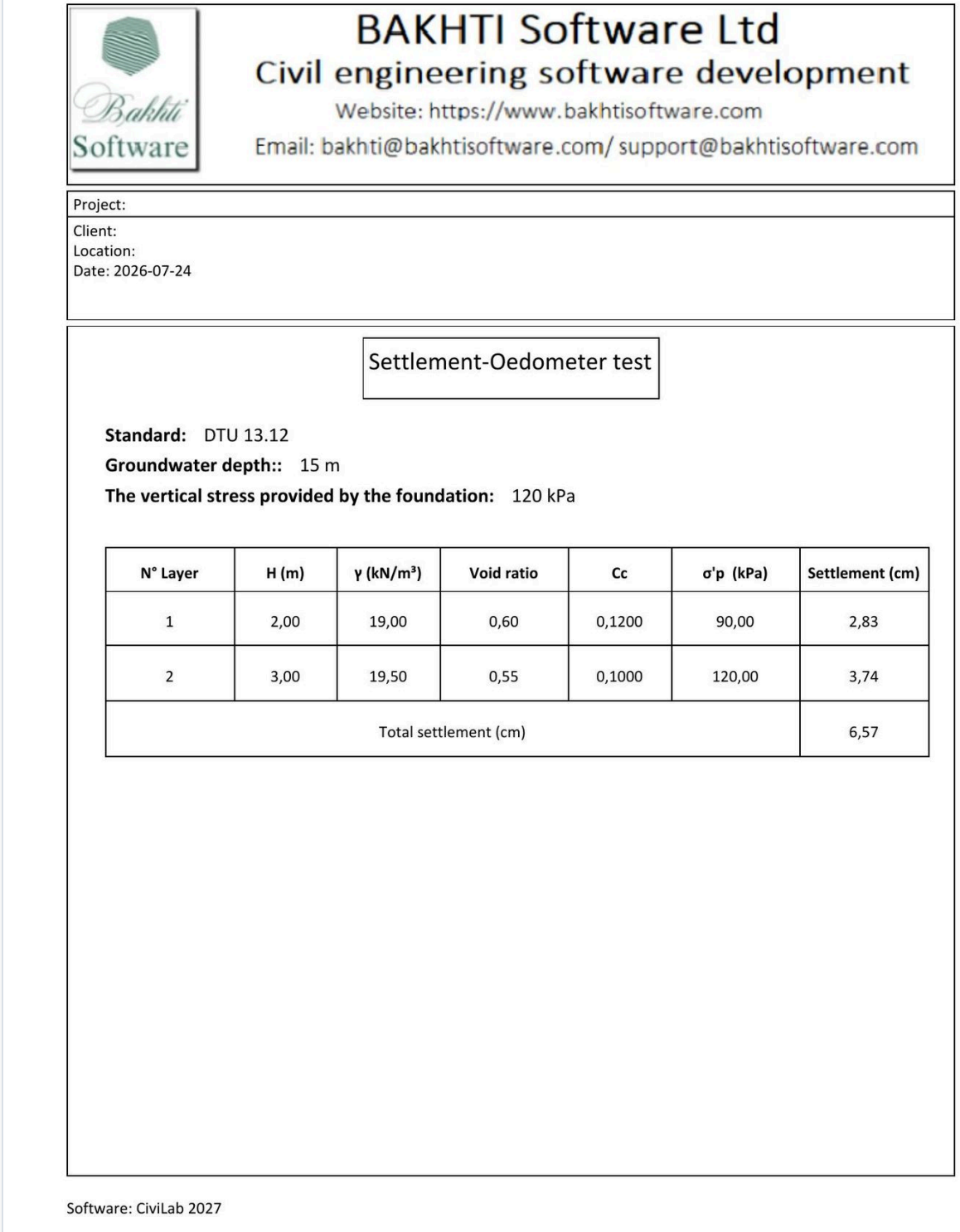
29.1 Settlement from the oedometer test

Settlement > Oedometer test > Data calculates the settlement of a rigid footing (strip or isolated) by the layer method:

1. **Name**, **Date**, **Method** (Eurocode 7: NF P 94-261, DTR BC 2.331, DTU 13.12).
2. **Soil layers**: for each layer, thickness, **Density** (unit weight), associated oedometer test and soil **State** (normally consolidated or overconsolidated; “Please select the soil state”).
3. **The vertical stress provided by the foundation**, groundwater depth.
4. At the middle of each layer, CiviLab calculates the initial effective stress and the stress increase, then the layer settlement from Cc, Cs, σ’p and e0 of the oedometer test; the **Total settlement** is the sum of the layer settlements.



Data entry window — Settlement from the oedometer test



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Project:

Client:
Location:
Date: 2026-07-24

Settlement-Oedometer test

Standard: DTU 13.12
Groundwater depth:: 15 m
The vertical stress provided by the foundation: 120 kPa

N° Layer	H (m)	γ (kN/m³)	Void ratio	Cc	σ'p (kPa)	Settlement (cm)
1	2,00	19,00	0,60	0,1200	90,00	2,83
2	3,00	19,50	0,55	0,1000	120,00	3,74
Total settlement (cm)						6,57

Software: CiviLab 2027

Test sheet — Settlement from the oedometer test

29.2 Pressuremeter settlement

1. **Name**, **Date**, **Method** (**Eurocode 7 (NF P 94-261)**, **DTR BC 2.331**, **DTU 13.12**), **Soil type**: **Homogeneous soil**, **Heterogeneous soil** or **Soft interlayer**.

2. **Footings width** B, applied stress **q'**, initial stress **σ'v0 = γ · D**.

3. Moduli: **EM** (homogeneous soil) or **E1 to E16** per B/2 slices (heterogeneous soil). The automatic calculation button reads them from a **pressuremeter profile** (**Calculate**):

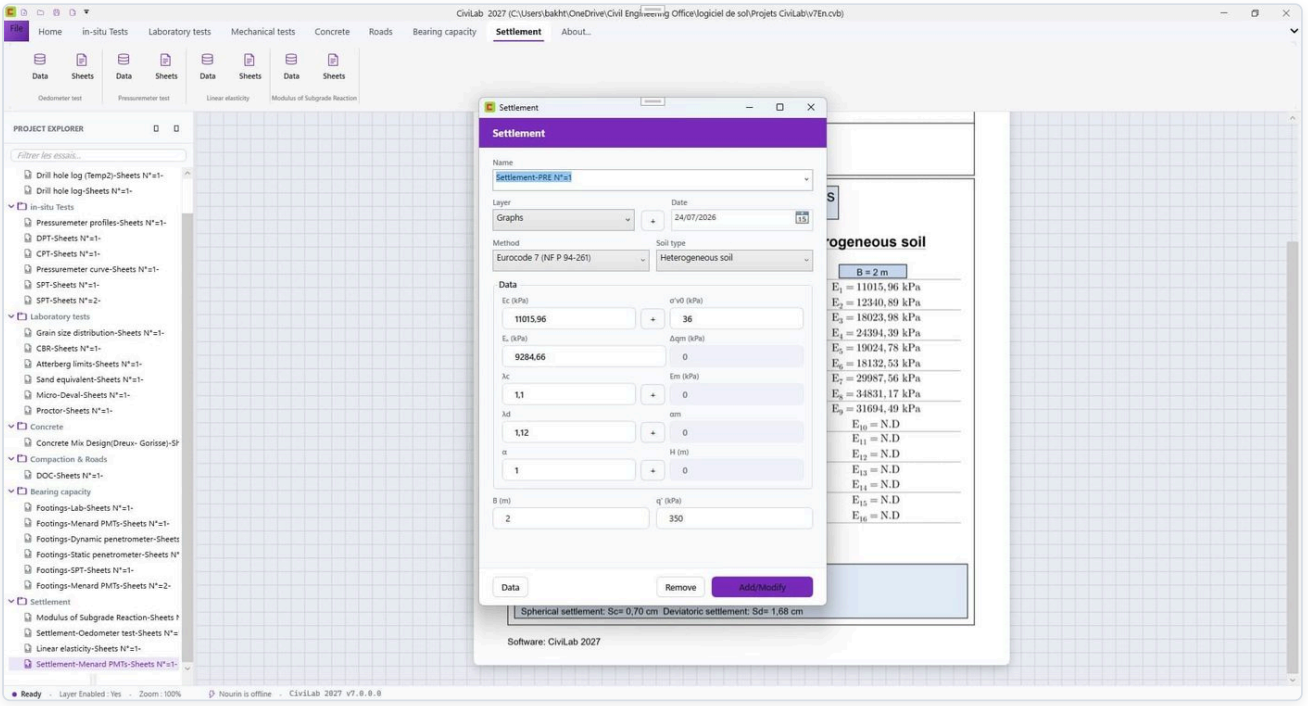
4. **Rheological factor α** depending on the soil (peat, clay, silt, sand, gravel, rock) and its state (overconsolidated, normally consolidated, underconsolidated):

5. **Shape factors λc and λd**, depending on the L/B ratio.

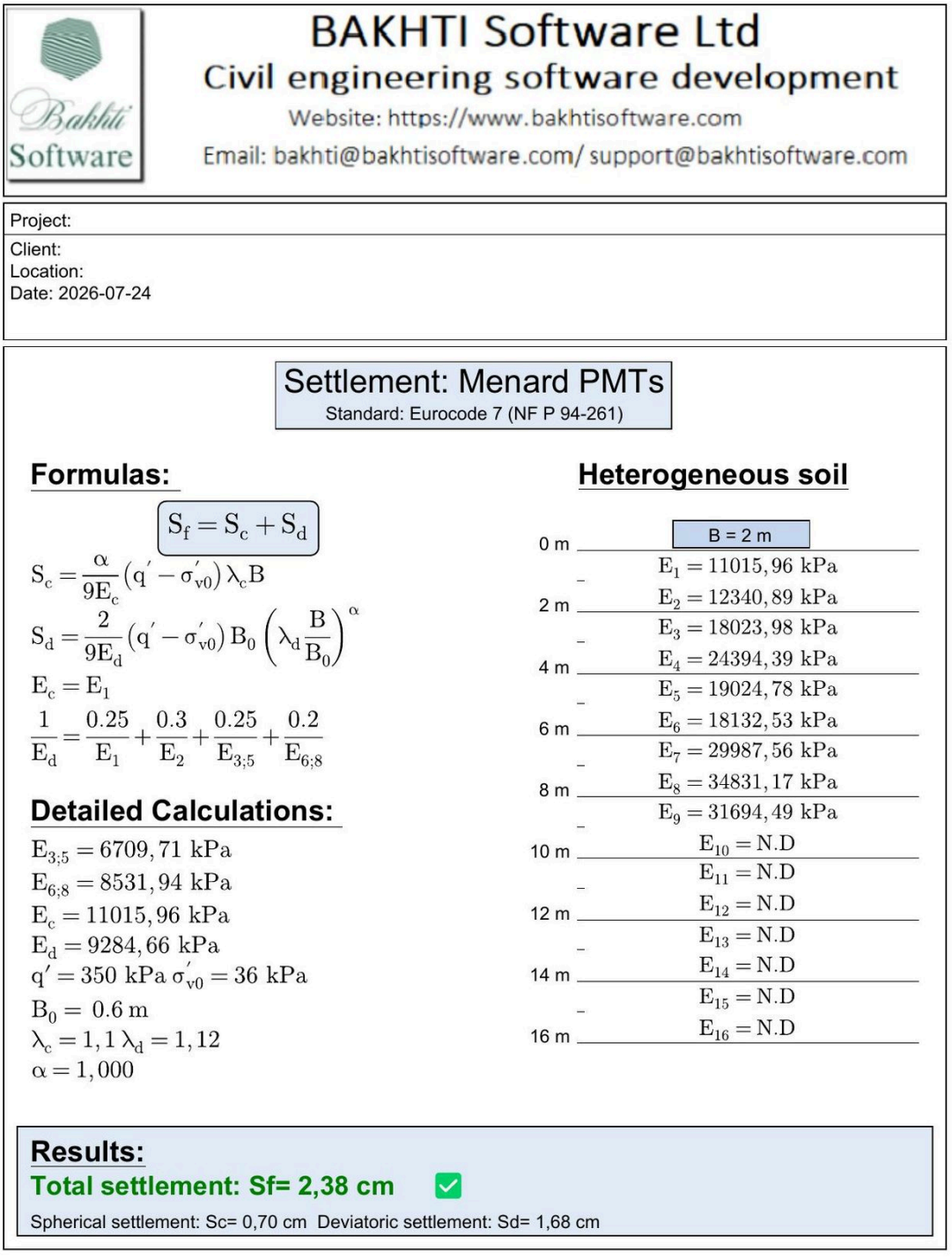
6. **Soft interlayer**: layer thickness, modulus **Em**, factor **αm**, surcharge **Δqm** at the level of the layer.

Formulas (pressuremeter method):

- spherical settlement: **sc = (α / 9Ec) · (q' – σ'v0) · λc · B**;
- deviatoric settlement: **sd = (2 / 9Ed) · (q' – σ'v0) · B0 · (λd · B / B0)^α**, with B0 = 0.6 m;
- heterogeneous soil: Ec = E1; Ed by the harmonic mean 4/Ed = 1/E1 + 1/(0.85 E2) + 1/E3,5 + 1/(2.5 E6,8) + 1/(2.5 E9,16);
- **total settlement sf = sc + sd** (+ additional settlement of the soft layer).



Data entry window — Pressuremeter settlement



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Project:

Client:
Location:
Date: 2026-07-24

Settlement: Menard PMTs

Standard: Eurocode 7 (NF P 94-261)

Formulas:

$$S_f = S_c + S_d$$

$$S_c = \frac{\alpha}{9E_c}(q' - \sigma'_{v0})\lambda_c B$$

$$S_d = \frac{2}{9E_d}(q' - \sigma'_{v0})\, B_0 \left(\lambda_d \frac{B}{B_0}\right)^{\alpha}$$

$$E_c = E_1$$

$$\frac{1}{E_d} = \frac{0.25}{E_1} + \frac{0.3}{E_2} + \frac{0.25}{E_{3;5}} + \frac{0.2}{E_{6;8}}$$

Detailed Calculations:

$E_{3;5} = 6709,71$ kPa
$E_{6;8} = 8531,94$ kPa
$E_c = 11015,96$ kPa
$E_d = 9284,66$ kPa
$q' = 350$ kPa $\sigma'_{v0} = 36$ kPa
$B_0 = 0.6$ m
$\lambda_c = 1,1$ $\lambda_d = 1,12$
$\alpha = 1,000$

Heterogeneous soil

B = 2 m

0 m	$E_1 = 11015,96$ kPa
2 m	$E_2 = 12340,89$ kPa
	$E_3 = 18023,98$ kPa
4 m	$E_4 = 24394,39$ kPa
	$E_5 = 19024,78$ kPa
6 m	$E_6 = 18132,53$ kPa
	$E_7 = 29987,56$ kPa
8 m	$E_8 = 34831,17$ kPa
	$E_9 = 31694,49$ kPa
10 m	$E_{10} = N.D$
	$E_{11} = N.D$
12 m	$E_{12} = N.D$
	$E_{13} = N.D$
14 m	$E_{14} = N.D$
	$E_{15} = N.D$
16 m	$E_{16} = N.D$

Results:

Total settlement: Sf= 2,38 cm

Spherical settlement: Sc= 0,70 cm Deviatoric settlement: Sd= 1,68 cm

Software: CiviLab 2027

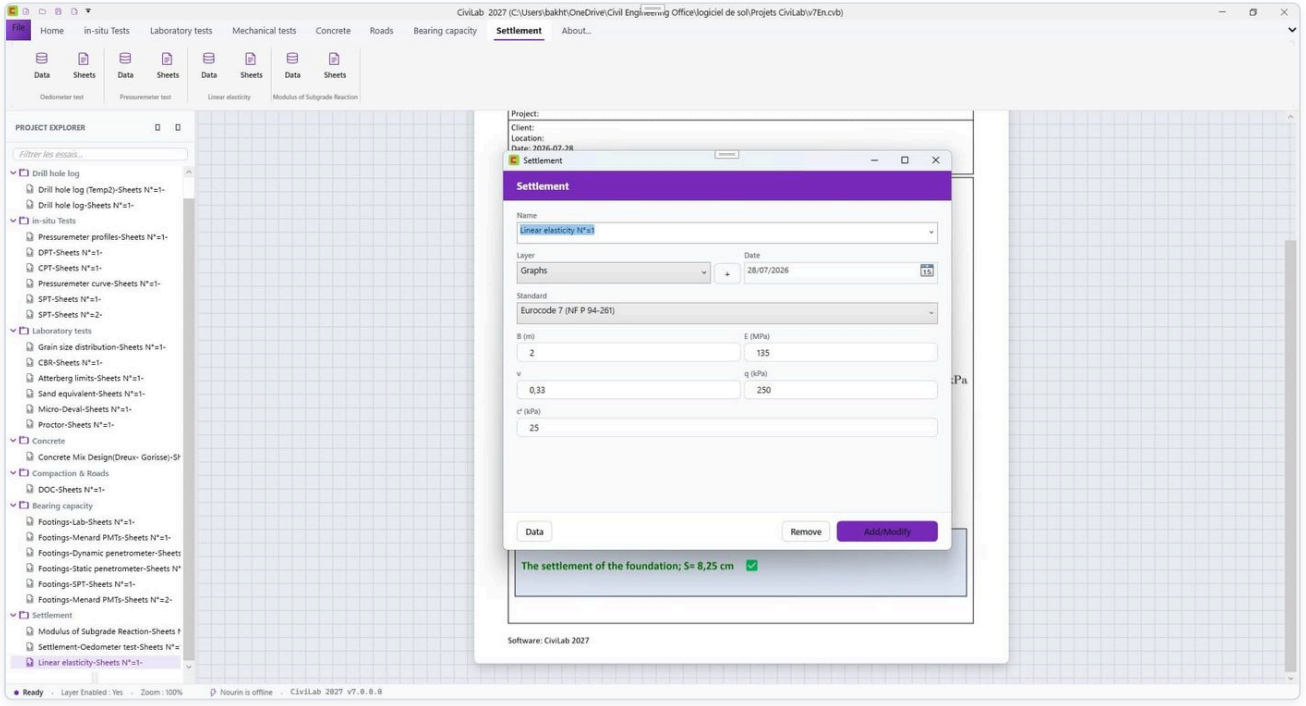
Test sheet — Pressuremeter settlement

29.3 Settlement by linear elasticity

Settlement > Linear elasticity (Eurocode 7, NF P 94-261):

1. **Name**, **Date**, **Standard**, **Footings width** B.

2. **The drained or undrained Young's modulus of the soil** E, **Poisson's ratio** v, **The effective vertical stress applied by the foundation to the ground** q, shape and rigidity factor f.
3. **Settlement: $s = q \cdot B \cdot f \cdot (1 - \nu^2) / E$.**



Data entry window — Settlement by linear elasticity

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Project:

Client:
Location:
Date: 2026-07-28

Settlement: Linear elasticity

Standard: Eurocode 7: NF P 94-261

Formulas:

$$s = c_f \frac{1-\nu^2}{E} B\ q$$

Detailed Calculations:

The width of the foundation; $B = 2$ m

The effective vertical stress (uniform or average) applied by the foundatic; $q = 250$ kPa

A coefficient depending on the shape of the foundation; $c_f = 25$

The drained or undrained Young′s modulus of the soil; $E = 135$ MPa

The drained or undrained Poisson′s ratio of the soil; $\nu = 0,33$

Results:

The settlement of the foundation; S= 8,25 cm ✅

Software: CiviLab 2027

Test sheet — Settlement by linear elasticity

30. Modulus of subgrade reaction

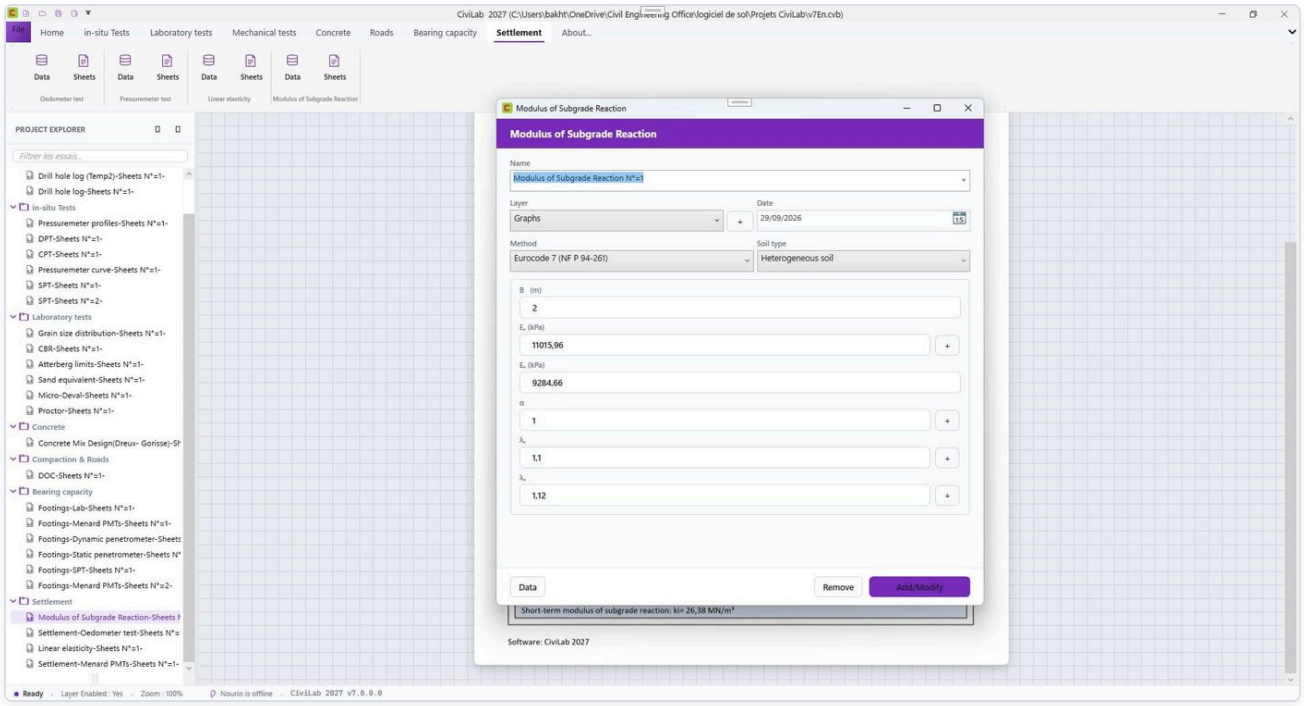
30.1 Principle

The modulus of subgrade reaction represents the soil by springs below the footing: at every point, the pressure p and the vertical displacement y are related by **p = k · y**. CiviLab evaluates k from pressuremeter tests, following Annex F of NF P 94-261 (Eurocode 7) or Fascicule 62 Title V: the settlement s of the footing under a uniform pressure q is calculated by the pressuremeter method, then **kv = q / s**.

> **Warning:** the footing must be stiff enough across its width B, which excludes large rafts; the displacements obtained are not very representative of actual displacements.

30.2 Entry

1. **Name**, **Date**, **Method** (**Eurocode 7 (NF P 94-261)** or **Fascicule 62 – Titre V**), **Soil type** (**Homogeneous soil** or **Heterogeneous soil**).
2. Geometry: **Footings width** B, length L, embedment D, footing type (isolated, strip, raft of limited width).
3. Moduli: **EM** or **E1 to E16**, read automatically from the pressuremeter profile; **rheological factor α**; **shape factors λc and λd**.
4. CiviLab calculates **Ec**, **Ed**, the settlement s, then the **Long-term modulus of subgrade reaction** kv and the **Short-term modulus of subgrade reaction**.



Data entry window — Modulus of subgrade reaction

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Project:

Client:
Location:
Date: 2026-09-25

Modulus of Subgrade Reaction: Menard PMTs

Standard: Eurocode 7 (NF P 94-261)

Formulas:

$$\frac{1}{k_v} = \frac{\alpha B}{9E_c}\lambda_c + \frac{2B_0}{9E_d}\left(\lambda_d \frac{B}{B_0}\right)^{\alpha}$$

$$E_c = E_1$$

$$\frac{1}{E_d} = \frac{0.25}{E_1} + \frac{0.3}{E_2} + \frac{0.25}{E_{3;5}} + \frac{0.2}{E_{6;8}}$$

Detailed Calculations:

$E_{3;5} = 6709,71\ \text{kPa}$
$E_{6;8} = 8531,94\ \text{kPa}$
$E_c = 11015,96\ \text{kPa}$
$E_d = 9284,66\ \text{kPa}$
$B_0 = 0.6\ \text{m}$
$\lambda_c = 1,1\ \lambda_d = 1,12$
$\alpha = 1,000$

Heterogeneous soil

B = 2 m

0 m	$E_1 = 11015,96$ kPa
2 m	$E_2 = 12340,89$ kPa
	$E_3 = 18023,98$ kPa
4 m	$E_4 = 24394,39$ kPa
	$E_5 = 19024,78$ kPa
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8 m	$E_8 = 34831,17$ kPa
	$E_9 = 31694,49$ kPa
10 m	$E_{10} = \text{N.D}$
	$E_{11} = \text{N.D}$
12 m	$E_{12} = \text{N.D}$
	$E_{13} = \text{N.D}$
14 m	$E_{14} = \text{N.D}$
	$E_{15} = \text{N.D}$
16 m	$E_{16} = \text{N.D}$

Results:

Long-term modulus of subgrade reaction: kv= 13,19 MN/m³ ✅

Short-term modulus of subgrade reaction: ki= 26,38 MN/m³

Software: CiviLab 2027

Test sheet — Modulus of subgrade reaction

31. Slope stability

31.1 Purpose and standards

CiviLab computes slope stability with the **method of slices** (vertical slices). Four methods are available:

Method	Equilibrium	Surfaces	Role
Simplified Bishop (1955)	moments	circles	reference method
Spencer (1967), f(x) = 1	forces and moments	any	reference method
Morgenstern-Price (1965), half-sine f(x)	forces and moments	any	reference method
Fellenius (ordinary method)	moments	circles	comparison only

Bishop: **$F = \Sigma [c'\cdot b + (W - u\cdot b)\cdot \tan \varphi'] / m\alpha \div \Sigma W\cdot \sin \alpha$**, with **$m\alpha = \cos \alpha \cdot (1 + \tan \alpha \cdot \tan \varphi' / F)$** (iterative solution). Spencer and Morgenstern-Price: interslice forces X = λ·f(x)·E, F and λ solved together with the algorithm of Zhu, Lee, Qian and Chen (2005).

Two results are given:

- the **classical factor of safety F** (characteristic values), compared with the required F (1.5 by default; **1.15 for an RPA 2024 earthquake**, §10.3.6);
- the **Eurocode 7 check** to **NF P 94-270 §10** (overall stability): design approach 3, sets **A2 + M2 + R3** (annex C) and inequality **$T_{dst;d} \leq R_{st;d} / \gamma_{R;d}$** (10.2.1), i.e. **$F_d \geq \gamma_{R;e} \cdot \gamma_{R;d}$**.

Factor	Value	Source (NF P 94-270)
γG / γQ (actions)	1.0 / 1.3	table C.2.1, set A2
γφ′ (on tan φ′) / γc′ / γcu / γγ	1.25 / 1.25 / 1.4 / 1.0	table C.3.1, set M2
γR;e (resistance)	1.0	table C.6.2, set R3
γR;d (model)	1.10 (1.20 near a sensitive structure)	§10.5

Slip surfaces

- **Circles**: search on a grid of centres and radii, then three refined grids around the minimum.
- **Specified polyline**: surface given point by point (increasing x, ends on the ground).

- **Three blocks along a weak layer** (NF P 94-270 §10.3, figures 10.3 and 10.4): upslope (active) block, central block in the weak layer, downslope (passive) block. The ends of the central block, its level in the layer and the inclination of both blocks are searched automatically (grid, then direct search).

Non-circular surfaces are computed with Spencer or Morgenstern-Price (Bishop applies to circles only: if Bishop is selected, Morgenstern-Price is used and a message says so). Polyline slices are split at the vertices of the surface, ground, layers and water table, and where the base changes layer.

Earthquake (pseudo-static analysis)

Horizontal force **kh·W** directed downslope, applied at the centroid of each slice, and vertical force **±kv·W**. Both combinations (kh, kv) and (kh, −kv) are computed; the more unfavourable one is retained and reported.

Code	kh	kv	Requirement
RPA 2024 §10.3	A·I·S·ST / 3 (10.22)	±kh/2 for type 1 (zones IV to VI), ±kh/3 for type 2 (zones I to III) (10.23)	F ≥ 1.15 (§10.3.6)
NF P 94-270 annex I.4	½·(ag/g)·S·ST (I.4.1)	±0.5·kh if avg/ag > 0.6; ±0.33·kh otherwise (I.4.2, I.4.3)	same principle as the static case (I.4(1)): Fd ≥ γR;e·γR;d with the factors entered
Imposed kh, kv	entered	entered	required F entered

RPA 2024: A from the zone (table 3.2: 0.07; 0.10; 0.15; 0.20; 0.25; 0.30), I from the importance group (table 3.10: 1.40; 1.20; 1.00; 0.80; I = 1 without a structure), S from the site class (table 3.3 for type 1, 3.4 for type 2), ST from annex C (maximum value at mid-height of the slope). The forces apply to the soil and to supported loads. The method does not apply to liquefiable soils (§10.3.3). For NF P 94-270, the forces apply to the soil mass.

31.2 Entry

Stability tab, four separate groups, each with its own window, list of calculations and sheets (**Data** opens the group's window, **Page** the group's sheet list):

Group	Window	Own content
Bishop method	Slope stability — Bishop method	circles, Bishop (Fellenius for comparison)

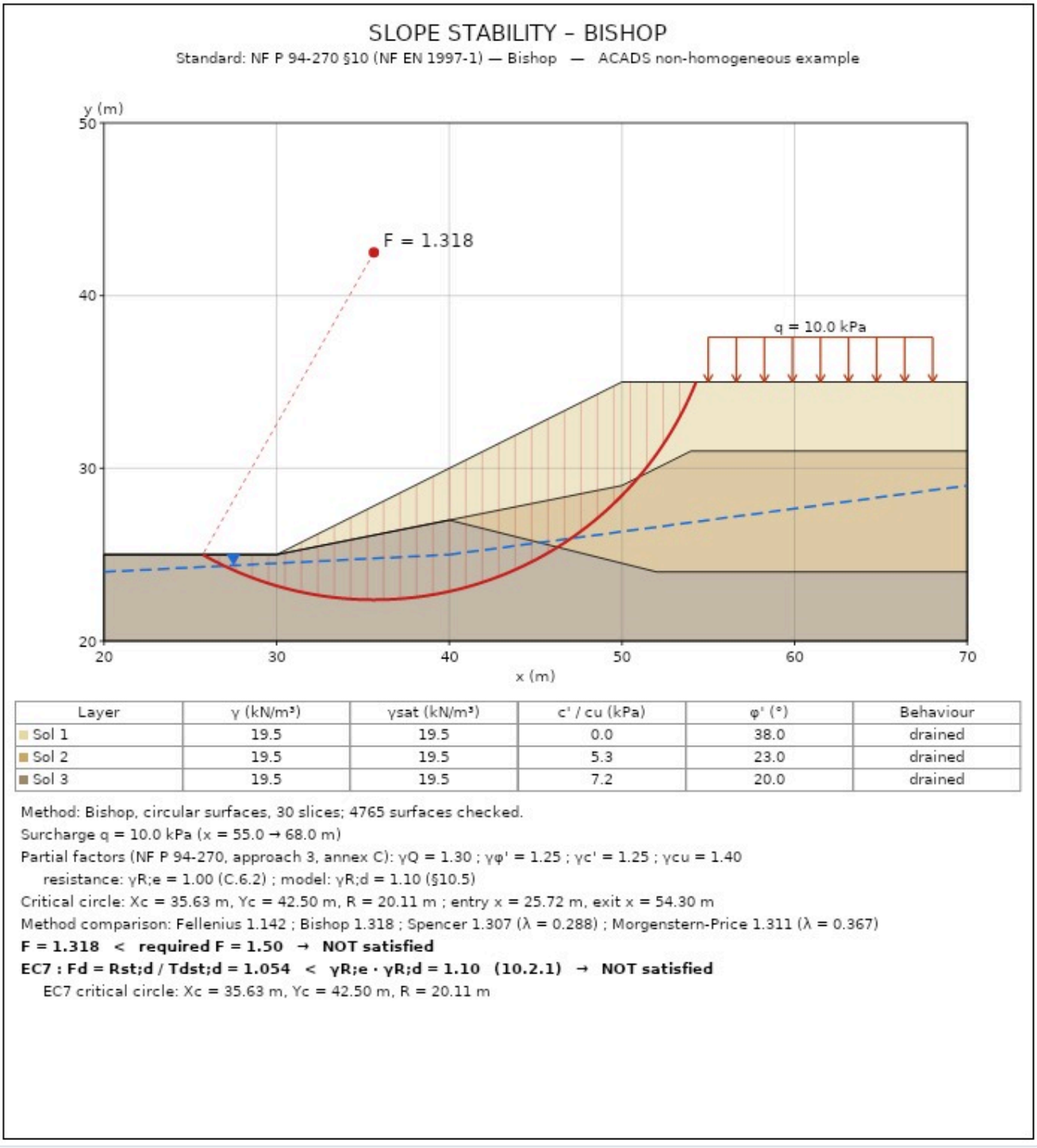
Group	Window	Own content
Spencer / Morgenstern-Price	Slope stability — Spencer / Morgenstern-Price	circles; Spencer or Morgenstern-Price
Non-circular surfaces	Slope stability — Non-circular surfaces	specified polyline or three blocks (weak layer); Spencer or Morgenstern-Price; weak-layer example at start
Earthquake	Slope stability — Earthquake	Earthquake tab (RPA 2024, NF P 94-270 I.4, imposed kh and kv); circles; Bishop, Spencer or Morgenstern-Price

A calculation saved before this separation is filed automatically: earthquake → Earthquake; non-circular surface → Non-circular surfaces; Spencer or Morgenstern-Price → Spencer / Morgenstern-Price; otherwise Bishop method. The window follows the order of common stability software; the section to scale is always drawn on the right.

1. **Test data**: name, layer, date; methods reminder.
2. **Geometry and soils**: layers from top to bottom. For each layer: γ, γsat (below the water table), c′ (or cu), φ′, **Undrained** box (cu, φ = 0, factor γcu) and the **upper boundary** (x, y points). Layer 1 boundary is the ground surface; a layer extends down to the next layer's boundary.
3. **Water and surcharge**: water table points (hydrostatic pressure u = γw·(zw − z)), γw; surcharge q (variable action) between x1 and x2.
4. **Earthquake**: none, RPA 2024, NF P 94-270 annex I.4 or imposed kh and kv. For RPA 2024: zone, importance group, site class and ST; for NF P 94-270: ag/g, S, avg/ag and ST. The box shows kh, kv and the calculation details.
5. **Analysis**: **reference method** (Bishop, Spencer, Morgenstern-Price) and **slip surface** (circles, specified polyline with its point grid, or three blocks with the choice of the weak layer); grid of centres and radii (circles), number of slices, **model base**, required F, partial factors. **Automatic grid** proposes a grid derived from the geometry.
6. ▶ **Calculate**: **Results** tab with the F, Fd, critical surface and earthquake cards, the governing seismic combination and the **method comparison table** (Fellenius, Bishop, Spencer, Morgenstern-Price, with λ) on the critical surface.
7. **Add/Modify** saves the calculation in the project; **Page** (menu) creates the sheet.

31.3 The sheet

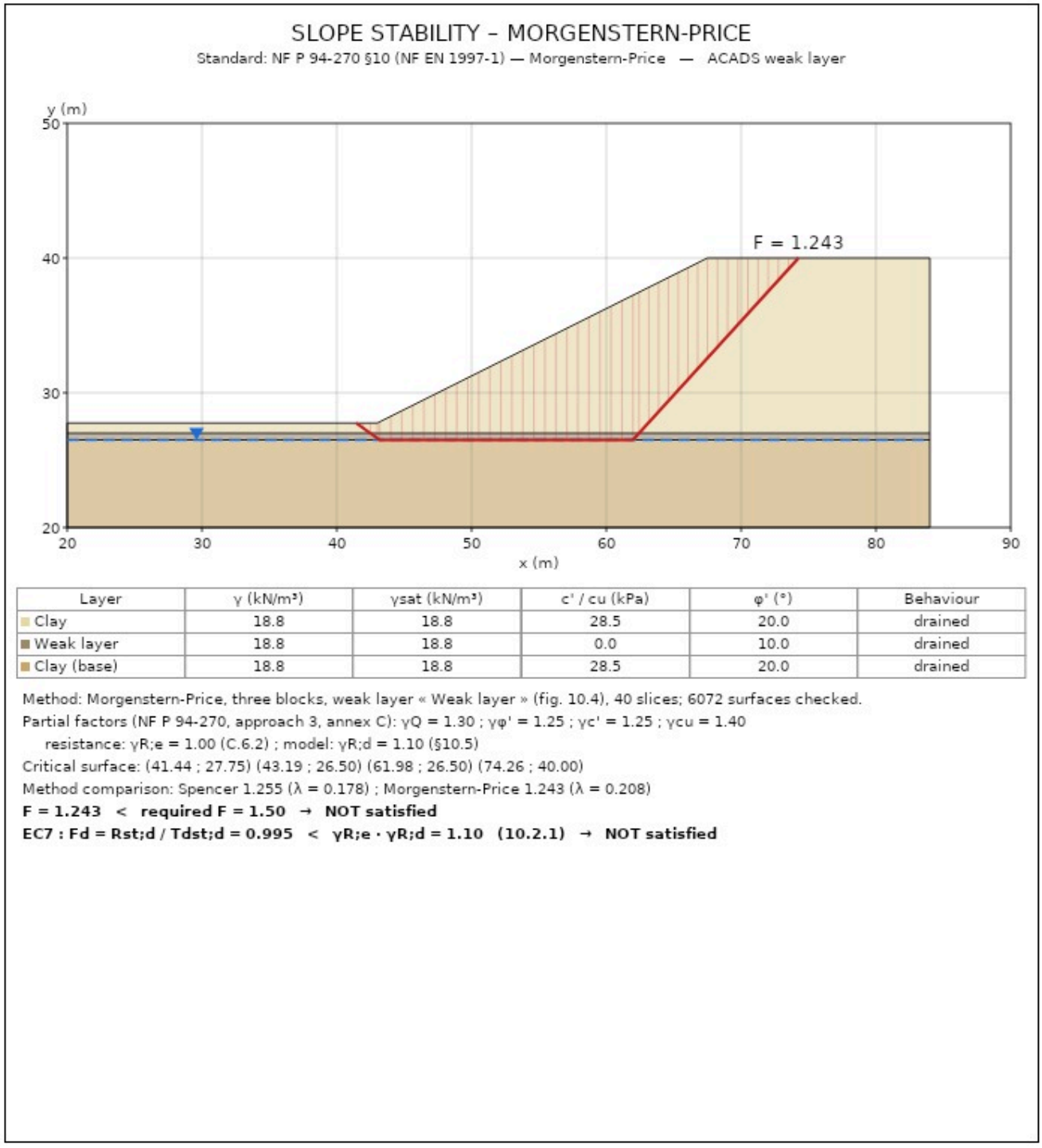
The sheet shows the section to scale (layers, water table, surcharge, critical surface, slices, centre and F), the soils table, the seismic data (kh, kv and their origin), the partial factors with their source, the critical surface, the **method comparison**, **F** (with the governing seismic combination) and **Fd** with inequality 10.2.1. The “Test data” pages give the geometry, soils, water table, the slices of the critical surface (x, b, α, W, u, c, φ), the surface points (non-circular) and the method comparison.



Layer	γ (kN/m³)	γsat (kN/m³)	c' / cu (kPa)	φ' (°)	Behaviour
Sol 1	19.5	19.5	0.0	38.0	drained
Sol 2	19.5	19.5	5.3	23.0	drained
Sol 3	19.5	19.5	7.2	20.0	drained

Method: Bishop, circular surfaces, 30 slices; 4765 surfaces checked.
Surcharge q = 10.0 kPa (x = 55.0 → 68.0 m)
Partial factors (NF P 94-270, approach 3, annex C): γQ = 1.30 ; γφ' = 1.25 ; γc' = 1.25 ; γcu = 1.40
resistance: γR;e = 1.00 (C.6.2) ; model: γR;d = 1.10 (§10.5)
Critical circle: Xc = 35.63 m, Yc = 42.50 m, R = 20.11 m ; entry x = 25.72 m, exit x = 54.30 m
Method comparison: Fellenius 1.142 ; Bishop 1.318 ; Spencer 1.307 (λ = 0.288) ; Morgenstern-Price 1.311 (λ = 0.367)
F = 1.318 < required F = 1.50 → NOT satisfied
EC7 : Fd = Rst;d / Tdst;d = 1.054 < γR;e · γR;d = 1.10 (10.2.1) → NOT satisfied
EC7 critical circle: Xc = 35.63 m, Yc = 42.50 m, R = 20.11 m

Sheet — Slope stability (ACADS non-homogeneous example, with water table and surcharge)



Layer	γ (kN/m³)	γsat (kN/m³)	c' / cu (kPa)	φ' (°)	Behaviour
Clay	18.8	18.8	28.5	20.0	drained
Weak layer	18.8	18.8	0.0	10.0	drained
Clay (base)	18.8	18.8	28.5	20.0	drained

Method: Morgenstern-Price, three blocks, weak layer « Weak layer » (fig. 10.4), 40 slices; 6072 surfaces checked.
Partial factors (NF P 94-270, approach 3, annex C): γQ = 1.30 ; γφ' = 1.25 ; γc' = 1.25 ; γcu = 1.40
resistance: γR;e = 1.00 (C.6.2) ; model: γR;d = 1.10 (§10.5)
Critical surface: (41.44 ; 27.75) (43.19 ; 26.50) (61.98 ; 26.50) (74.26 ; 40.00)
Method comparison: Spencer 1.255 (λ = 0.178) ; Morgenstern-Price 1.243 (λ = 0.208)
F = 1.243 < required F = 1.50 → NOT satisfied
EC7 : Fd = Rst;d / Tdst;d = 0.995 < γR;e · γR;d = 1.10 (10.2.1) → NOT satisfied

Sheet — Three-block search along a weak layer (ACADS, Morgenstern-Price)

31.4 Validation

Case (ACADS, Giam and Donald 1989; GeoStudio verification manual)	ACADS reference	GeoStudio	CiviLab 7.1
Simple slope 1(a) (§2.1)	1.00	Bishop 0.993; M-P 0.993	Bishop 0.985; M-P 0.985

Case (ACADS, Giam and Donald 1989; GeoStudio verification manual)	ACADS reference	GeoStudio	CiviLab 7.1
Non-homogeneous slope, 3 layers (§2.3)	1.39	Bishop 1.413; M-P 1.382	Bishop 1.393; M-P 1.365
Non-homogeneous with seismic kh = 0.15 (§2.4)	1.00	Bishop 1.016; M-P 0.989	Bishop 1.011; M-P 0.983
Weak layer, search (§2.7)	1.26	M-P 1.261	M-P 1.243 (three blocks)
Weak layer, specified surface (§2.8)	1.34	M-P 1.261	M-P 1.260

CiviLab finds slightly lower values in searches (a more critical surface is found); on the specified surface, the difference from GeoStudio is 0.001. On the weak layer, circles give F = 1.506: they miss this mechanism, hence the three-block search.

The **Validation-Essais-7.1.xlsx** workbook recomputes with Excel formulas, slice by slice, on the critical circle of case 1(a):

- “Stabilité talus (Bishop)”: F = 0.985 and Fd = 0.788;
- “Talus séisme (Bishop)”: Fellenius and Bishop with kh = 0.15 (0.68711 and 0.71586);
- “Talus Morgenstern-Price”: explicit iterations of F and λ (M-P 0.98410, λ = 0.529; Spencer with kh = 0.15: 0.71711);
- “Séisme kh kv”: kh and kv to RPA 2024 and NF P 94-270;
- “Talus surface imposée (M-P)”: ACADS §2.8 polyline surface (weak layer), Morgenstern-Price 1.26033 and Spencer 1.27602.

All these values are identical to CiviLab. Unit tests also check the φ = 0 case: Bishop, Spencer and Morgenstern-Price give the exact moment equilibrium (1.39264).

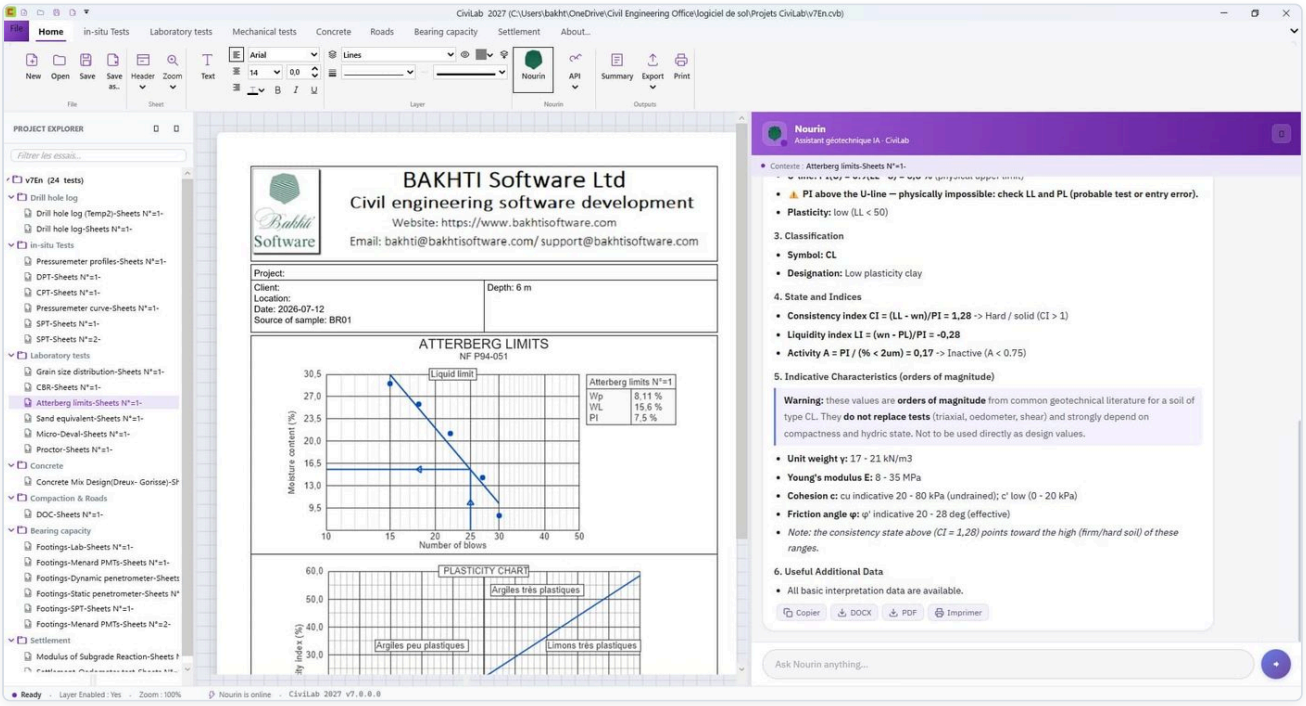
> **Limits:** no reinforcement or tension crack; hydrostatic water pressure; pseudo-static earthquake only (no dynamic analysis or displacements); not applicable to liquefiable soils. SI units.

32. Nourin

The **Home > Nourin > Nourin** button opens the geotechnical agent panel; the access key is entered in **Home > Nourin > API > Input Nourin Key**.

Nourin reads the CiviLab sheets, reports errors, interprets tests, calculates foundations step by step in depth and writes the geotechnical report and the concrete mix design report.

It is described in detail in the **Nourin manual**.



CiviLab 2027 screen — Nourin

33. Common messages

Message	Cause	Solution
Cannot delete this test: Test already used in a sheet	The test is shown on a sheet	Delete or edit the sheet first
Cannot delete this test: Test already used in a pressuremeter profile	The test belongs to a profile	Remove it from the profile
Cannot delete this test: Calibration already used in a pressuremeter test	The calibration is used by a test	Change the test's calibration
Unable to generate the Pressuremeter Profile; less than two pressuremeter curves are provided	Fewer than two tests ticked	Tick at least two tests, or use manual entry
Enter at least two rows in the table	Manual profile with fewer than two rows	Complete the table
Invalid value in row ...	Non-numeric value in the manual profile	Correct the indicated row
Illogical value, the calibration pressure value is greater than the pressure value read from the test	Pressuremeter test or calibration error	Check the calibration and readings (**Details** button)
The limit pressure cannot be calculated from this test	Insufficient pressuremeter curve	Use extrapolation by the reciprocal curve or repeat the test
Proctor's test cannot be done...	More than 25 % of particles D > 20 mm	Use another compaction reference
Impossible to use the Dreux-Gorisse mix design...	Cement dosage outside 200-400 kg/m³	Change the dosage or the method
This name is already used in another sheet	Two sheets have the same name	Choose another name
Could not find header, please import it	No header imported	**File > Header > Import**
Cannot open this file...	File saved by a newer version	Update CiviLab
Unable to verify your license...	No Internet connection	Check the connection, or use offline activation

34. Support

- **Help** (in the ribbon and in the **File** button) opens this manual in the interface language.
- Website: **www.bakhtisoftware.com**: detailed pages and sample sheets for each test, demonstration videos, pricing, contact.
- The version number and the licence are shown in **About...**.

35. Validation

This chapter summarises the validation of the CiviLab 7.1 calculations. Details are in the verification documents published with this manual: **Validation-Stabilite-CiviLab-7.1.pdf**, **Validation-CiviLab-7.1-Tous-les-essais.pdf**, **Verification-a-la-main-CiviLab-7.1.pdf** and the workbooks **Validation-Essais-7.1.xlsx** and **Validation-Triaxial-7.1.xlsx** (in French).

35.1 Approach and categories

Each test and calculation is checked on a case with a known result. The category gives the origin of the expected value:

Category	Origin of the expected value
A	Published example (report, manual, reference study), reproduced with the CiviLab code
B	Standard (tables, expressions) or exact analytical solution
C	Independent calculation to the standard's formula on a constructed data set, and hand check (no verifiable published numerical example found)

35.2 Slope stability — published cases

Published case	Method	Reference	GeoStudio	CiviLab 7.1
ACADS 1(a). simple slope	Bishop	1.00	0.993	0.985
ACADS non-homogeneous	Morgenstern-Price	1.39	1.382	1.365
ACADS non-homogeneous. earthquake kh = 0.15	Morgenstern-Price	1.00	0.989	0.983
Arai and Tagyo (1985)	Bishop	1.451	1.417	1.404
Greco (1996). layered	Morgenstern-Price	1.40 to 1.42	1.389	1.414
ACADS weak layer. specified surface	Morgenstern-Price	1.34	1.261	1.260

Published case	Method	Reference	GeoStudio	CiviLab 7.1
ACADS weak layer. search (three blocks)	Morgenstern-Price	1.26	1.261	1.243

Analytical solutions: exact equilibrium φ = 0 (1.39264 ; CiviLab 1.39258) ; static infinite slope (1.4004 ; CiviLab 1.4012) and seismic kh = 0.10 (1.1087 ; CiviLab 1.1093).

35.3 Validation table for all tests

Cat.	Test / calculation	Expected	CiviLab 7.1
	Slope stability		
A	Bishop, Spencer, Morgenstern-Price, séisme, surfaces non circulaires	voir dossier dédié	écarts 0,1 à 1,8 % (Greco Bishop +2,5 %)
B	Équilibre exact φ = 0 ; pente infinie statique et sismique	1,39264 ; 1,4004 ; 1,1087	1,39258 ; 1,4012 ; 1,1093
B	Coefficients sismiques	0,100 / 0,050 ; 0,120 / 0,060	identiques
	Triaxial (NF EN ISO 17892-8/9, NF P 94-070)		
A	CIU — c′, φ′	φ′ 24,45 / 26,7 / 17,56 / 26,44° ; c′ 28,78 / 0,36 / 7,4 / 3,76 kPa	identiques à 0,01° et 0,01 kPa
A	CD — rupture, c′, φ′	φ′ 17,97° ; c′ 26,14 kPa (calcul indépendant)	17,97° ; 26,14 kPa
B	UU — formules (1) à (6)	calcul à la main	identique
	Laboratory — soils		
A	Granulométrie — passants	95,99 ; 86,63 ; 57,65 ; 23,98 ; 6,01 ; 0,39 %	identiques (au centième)
A	Limites d'Atterberg — wP, wL (Casagrande)	wP 28 % ; wL ≈ 40 %	wP 27,99 % ; wL 39,55 % (teneurs recalculées sur les masses) ; 39,93 % avec les teneurs imprimées
C	Limites — cône 80 g/30°	44,6 %	44,6 %
C	Proctor — wOPN, ρd max	12,78 % ; 1,879	identiques
C	CBR	22,2	22,2

Cat.	Test / calculation	Expected	CiviLab 7.1
C	Sédimentométrie — diamètre de Stokes	0,0751 mm	identique
C	Cisaillement direct — c′, φ′	16,6 kPa ; 29,9°	identiques
C	Oedomètre — Cc	0,172	identique
C	Los Angeles, Micro-Deval, Équivalent de sable	22,6 ; 13,8 ; 77,0	identiques
C	Granulométrie — Mf, Cu, Cc	2,68 ; 5,26 ; 0,84	identiques
	In situ tests		
C	Pressiomètre Ménard — pl (courbe inverse, hyperbole)	2,006 MPa	2,006 MPa
C	Pressiomètre Ménard — EM	8,80 MPa	identique
C	Pénétromètre dynamique — qd	3,39 MPa	identique
C	CPT — qc, fs	2,100 MPa ; 50,000 kPa	2,100 MPa ; 50,000 kPa
	Foundations (bearing capacity)		
A	c-φ, semelle filante — termes c·Nc et q·Nq	7 400 psf ; 4 000 psf ; qult 13 425 psf (Nγ Vesic 5,4)	7 400 ; 4 000 psf ; qu 12 712 psf avec Nγ DTU 13.12 = 3,5 (écart dû au seul Nγ réglementaire)
B	Facteurs Nc, Nq, Nγ	18,40 / 20,09 (φ = 30°) ; 5,14 (φ = 0) ; DTU 30 / 18,4 / 18,1	identiques
B	Facteurs de forme et d'inclinaison	1,15 / 0,85 / 0,790 / 0,444	identiques
C	qu laboratoire, pressiomètre, CPT (DTU 13.12)	626,6 ; 928,3 ; 670,6 kPa	identiques
C	SPT — Meyerhof (1956), Bowles (1977), Terzaghi et Peck (1948)	239,1 kPa	identique
	Settlements		
A	Oedométrique — remblai large	1,75 ft (0,53 m)	1,747 ft (0,5326 m)

Cat.	Test / calculation	Expected	CiviLab 7.1
A	Oedométrique — sous semelle	0,09 ft = 1,1 in	0,0919 ft = 1,10 in
C	Pressiométrique Ménard — sc, sd	0,40 ; 0,85 cm	0,40 ; 0,85 cm
C	Élastique ; module de réaction	1,28 cm	identique
	Concrete		
A	Formulation ACI	eau 181 ; ciment 289,1 ; gros granulat 1136 ; sable 774,4 kg/m³ ; eau à ajouter 123	181 ; 289,1 ; 1136 ; 774,4 ; 122,9
C	Scléromètre	32 ; 31,33 ; zone dispersée rejetée	identiques
C	Compression ; ultrasons	26,2 MPa ; 4161 m/s	identiques
C	SonReb	34,5 MPa	identique
C	Dreux-Gorisse, Bolomey, Faury	YA 46,13 % ; P(0,08) 15,1 % ; brisure 60,87 %	identiques
	Roads and asphalt		
C	Masse volumique paraffinée	2,341 g/cm³	2,341
C	Kumagawa ; compacité	5,63 % ; 96,6 %	identiques

35.4 Hand check (category C)

Each calculation is redone by hand (formula, data, steps, result), independently of the code and of the workbook, and compared with CiviLab. All 26 checks agree.

Test	By hand	CiviLab 7.1
Laboratory		
1. Proctor — wOPN et ρd max	wOPN 12,78 % ; ρd max 1,879 g/cm³	12,78 % ; 1,879 g/cm³
2. Limites d'Atterberg — Casagrande et cône	wL 45,73 % ; IP 23,33 ; wL cône 44,59 %	45,7 % ; 23,3 ; 44,6 %
3. CBR	22,2	22,2
4. Sédimentométrie — diamètre de Stokes	0,0751 mm	0,0751 mm
5. Cisaillement direct — c′, φ′	c′ 16,6 kPa ; φ′ 29,9°	16,6 kPa ; 29,9°

Test	By hand	CiviLab 7.1
6. Oedomètre — Cc	0,172	0,172
7. Los Angeles, Micro-Deval, équivalent de sable	22,6 ; 13,8 ; 77,0	22,6 ; 13,8 ; 77,0
8. Granulométrie — Mf, Cu, Cc	2,68 ; 5,26 ; 0,84	2,68 ; 5,26 ; 0,84
In situ		
9. Pénétromètre dynamique — qd	3,39 MPa	3,39 MPa
10. Pressiomètre Ménard — EM, VI	EM 8,80 MPa ; VI 914,84 cm³	8,80 MPa ; 914,84 cm³
11. Pressiomètre Ménard — pl par la courbe inverse	2,006 MPa	2,006 MPa
12. CPT — qc, fs	2,10 MPa ; 50,0 kPa ; 2,38 %	2,100 MPa ; 50,000 kPa ; 2,381 %
Foundations		
13. Capacité portante laboratoire (DTU 13.12)	626,6 kPa	626,6 kPa
14. Capacité portante pressiométrique (DTU 13.12)	928,3 kPa	928,3 kPa
15. Capacité portante pénétrométrique (DTU 13.12)	670,6 kPa	670,6 kPa
16. SPT — Meyerhof (1956)	239,1 kPa	239,1 kPa
Settlements		
17. Tassement pressiométrique Ménard	sc 0,40 ; sd 0,85 cm	0,40 ; 0,85 cm
18. Oedométrique (3 couches) et élastique	48,5 cm ; 1,28 cm	48,5 cm ; 1,28 cm
Concrete		
19. Compression	26,2 ; 31,9 MPa	26,2 ; 31,9 MPa
20. Ultrasons	4 161 m/s	4 161 m/s
21. Scléromètre	32 ; 31,33	32 ; 31,33
22. SonReb — corrélation « Meynink et al. (1979) »	34,5 MPa	34,5 MPa
23. Dreux-Gorisse	YA 46,13 % ; eau 184,2 L	46,13 % ; 184,2 L
24. Bolomey	P(0,08) 15,1 % ; eau 189,8 L	15,1 % ; 189,8 L
25. Faury	60,87 % ; 154,5 L	60,87 % ; 154,5 L
Roads and asphalt		

Test	By hand	CiviLab 7.1
26. Kumagawa, masse volumique paraffinée, compacité	5,63 % ; 2,341 ; 96,6 %	5,63 % ; 2,341 ; 96,6 %

35.5 Corrections and open points

- **CPT**: qc (MPa) = 10·Qc (kN)/Ac (cm²); fs (kPa) = 10,000·Qs (kN)/As (cm²); the Rf plot of the sheet uses the stored fs and qc (calculation revised in 7.1). CPT tests saved with an earlier version must be reopened and saved again.
- **c-φ bearing capacity**: CiviLab applies the Nγ of the chosen standard (DTU 13.12 or EN 1997-1); FHWA example 8-1 uses Vesic's Nγ: the cohesion and surcharge terms are identical.
- **SonReb**: CiviLab uses 0.0297 for the Meynink et al. (1979) correlation; the ALCONPAT (2023) paper prints 0.0294; difference 0.09 MPa on the example; to be checked against the original paper.
- **Category C**: real test reports whose results were established by other means can be added to move these tests to category A.

35.6 References

- FHWA (2006). Soils and Foundations Reference Manual, Vol. I and II (FHWA-NHI-06-088, -089).
- Hu D. and al. (2025). Geotechnical Engineering Lab Manual, Kennesaw State University (CC BY-NC 4.0).
- British Geological Survey (2006), report IR/06/065 ; University of Waterloo (2006), CIV E 353.
- ACI 211.1-91, annex 1, example 1.
- Giam and Donald (1989), ACADS ; Arai and Tagyo (1985) ; Greco (1996) ; Seequent/GeoStudio (2025), verification manual SLOPE/W.
- Zhu and al. (2005) ; Bishop (1955) ; Spencer (1967) ; Morgenstern and Price (1965).
- Standards : NF P 94-261, NF P 94-270, DTU 13.12, EN 1997-1, NF P 94-110-1, NF EN ISO 22476-1/-2, NF EN ISO 17892-5/-8/-9/-10, NF P 94-051/-052-1/-057/-078/-093, NF EN 933-8, NF EN 1097-1/-2, NF EN 12620, NF EN 12390-3, NF EN 12504-2/-4, ASTM C805, NF EN 12697-6, RPA 2024.