



Part D: TASSELDO MODULE

D.1. INTRODUCTION	5
D.2. THEORETICAL ASPECTS.....	6
D.2.1. Problem.....	6
D.2.2. Stresses	6
D.2.3. Settlements	7
D.2.3.1. One-dimensional settlement	8
D.2.3.2. 3-dimensional settlement (approximate Steinbrenner formula)	8
D.2.3.3. Oedometric settlement.....	9
D.2.4. Applications and limits	10
D.3. USER'S MANUAL	11
D.3.1. "Parameters" tab	11
D.3.1.1. "General parameters" frame	11
D.3.1.2. "Import" frame.....	11
D.3.2. "Layers" tab	12
D.3.2.1. "Calculation type" frame.....	13
D.3.2.2. "Soil layers definition" frame	13
D.3.2.3. "Oedometric calculation parameters" frame	14
D.3.3. "Loads" tab	15
D.3.3.1. "Loads on soil" frame	15
D.3.3.2. Loads wizard	17
D.3.4. "Consolidation" tab	23
D.3.4.1. "Consolidation dates definition" frame.....	23
D.3.4.2. "Consolidation rates by layer and by date" frame	23
D.3.5. "Calculation" tab	24
D.3.5.1. "Calculation points definition" frame.....	24
D.3.5.2. Calculation points wizards	26
D.3.5.3. Adjustment of an average settlement plane	32
D.3.6. Calculation and results	32
D.3.6.1. Calculation.....	32
D.3.6.2. Results	32
D.4. CALCULATION EXAMPLES	40
D.4.1. Example 1	40
D.4.1.1. Introduction.....	40
D.4.1.2. Data input	40
D.4.1.3. Calculation and results	45

D.4.2. Example 2	53
D.4.2.1. Presentation of the problem.....	53
D.4.2.2. Data input	53
D.4.2.3. Calculation and results	59

TABLE OF FIGURES

Figure D.1 : Point vertical load Q applied to the soil surface.....	6
Figure D.2 : Rectangular uniform load q - Superposition method	7
Figure D.3 : Application of Steinbrenner's formula	8
Figure D.4 : Void ratio e versus σ'_v	9
Figure D.5 : "Parameters" tab	11
Figure D.6 : Wizard for importing a Tasplaq file into the TasselDO module.....	12
Figure D.7 : "Layers" tab	13
Figure D.8 : "Loads" tab	15
Figure D.9 : View of a particular load	16
Figure D.10 : Automatic loads (wizards).....	17
Figure D.11 : "Uniform circular load"	18
Figure D.12 : Calculated values: "Uniform circular load".....	18
Figure D.13 : "Uniform annular load"	19
Figure D.14 : Calculated values: "Uniform annular load"	20
Figure D.15 : Example of 3D embankment-type load	20
Figure D.16 : Wizard: "3D embankment-like load"	21
Figure D.17 : Calculated values: "3D embankment-like load"	22
Figure D.18 : "Consolidation" tab	23
Figure D.19 : "Calculation" tab	24
Figure D.20 : Selection of a calculation point – Graphic representation	25
Figure D.21 : Example of graphic representation of side view (Oyz plane)	25
Figure D.22 : Calculation points situated along a segment	26
Figure D.23 : Calculated values: Calculation points situated along a segment	27
Figure D.24 : Calculation points situated along a horizontal circle.....	28
Figure D.25 : Calculated values: Calculation points situated along a horizontal circle	28
Figure D.26 : Calculation points distributed on a horizontal rectangle	29
Figure D.27 : Calculated values: Calculation points distributed on a horizontal rectangle	29
Figure D.28 : Calculation points distributed on a horizontal quadrilateral	30
Figure D.29 : Calculated values: Calculation points distributed on a horizontal quadrilateral	31
Figure D.30 : Calculation points distributed on a horizontal disk	31
Figure D.31 : Calculated values: Calculation points situated on a horizontal disk.....	32
Figure D.32 : Numerical and graphical results	33
Figure D.33 : Numerical results: Formatted results – Data reminder.....	33
Figure D.34 : Numerical results: Formatted results – Results (normal printing)	34
Figure D.35 : Numerical results: Formatted results (detailed printing).....	35
Figure D.36 : Numerical results: Formatted results – Results (adjusted plane).....	36
Figure D.37 : Numerical results: Stresses and settlements	37
Figure D.38 : Numerical results: Consolidation settlements (oedometric)	37
Figure D.39 : Graphical results: Stresses and settlements	38
Figure D.40 : Graphical results: Oedometric consolidation settlement	38
Figure D.41 : Graphical results : Settlements at given Z	39

TABLE OF TABLES

<i>Table D.1 : Soil layer parameters</i>	14
<i>Table D.2 : Oedometric calculation parameters</i>	14
<i>Table D.3 : Parameters for loads definition</i>	16
<i>Table D.4 : Parameters for uniform circular load</i>	17
<i>Table D.5 : Parameters for uniform annular load</i>	19
<i>Table D.6 : Parameters for 3D embankment-like load</i>	21
<i>Table D.7 : Consolidation parameters</i>	24
<i>Table D.8 : Parameters for defining calculation points situated along a segment</i>	26
<i>Table D.9 : Parameters for definition of calculation points situated along a horizontal circle</i>	28
<i>Table D.10 : Parameters for definition of calculation points distributed on a horizontal rectangle</i>	29
<i>Table D.11 : Parameters for definition of calculation points distributed on a horizontal quadrilateral</i>	30
<i>Table D.12 : Parameters for definition of calculation points distributed on a horizontal disk</i>	31
<i>Table D.13 : Details of numerical results (stresses and settlements)</i>	36
<i>Table D.14 : Details of numerical results: Consolidation settlements (oedometric)</i>	37

D.1. Introduction

The Tasseldo module is a program based on analytical formulas designed to compute the **variations of the vertical stress and vertical settlement in an elastic**, homogeneous and isotropic medium, subjected to uniform rectangular loads on the soil surface.

It can take account of a horizontal multilayer soil, with elastic and/or oedometric behaviour. In the case of an oedometric calculation, it can also take account of degrees of consolidation.

Numerous wizards are available for automatic generation of a load mesh and calculation points, or for importing results from the Tasplaq module (interaction pressures and calculation points).

Finally, it is possible to adjust an average settlement plane by the least squares method.

D.2. Theoretical aspects

D.2.1. Problem

We have an elastic, homogeneous and isotropic medium subjected on its surface to a load applied in the form of a distributed (uniform) pressure.

At a point M(x,y,z) we aim to assess:

- the stress variation $\Delta\sigma_{zz}$ induced by load Q on the surface,
- the settlement (one-dimensional, three-dimensional or oedometric).

D.2.2. Stresses

Boussinesq formula: point load (Figure D.1)

The vertical load Q is applied to the surface of a semi-infinite, homogeneous and isotropic medium (Figure D.1). The vertical stress variation at any point N of the medium was given by Boussinesq:

$$\Delta\sigma_{zz} = \frac{3 \cdot Q}{2 \cdot \pi \cdot z^2} \cdot \left(\frac{1}{1 + \left(\frac{r}{z}\right)^2} \right)^{\frac{5}{2}} \quad (1)$$

Where:

z: depth of point N,

r: horizontal distance from N to the action line of Q.

This solution (established for a homogeneous medium) is independent of the mechanical characteristics (E and ν) of the soil.

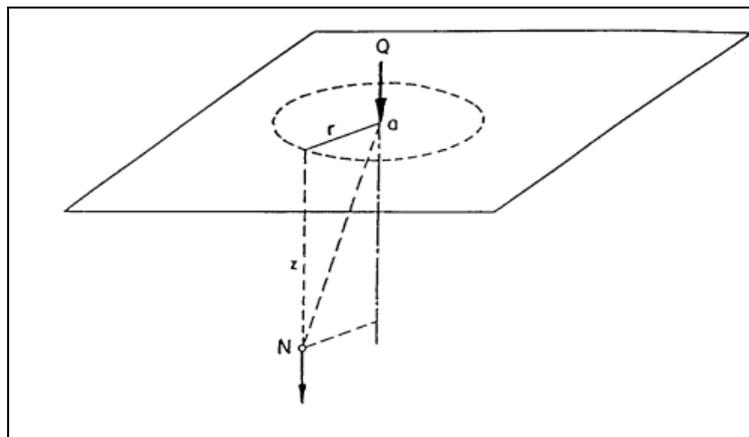


Figure D.1 : Point vertical load Q applied to the soil surface

Distributed load (Figure D.2)

The vertical stress variation $\Delta\sigma_{zz}$, due to a uniform load of density q distributed over a surface is obtained by integrating the formula (1) over the considered surface. If the load surface is a rectangle ($l \times b$), where l is the length and b the width, the analytical solution at all points along axis D passing through one of the four corners of the rectangle can be written (Figure D.2):

$$\sigma_{zz} = q \cdot k_0 \quad (2)$$

$$k_0 = \left[\frac{1}{2\pi} \right] \left[\operatorname{atg} \left(\frac{lb}{z \cdot R_3} \right) + \frac{lb \cdot z}{R_3} \left(\frac{1}{R_1^2} + \frac{1}{R_2^2} \right) \right] \quad (3)$$

with $R_1 = \sqrt{l^2 + z^2}$; $R_2 = \sqrt{b^2 + z^2}$; $R_3 = \sqrt{l^2 + b^2 + z^2}$

The vertical stress under a rectangular load is also independent of the characteristics E and ν (homogeneous medium).

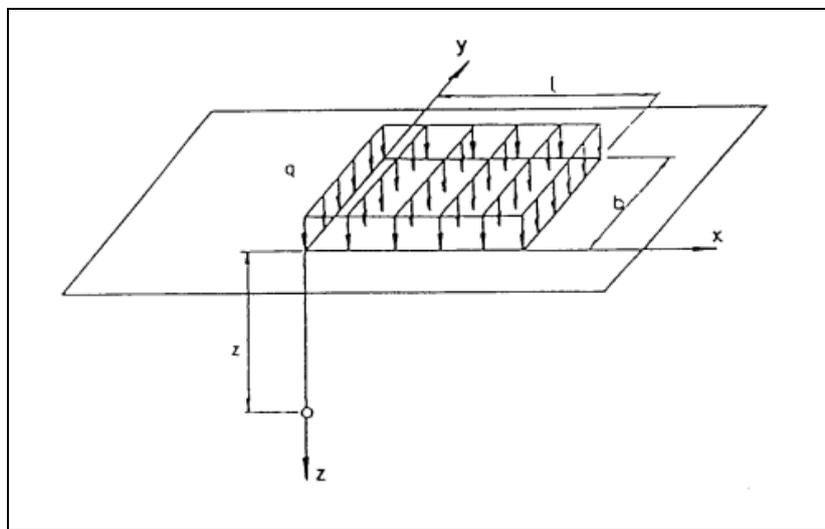


Figure D.2 : Rectangular uniform load q - Superposition method

As the medium is isotropic, homogeneous and linearly elastic, we use the superposition method to calculate the stress variation $\Delta\sigma_{zz}$ and the settlement at all points, for all allowable loads. The solution is known, using formula (2), under one of the four corners of the rectangle; the problem can thus be broken down in a way appropriate to the solution.

The solution can be written:
$$\sigma_{zz} = \sum_{i=1}^n \sigma_{zz}^i \quad \text{and} \quad \varepsilon_{zz} = \sum_{i=1}^n \varepsilon_{zz}^i$$

where n is the number of problems to be superposed.

D.2.3. Settlements

The vertical displacement at a point M is deduced from $\Delta\sigma_{zz}$, calculated with formula (2), in the case of the calculation of a one-dimensional and oedometric settlement. In the case of a three-dimensional displacement (Steinbrenner formula), the settlement of a given layer is calculated directly from the geometry of the surface loading.

D.2.3.1. One-dimensional settlement

We make the following assumption: the displacements along x and y are nil (oedometric conditions), only the displacement ϵ_{zz} is other than zero. The soil behaviour is assumed to be elastic; ϵ_{zz} is deduced from σ_{zz} by the law:

$$\epsilon_{zz} = \frac{\sigma_{zz}}{E_{oed}}; \quad E_{oed} = E \cdot \left(\frac{(1-\nu)}{(1+\nu) \cdot (1-2\nu)} \right) \quad (4)$$

With:

- E_{oed} : Oedometric modulus,
- E: Young's modulus,
- ν : Poisson's ratio.

The stress used in the calculations is the mean value of the vertical stress in the considered layer. The one-dimensional settlement ΔH is then equal to:

$$\Delta H = \frac{\Delta \sigma_{zz}}{E_{oed}} \cdot H$$

D.2.3.2. 3-dimensional settlement (approximate Steinbrenner formula)

The calculation of 3-dimensional settlements is based on the approximate Steinbrenner formula, which derives from the Boussinesq formulas (Terzaghi, 1943). This formula can be used to express settlement under the corner of a uniform rectangular load L x B, from a layer situated between depths D1 and D2, of modulus E and Poisson's ratio ν :

$$\rho_{D1-D2} = \frac{qB}{E} \left((1-\nu^2)(F_1(D_2) - F_1(D_1)) + (1-\nu-2\nu^2)(F_2(D_2) - F_2(D_1)) \right)$$

Where:

$$\left\{ \begin{aligned} F_1(D) &= \frac{1}{\pi} \left(l \ln \left(\frac{(1 + \sqrt{l^2 + 1}) \sqrt{l^2 + d^2}}{l(1 + \sqrt{1 + d^2 + l^2})} \right) + \ln \left(\frac{(l + \sqrt{l^2 + 1}) \sqrt{1 + d^2}}{(l + \sqrt{1 + d^2 + l^2})} \right) \right) \\ F_2(D) &= \frac{d}{2\pi} \arctan \left(\frac{l}{d \sqrt{1 + d^2 + l^2}} \right) \end{aligned} \right. \quad \text{with } d = \frac{D}{B} \text{ and } l = \frac{L}{B}$$

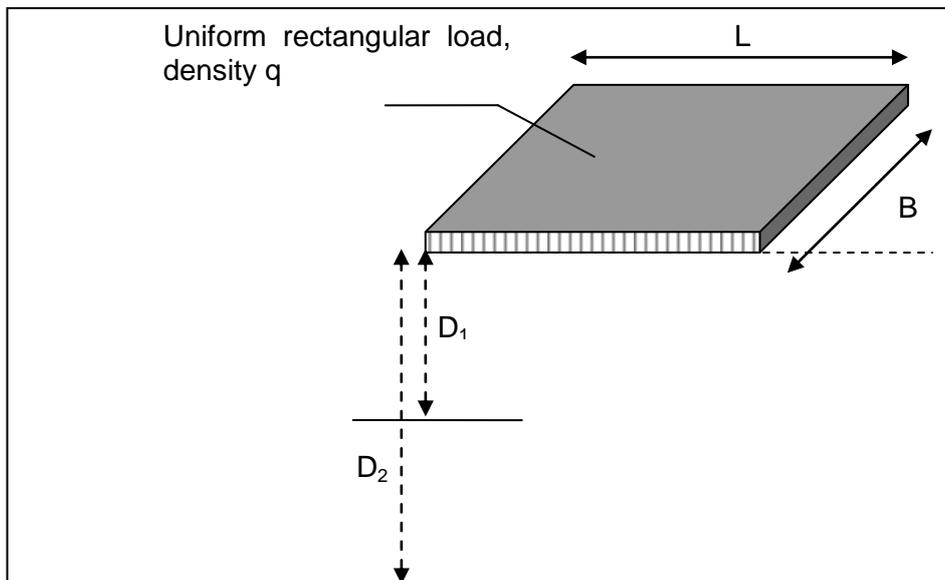


Figure D.3 : Application of Steinbrenner's formula

D.2.3.3. Oedometric settlement

a) Final oedometric settlement

The oedometric settlement ΔH is deduced from the oedometric curve (Figure D.4) representing the void ratio as a function of the vertical effective stress σ'_v in the soil: $e = f(\sigma'_{zz})$, characterised by:

C_s : swelling ratio;

C_c : consolidation ratio;

e_o : initial void ratio;

σ'_o : initial effective geostatic stress;

σ'_p : preconsolidation pressure;

t_c : overconsolidation factor, by convention

$$t_c = \sigma'_p / \sigma'_o \text{ if } t_c > 0$$

$$t_c = -(\sigma'_p - \sigma'_o) \text{ if } t_c < 0$$

We assume that lateral displacements are nil (one-dimensional displacement assumption is valid) and that the volume of skeleton grains remains constant. The relationship between the variation in vertical displacement and that of the void ratio is defined by:

$$\frac{\Delta H}{H_o} = \frac{\Delta e}{(1 + e_o)}$$

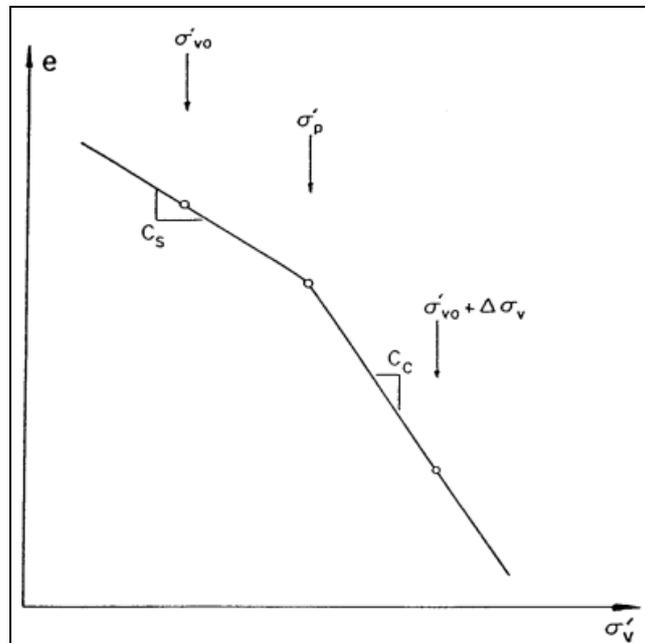


Figure D.4: Void ratio e versus σ'_v

The oedometric settlement ΔH due to a rise in the effective stress $\Delta\sigma'_{zz}$ (calculated) depends on the reference state and the soil loading history:

- first case: normally consolidated soil: $\sigma'_o = \sigma'_p$, the oedometric settlement can be written:

$$\text{if } \Delta\sigma'_{zz} > 0, \quad \Delta H = H \cdot \frac{C_c}{1 + e_o} \cdot \left[\log_{10} \left(\frac{\sigma'_o + \Delta\sigma'_{zz}}{\sigma'_o} \right) \right] \quad (5)$$

$$\text{if } \Delta\sigma'_{zz} < 0, \quad \Delta H = H \cdot \frac{C_s}{1 + e_o} \cdot \left[\log_{10} \left(\frac{\sigma'_o + \Delta\sigma'_{zz}}{\sigma'_o} \right) \right] \quad (6)$$

- second case: overconsolidated soil: $\sigma_0' < \sigma_p'$

If $\sigma_p' < \Delta\sigma_{zz}' + \sigma_0'$ and $\Delta\sigma_{zz}' > 0$ (load case), oedometric settlement can be written:

$$\Delta H = \frac{H_o}{(1 + e_o)} \left[C_s \cdot \log_{10} \left(\frac{\sigma_p'}{\sigma_o'} \right) + C_c \cdot \log_{10} \left(\frac{\sigma_o' + \Delta\sigma_{zz}'}{\sigma_p'} \right) \right] \quad (7)$$

If $\sigma_p' > \Delta\sigma_{zz}' + \sigma_0'$ then settlement ΔH can be deduced from formula (6).

b) Settlement at time t

We can consider that in the overconsolidated domain, consolidation is far faster than in the normally consolidated domain.

Thus, for each layer, the degree of consolidation is only applied to the stress variation exceeding the consolidation pressure.

At a time t, we consider that the stress value is:

$$\sigma_v'(t) = \sigma_p' + U_s(t) \times (\sigma_0' + \Delta\sigma - \sigma_p')$$

$U_s(t)$, provided layer by layer by the user, must be deduced from a prior consolidation calculation (to be carried out with specific software).

The additional stress at time t can be written:

$$\Delta\sigma(t) = \sigma_v'(t) - \sigma_0'$$

The value thus evaluated is input into whichever of formulas (5) to (7) is applicable.

D.2.4. Applications and limits

Application of the Boussinesq formulas for the semi-infinite, elastic, homogeneous, isotropic medium is acceptable as long as there are no significant differences in stiffness between the various layers.

This is generally the case of soils subject to significant displacements. The case of a stiff layer on top of a soft layer cannot be dealt with in this way.

The elasticity displacements approach (1D or 3D calculation) requires a correct evaluation of the Young's modulus for the stresses domain and the range of expected displacements under the structure. This is important in the case of granular soils in which the modulus increases with the mean stress σ_m and decreases with displacement.

The calculations performed generally show little difference between the 1D calculation and the 3D calculation.

Burland underlined that the oedometric approach for estimating total settlement under a foundation gave an order of magnitude at least equivalent to that given by the most sophisticated calculation methods, for all soils with approximate "elastic" behaviour under the effect of vertical loads.

The oedometric approach implicitly includes the variation in stiffness with the level of loading.

The degrees of consolidation introduced for the settlement calculation as a function of time must be deduced from a consolidation calculation representative of the conditions encountered (to be performed using specific software).

D.3. USER’S MANUAL

This chapter presents:

- the Tasseldo module input parameters.
Some zones can only take data with a physical meaning (for example, a Poisson’s ratio must always be strictly included between 0 and 0.5).
The input window for the Tasseldo calculation parameters comprises 5 separate tabs. The data to be filled out in each tab sometimes depend on certain choices made by the user: for example, the data from to the oedometric calculation are only required if this type of calculation was requested by the user.
- the results provided by the Tasseldo module. Here again, they partly depend on the data input by the user, in particular the type of calculation.

This chapter does not detail the actual user interface and its operations (buttons, menus, etc.): these aspects are dealt with in part C of the manual.

D.3.1. “Parameters” tab

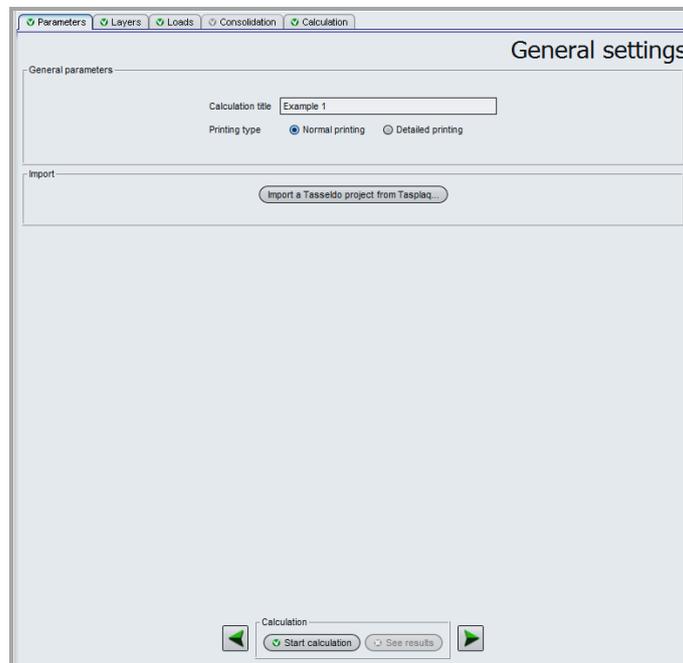


Figure D.5 : “Parameters” tab

D.3.1.1. “General parameters” frame

This tab is used to define

- the calculation title: maximum of 80 characters;
- the level of printing detail: this is in fact the level of detail for generation of the formatted numerical results file (see chapter D.3.6.2.1).

D.3.1.2. “Import” frame

In the Tasseldo module, it is possible to import a project from the Tasplaq module.

In the context of a Tasplaq calculation, the Foxta software edits a .tso file, which is the format recognised by the Tasseldo module. This file can be imported into the Tasseldo module.

In the “Parameters” tab, the **Import a Tasseldo project from Tasplaq...** button opens the “Tasseldo project import wizard” which is used to select the directory containing the *[TQ].tso file from the Tasplaq project and then carry out the import operation:

- “Import directory” frame: please, provide the path to the directory containing the Tasseldo project. By default, Foxta proposes the directory containing the current project. If necessary, use the Browse button **...** to select the relevant directory. Foxta could display a warning message if the calculation date is a long time in the past and ask you to check the project data;
- The names of the available Tasplaq projects appear in the left-hand frame: select one;
- The corresponding calculation date appears on the right;
- Information about data imported from the Tasplaq module appears in the right-hand frame.

Click the **OK** button to confirm data import or click **Cancel**.

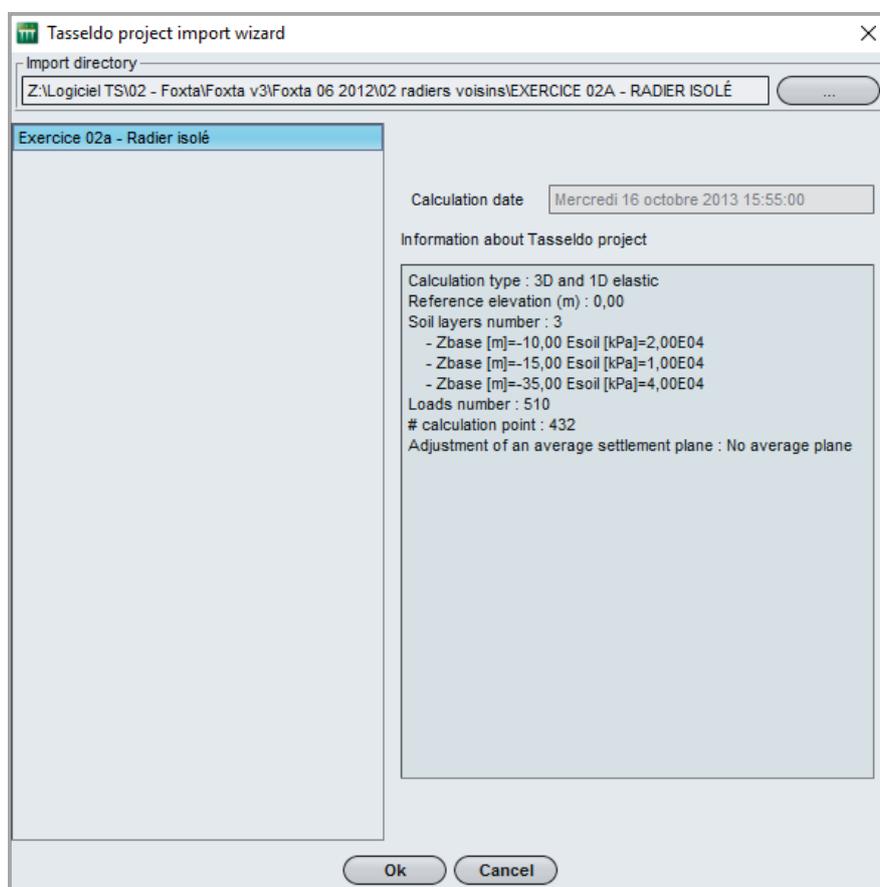


Figure D.6 : Wizard for importing a Tasplaq file into the Tasseldo module

It is also possible to export the results of a Tasplaq calculation to the Tasseldo module. For more details, check the Tasplaq User's Manual (part I).

D.3.2. “Layers” tab

This second tab is used to input parameters concerning soil behaviour.

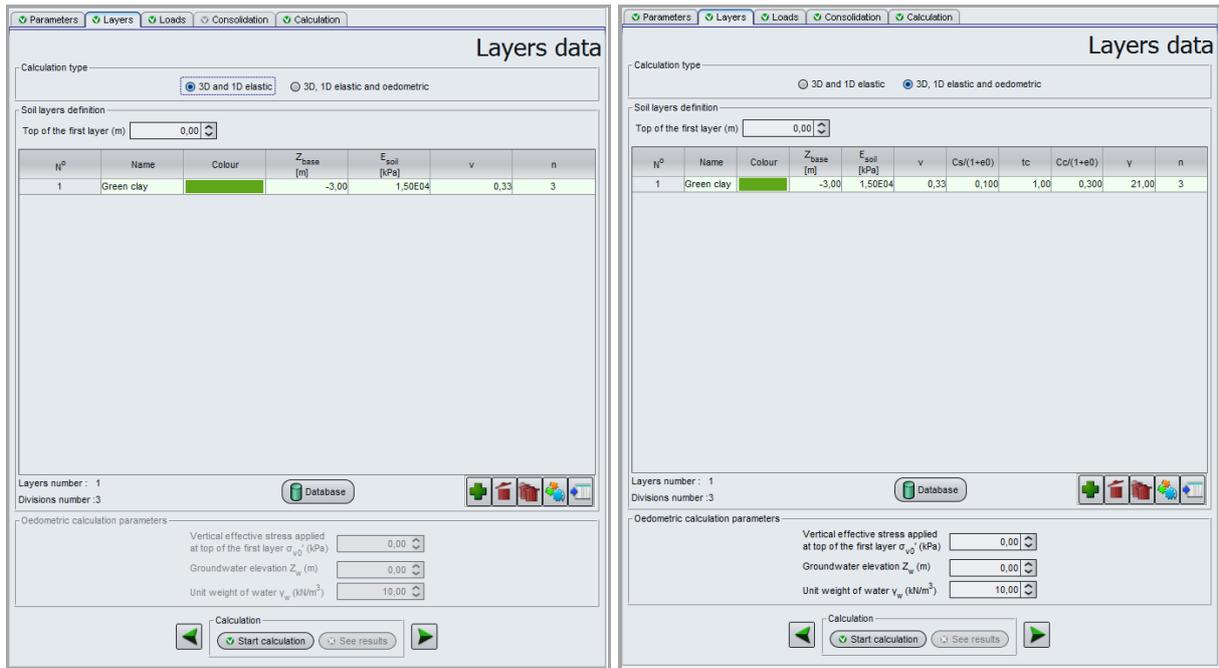


Figure D.7: “Layers” tab

Various information is accessible according to the type of calculation selected.

D.3.2.1. “Calculation type” frame

The choice of calculation type lets the user state whether he wants to perform an oedometric calculation in addition to the 3D and 1D Elastic calculation.

If “3D, 1D elastic and oedometric” calculation is selected:

- The soil layers definition table contains additional columns;
- The “Oedometric calculation parameters” frame appears;
- The “Consolidation” tab is activated.

Note: the combination of elastic and oedometric approaches can for example be useful for adjusting the elastic moduli of project layers with respect to oedometric settlement, or in the general case of a soil consisting of a succession of sands and clays.

D.3.2.2. “Soil layers definition” frame

This frame first requires the input of the top of the first soil layer that is the GL elevation (m). It must be higher than the base elevation of the first layer which will be defined in the soil layers definition table immediately below.

The choice of an oedometric calculation requires definition of an overconsolidation parameter ‘t_c’ as follows:

- if t_c>0 then $t_c = \sigma'_p / \sigma'_{v0}$
- if t_c<0 then $t_c = - (\sigma'_p - \sigma'_{v0})$

Where σ'_{v0} is the initial vertical effective stress and σ'_p the pre-consolidation stress.

The following table describes the soil properties to be defined for each layer:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Z : elevation of layer base	m	1 m below the base of the layer above	Always	Yes	Strictly decreasing values
E : Young's modulus	kPa	-	Always	Yes	> 0
v : Poisson's ratio	-	-	Always	Yes	$0 < v < 0.5$
C_s/(1+e₀) : recompression (or swelling) ratio	-	-	Oedometric calculation only	Yes if displayed	≥ 0
t_c : overconsolidation parameter	- or kPa	-	Oedometric calculation only	Yes if displayed	-
C_c/(1+e₀) : consolidation ratio	-	-	Oedometric calculation only	Yes if displayed	≥ 0
γ : total unit weight of layer (γ' is automatically taken into account if the layer is submerged, always input γ)	kN/m ³	-	Oedometric calculation only	Yes if displayed	> 0
n : number of layer subdivisions (discretisation for the calculations)	-	1	Always	Yes	≥ 1

Table D.1 : Soil layer parameters

Foxta can be used to save soil layers in the project soils database and/or in the global soils database by clicking the  button.

This saves the soil layers with their parameters and avoids having to input them again when creating a new module in the current project, or in another Foxta project.

Use of the soils database is described in detail in part C of the manual.

D.3.2.3. “Oedometric calculation parameters” frame

This frame, which is only visible if the user has chosen an oedometric calculation, is used to input the following:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
σ_{vo}' : vertical effective stress applied to the top of the first layer	kPa	0.00	Always	Yes	≥ 0
Z_w : groundwater level	m	0.00	Always	Yes	-
γ_w : unit weight of water	kN/m ³	10.00	Always	Yes	> 0

Table D.2 : Oedometric calculation parameters

D.3.3. “Loads” tab

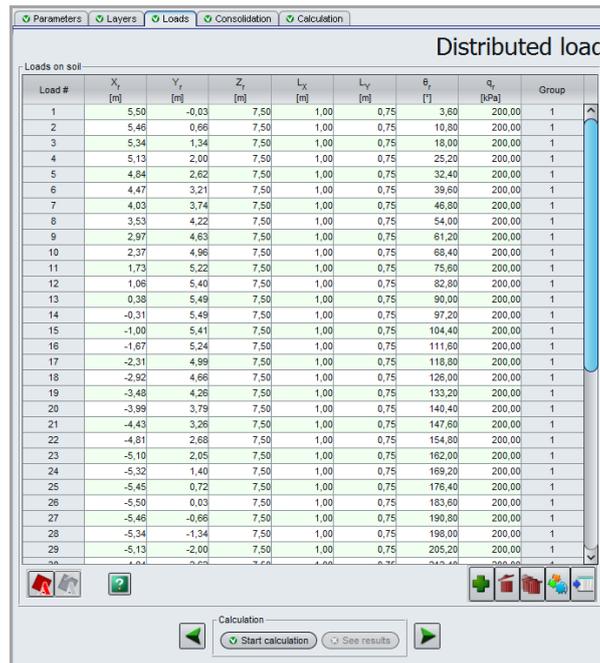


Figure D.8 : “Loads” tab

D.3.3.1. “Loads on soil” frame

The loads taken into account in the TasselDO module must be rectangular. However, complex shaped loads can be defined by combining rectangles of equivalent footprint.

At least one non-null rectangular load must be defined in order to be able to make a settlement calculation. The data to be input for each rectangle (in other words on each load line in the “Loads” tab table) are described in the following table.

Note:

- the loads can be applied to the surface (at ground level), but also at any other level;
- this tab has a Wizard button  for easier definition of the loads. See chapter D.3.3.2.

To view a particular load, select a line in the loads table: the corresponding load is then framed in green on the graphic representation in the left-hand part of the window.

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
X_r, Y_r, Z_r : Coordinates of the reference corner of the rectangle (Z axis upwards)	m	-	Always	Yes	
L_x, L_y : dimensions along local x and y axis of the rectangle	m	-	Always	Yes	
θ_r : angle between side L_x and axis Ox (positive in the counter-clockwise direction)	°	-	Always	Yes	
q_r : uniform load density	kPa		Always	Yes	$\neq 0$
Group (a group of loads corresponds to a set of load rectangles generated with the wizard)	-	-	If one of the "loads" wizards was used	Filled out automatically	-

Table D.3 : Parameters for loads definition

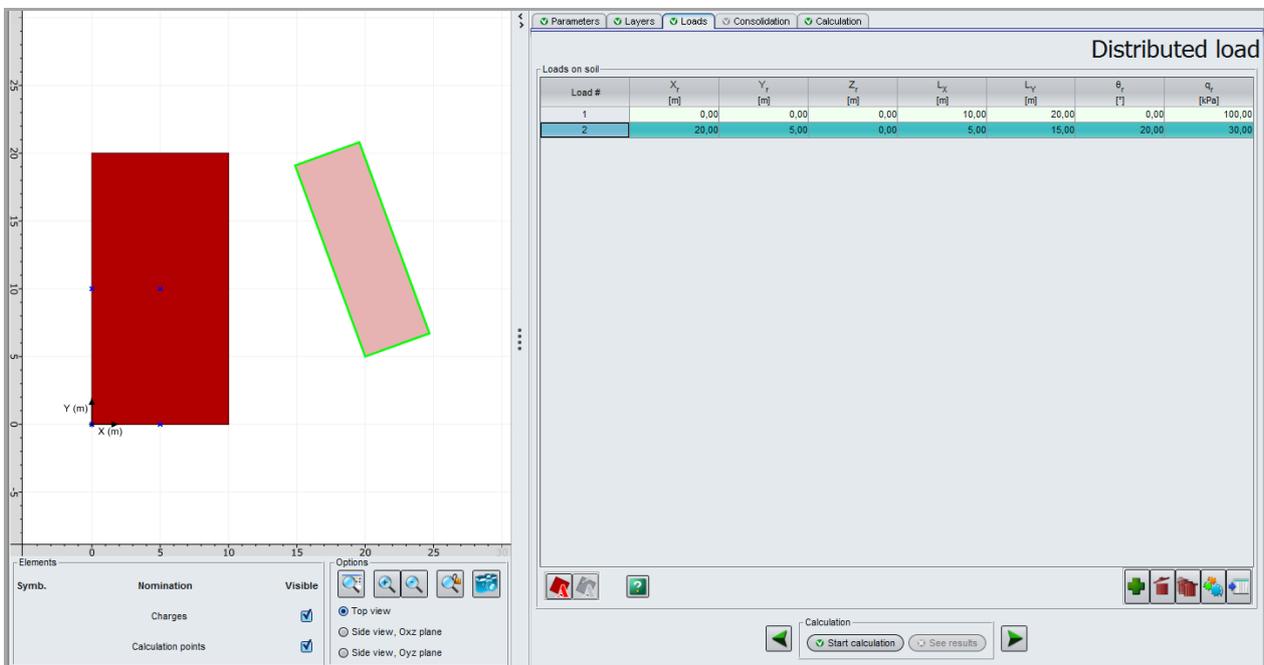


Figure D.9 : View of a particular load

D.3.3.2. Loads wizard

To make the definition of “routine” loads easier, this tab has a Wizard button  used for simple definition of:

- a uniform circular load;
- a uniform annular load;
- a 3D embankment type load.

Figure D.10 illustrates the various available wizards:

- Choose the type of load;
- Fill out the various input fields;
- Click the **Transfer** button.

The use of the various load tabs is described in the following sub-chapters.

Note: it is possible to use several wizards or the same Loads wizard several times for the same Tasseldo calculation.

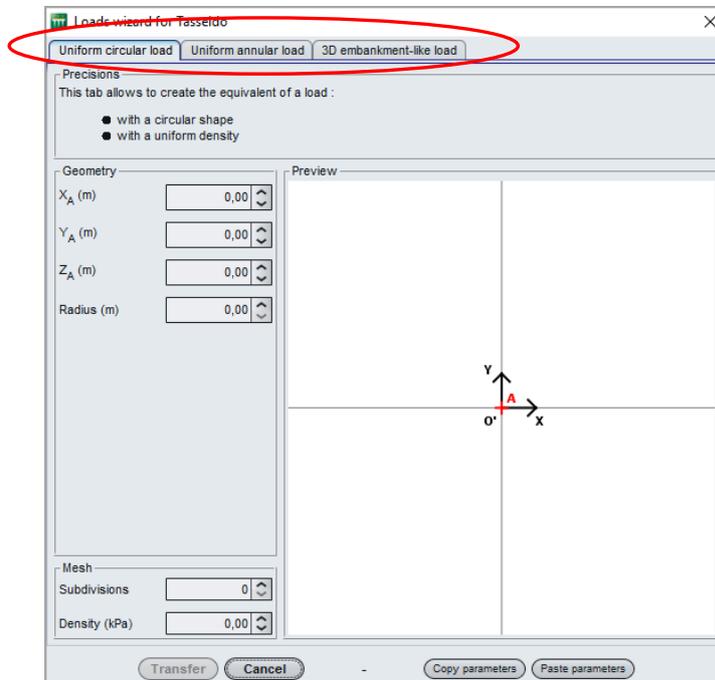


Figure D.10 : Automatic loads (wizards)

D.3.3.2.1. Wizard: "Uniform circular load"

This wizard is used to generate a group of rectangular loads equivalent to a uniform circular load.

The data to be input are as follows:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Point A (X_A, Y_A, Z_A): coordinates of centre of loaded disk	m	(0,0,0)	Always	Yes	
Radius of loaded disk	m	-	Always	Yes	>0
Subdivisions number	-	10	Always	Yes	>0
Density of load	kPa	-	Always	Yes	-

Table D.4 : Parameters for uniform circular load

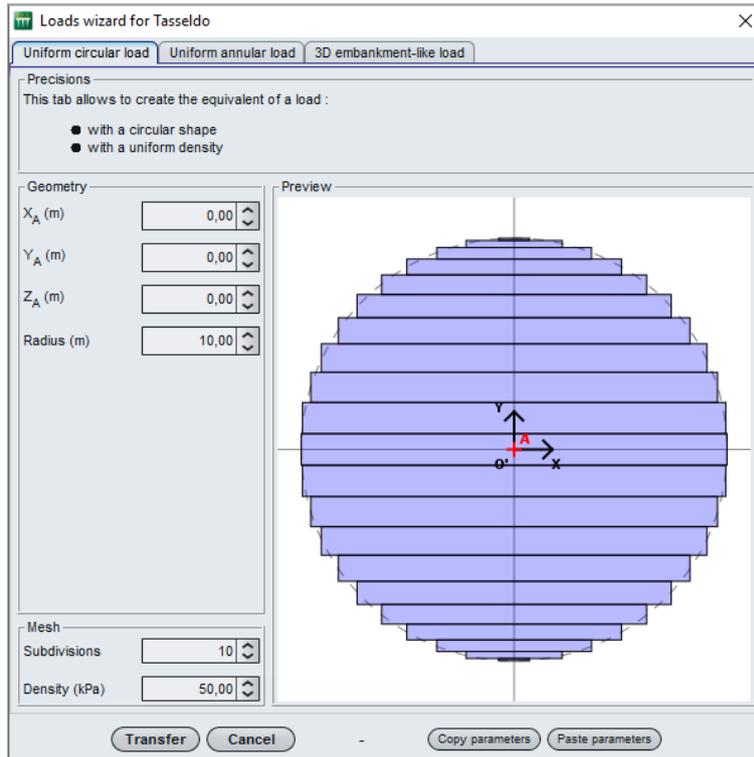


Figure D.11 : "Uniform circular load"

Generation of rectangular loads representing the circular load and calculation of their properties X_r , Y_r , Z_r , L_x , L_y , θ_r and q_r , are activated by clicking the **Transfer** button:

Load #	X_r [m]	Y_r [m]	Z_r [m]	L_x [m]	L_y [m]	θ_r [°]	q_r [kPa]	Group
1	-0.72	-10.00	0.00	1.44	0.11	0.00	50.00	1
2	-2.26	-9.89	0.00	4.52	0.33	0.00	50.00	1
3	-3.64	-9.56	0.00	7.27	0.55	0.00	50.00	1
4	-5.04	-9.01	0.00	10.08	0.75	0.00	50.00	1
5	-6.22	-8.26	0.00	12.45	0.93	0.00	50.00	1
6	-7.38	-7.33	0.00	14.76	1.10	0.00	50.00	1
7	-8.26	-6.23	0.00	16.52	1.23	0.00	50.00	1
8	-9.06	-5.00	0.00	18.13	1.35	0.00	50.00	1
9	-9.55	-3.65	0.00	19.11	1.43	0.00	50.00	1
10	-9.94	-2.23	0.00	19.89	1.48	0.00	50.00	1
11	-10.00	-0.75	0.00	20.00	1.49	0.00	50.00	1
12	-9.94	0.75	0.00	19.89	1.48	0.00	50.00	1
13	-9.55	2.23	0.00	19.11	1.43	0.00	50.00	1
14	-9.06	3.65	0.00	18.13	1.35	0.00	50.00	1
15	-8.26	5.00	0.00	16.52	1.23	0.00	50.00	1
16	-7.38	6.23	0.00	14.76	1.10	0.00	50.00	1
17	-6.22	7.33	0.00	12.45	0.93	0.00	50.00	1
18	-5.04	8.26	0.00	10.08	0.75	0.00	50.00	1
19	-3.64	9.01	0.00	7.27	0.55	0.00	50.00	1
20	-2.26	9.56	0.00	4.52	0.33	0.00	50.00	1
21	-0.72	9.89	0.00	1.44	0.11	0.00	50.00	1

Figure D.12 : Calculated values: "Uniform circular load"

D.3.3.2.2. Wizard: Uniform annular load

This wizard is used to generate a group of rectangular loads equivalent to a uniform annular load.

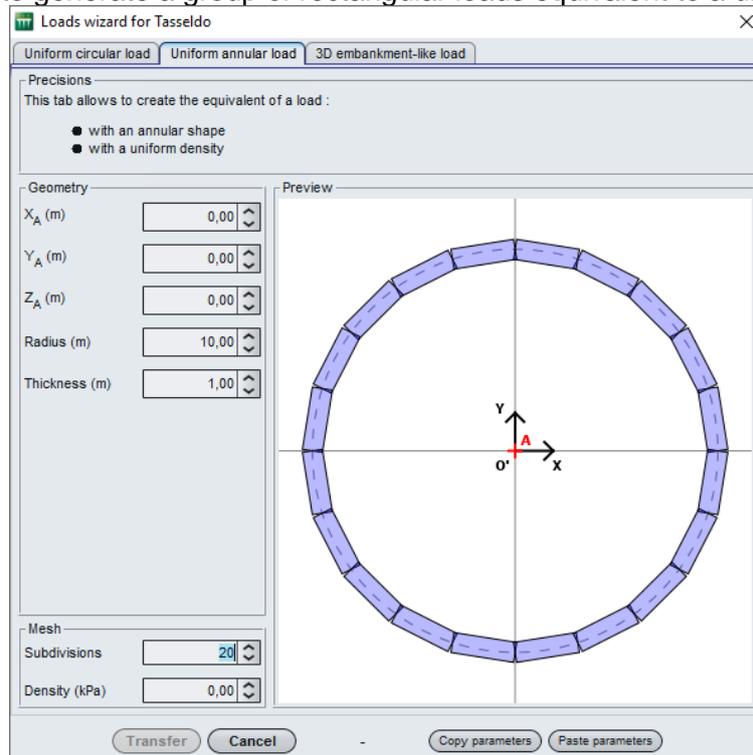


Figure D.13 : "Uniform annular load"

The data to be input are as follows:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Point A (X_A, Y_A, Z_A): coordinates of centre of ring	m	(0,0,0)	Always	Yes	
Average radius of ring	m	-	Always	Yes	> 0
Thickness of ring	m	-	Always	Yes	> 0
Subdivisions number	-	20	Always	Yes	> 0
Density of load	kPa	-	Always	Yes	-

Table D.5 : Parameters for uniform annular load

The generation of rectangular loads representing the annular load and the calculation of their properties X_r , Y_r , Z_r , L_x , L_y , θ_r and q_r , are activated by clicking the **Transfer** button:

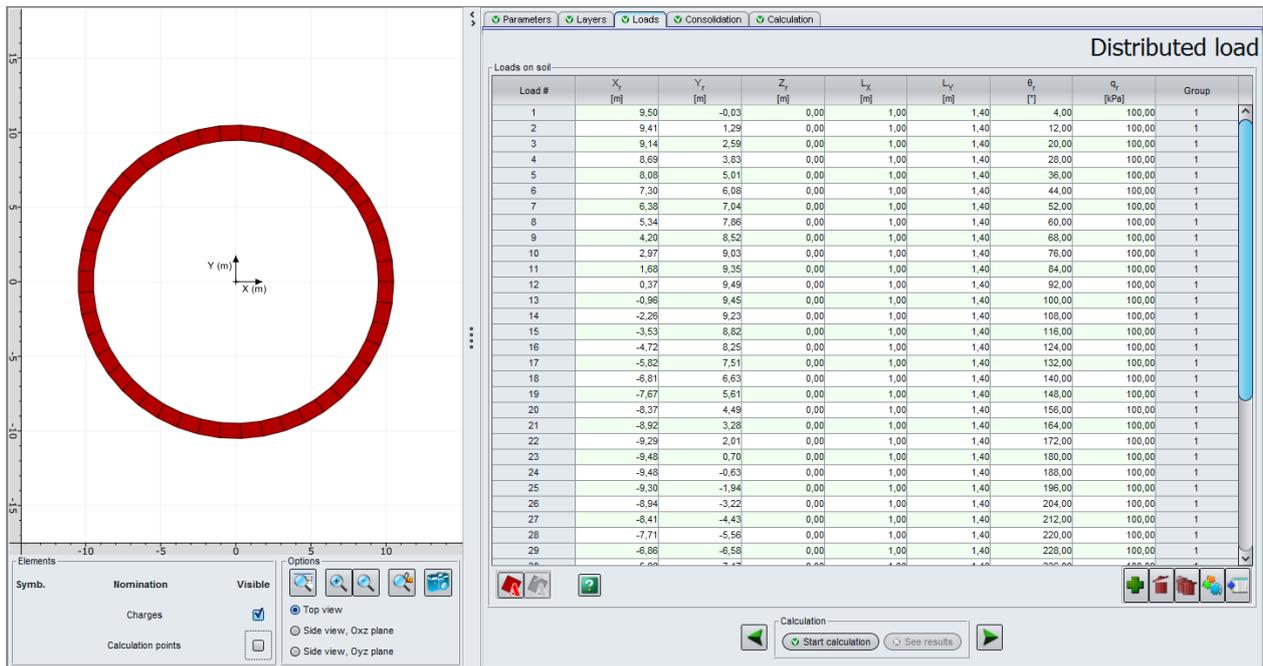


Figure D.14 : Calculated values: "Uniform annular load"

D.3.3.2.3. Wizard: 3D embankment-like load

This wizard is used to generate a group of rectangular loads equivalent to a three-dimensional embankment.

The following example of this type of load illustrates the general case (different load value at each of the 4 points A, B, C and D).

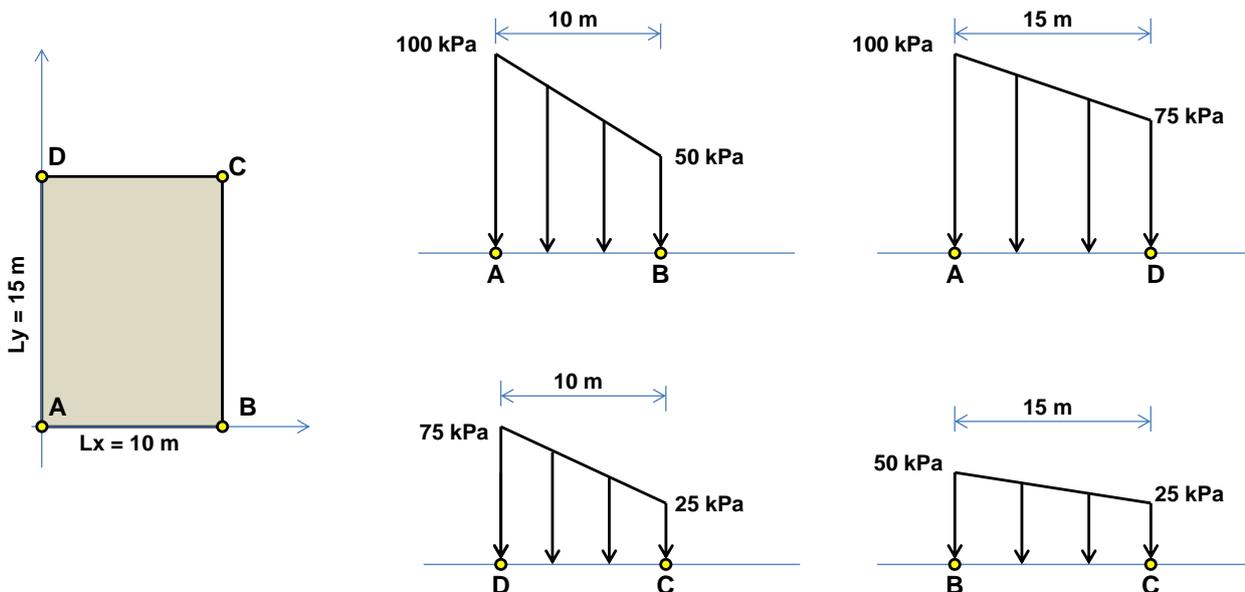


Figure D.15 : Example of 3D embankment-type load

The corresponding definition in the wizard is as follows:

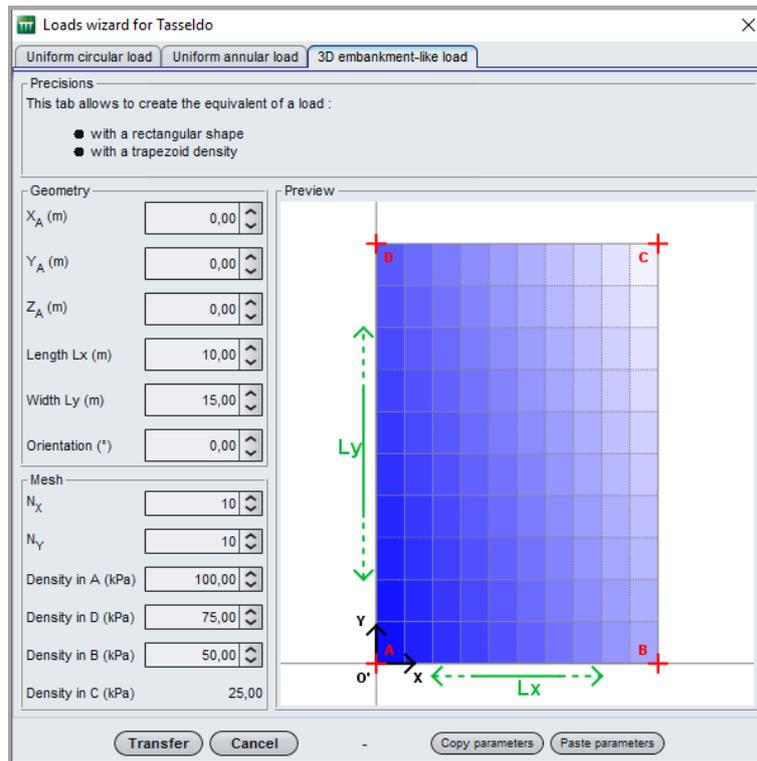


Figure D.16 : Wizard: "3D embankment-like load"

The data to be input are as follows:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Point A (X_A, Y_A, Z_A): Coordinates of lower left corner of the embankment	m	-	Always	Yes	
L_x: Length of embankment	m	-	Always	Yes	> 0
L_y: Width of embankment	m	-	Always	Yes	> 0
θ : Orientation	°	-	Always	Yes	
N_x: Subdivisions along X	None	10	Always	Yes	≥ 2
N_y: Subdivisions along Y	None	10	Always	Yes	≥ 2
Load density at A	kPa	-	Always	Yes	At least one of the 3 values must be other than zero
Load density at D	kPa	-	Always	Yes	
Load density at B	kPa	-	Always	Yes	
Load density at C	kPa	-	Always	Yes	Automatically calculated from the preceding 3 values

Table D.6 : Parameters for 3D embankment-like load

The generation of load rectangles representing the “3D embankment-like load” and the calculation of their properties X_r , Y_r , Z_r , L_x , L_y , θ_r and q_r , are activated by clicking the **Transfer** button:

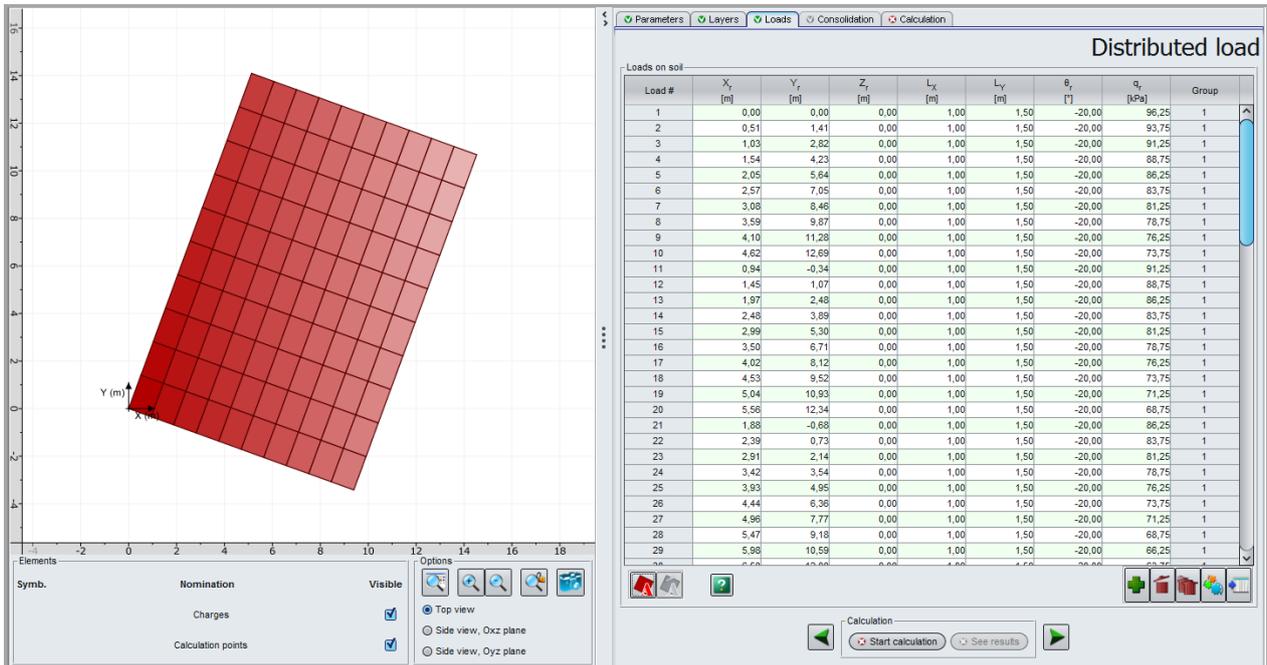


Figure D.17 : Calculated values: "3D embankment-like load"

D.3.4. "Consolidation" tab

This tab is only accessible if the "3D, 1D elastic and oedometric" option in the "Layers" tab has been selected.

To take account of consolidation in the context of an oedometric calculation, it is necessary first of all to check the "Consideration of consolidation" box and then input the required data in the 2 frames of the tab.

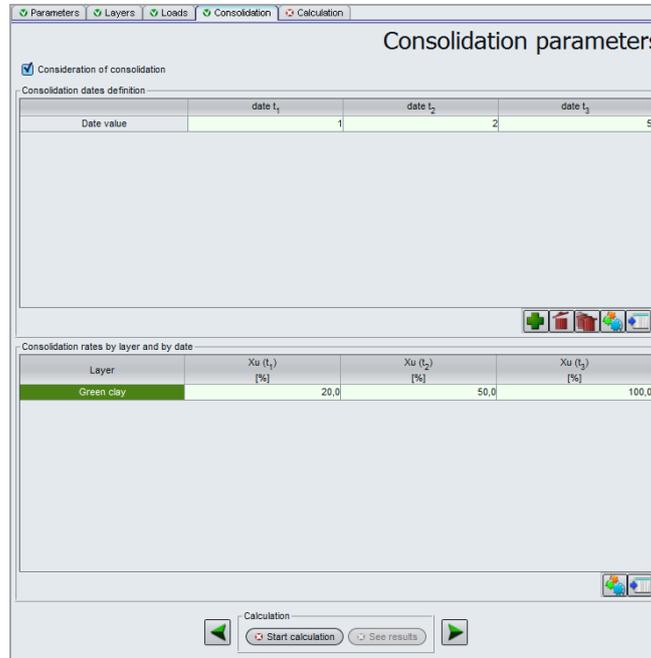


Figure D.18 : "Consolidation" tab

D.3.4.1. "Consolidation dates definition" frame

This frame is used to define the various consolidation dates (ascending) $t_1, t_2, \dots, t_i, \dots, t_{20}$ to be considered, in other words the dates for which the user is then required to define the consolidation percentage rate of each layer $X_u(t_i)$.

The dates are expressed without units (because they are not used in the calculations but only for display): it is therefore user’s responsibility to define dates that are consistent.

Adding a date ("+" button under the table) adds a column to the table.

D.3.4.2. "Consolidation rates by layer and by date" frame

This should be used to define the consolidation percentage of each layer, for each date defined above. The software automatically creates a line per layer in the table.

Value $X_u(t_i) = 100\%$ corresponds to complete consolidation of the layer concerned on date t_i .

The consolidation percentages input are allocated to the active layers base. When a layer is subdivided into several sub-layers, the program performs linear interpolation of the consolidations to allocate a consolidation percentage for each date that is consistent with the position of each sub-layer.

The parameters to be filled out are:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Xu(t_i) : consolidation rate of the layer indicated on date t _i	%	-	Always	Yes	$0 \leq Xu(t_i) \leq 100\%$ The values of Xu must be ascending (not strictly) over time within a given layer

Table D.7 : Consolidation parameters

D.3.5. "Calculation" tab

This tab is used to define the calculation points for which one wishes to evaluate settlement and stresses. At least one calculation point must be defined.

These points must be chosen according to the project requirements: these points are those for which detailed results will be given. They are also the points which are used to calculate the average settlement plane when this is requested.

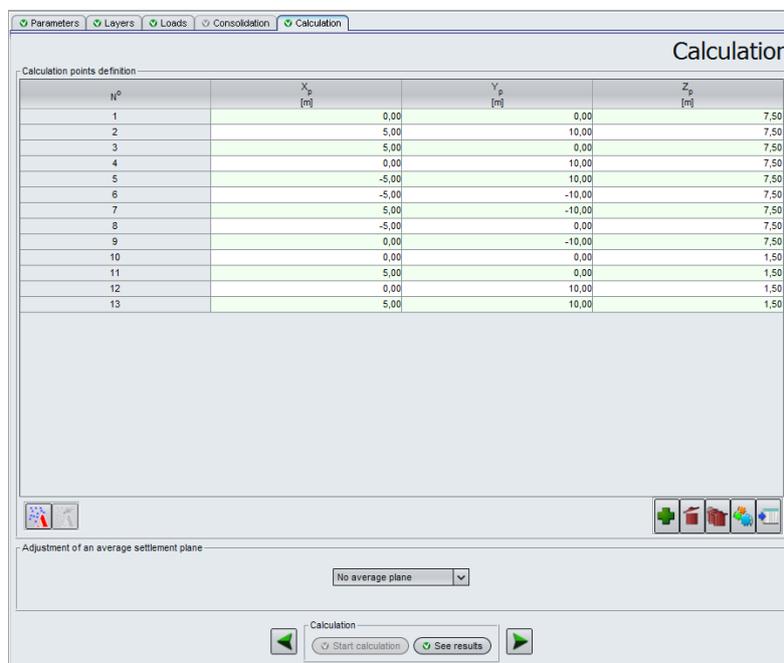


Figure D.19 : "Calculation" tab

D.3.5.1. "Calculation points definition" frame

The coordinates (X_P, Y_P, Z_P) (m) must be defined for each calculation point the user wishes to define.

To make it easier to define calculation points, it is possible to use one of the proposed wizards (see next chapter).

Note:

- It is advised to choose a beginning of calculation elevation Z_p situated on a limit between layers;
- Settlements and stresses are only calculated from (below) the elevation of the point considered;
- The "group" column appears when the calculation points wizard has been used: a group of calculation points corresponds to a set of calculation points generated via the wizard;

- The application marks the point selected in the table with a green cross in the graphic part:

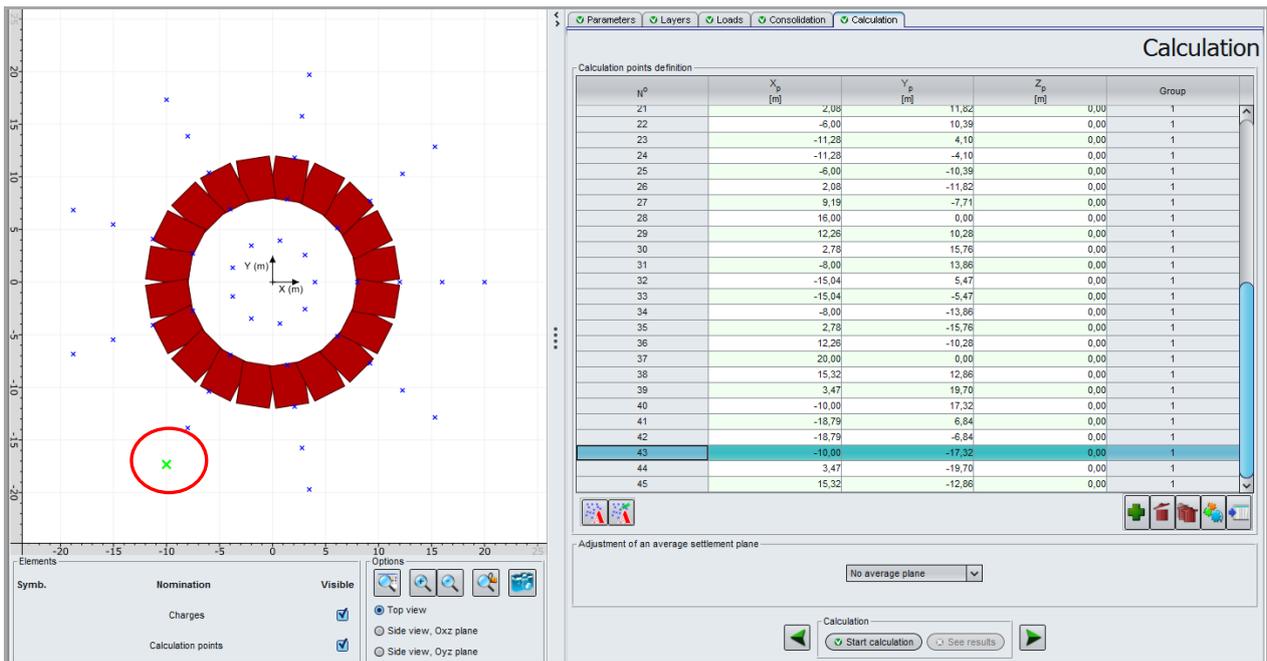


Figure D.20 : Selection of a calculation point – Graphic representation

Note: the view presented by default in the graphic space is the project top view. Using the Side view, Oyz plane and Side view, Oxz plane buttons, it is also possible to display the side view (planes Oyz or Oxz).

These views can for example be used to visualise load and calculation points defined at depth.

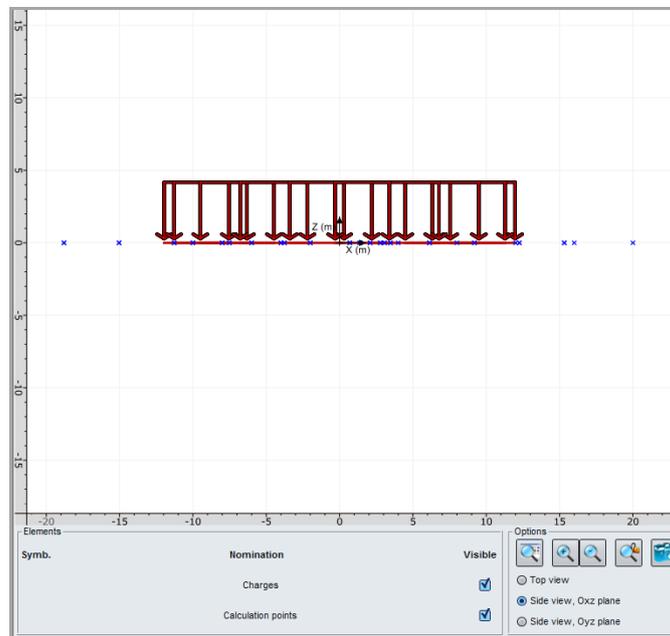


Figure D.21 : Example of graphic representation of side view (Oyz plane)

D.3.5.2. Calculation points wizards

These wizards are used to automatically generate aligned points or points distributed according to predetermined geometries. They are accessible by clicking the  button.

Several wizards can be used or the same wizard can be used several times in the same TasselDO calculation.

After using at least one “Calculation points” wizard, the  button becomes accessible: it is used to modify the selected group of calculation points.

D.3.5.2.1. Calculation points situated along a segment

This wizard is used to automatically generate calculation points aligned along a segment [A, B].

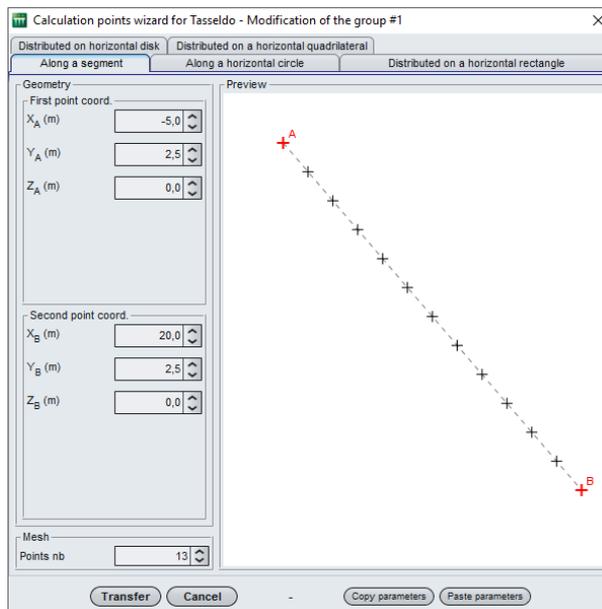
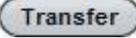


Figure D.22 : Calculation points situated along a segment

The following parameters are to be filled out:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Point A (X_A, Y_A, Z_A): Coordinates of point A	m	-	Always	Yes	The 2 points must be distinct
Point B (X_B, Y_B, Z_B): Coordinates of point B	m	-	Always	Yes	
Number of points	-	10	Always	Yes	≥ 2

Table D.8 : Parameters for defining calculation points situated along a segment

Once the wizard data have been completed, click the  button: the points generated are then automatically copied into the table of calculation points in the “Calculation” tab:

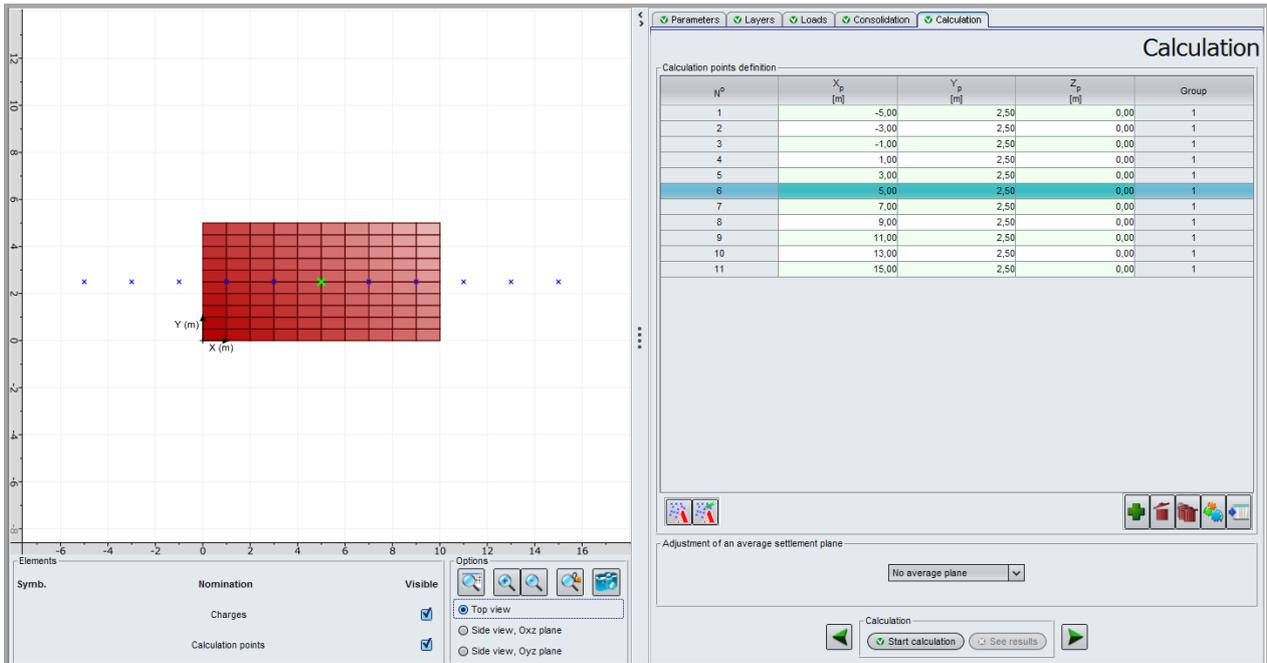


Figure D.23 : Calculated values: Calculation points situated along a segment

D.3.5.2.2. Calculation points situated along a horizontal circle

This wizard is used to automatically define calculation points aligned along a circle with centre A.

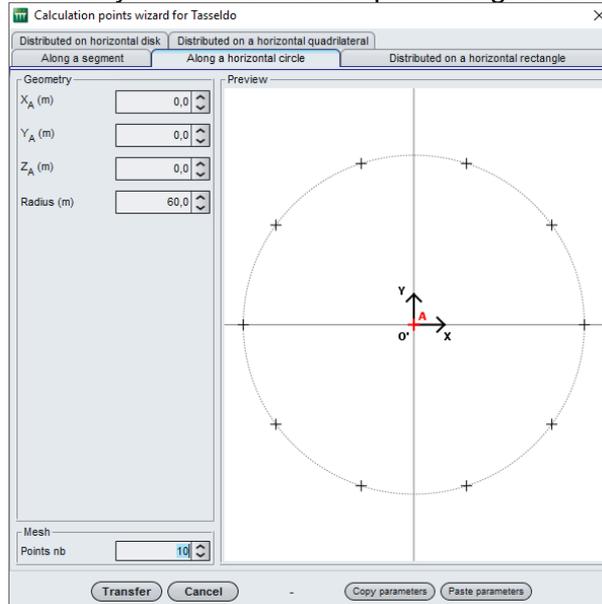


Figure D.24 : Calculation points situated along a horizontal circle

The parameters to be filled out are as follows:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Point A (X_A, Y_A, Z_A)	m	-	Always	Yes	
Radius of circle	m	-	Always	Yes	> 0
Number of points	-	10	Always	Yes	≥ 2

Table D.9 : Parameters for definition of calculation points situated along a horizontal circle

Once the wizard data have been completed, click the **Transfer** button: the points generated are then automatically copied into the calculation points table in the “Calculation” tab:

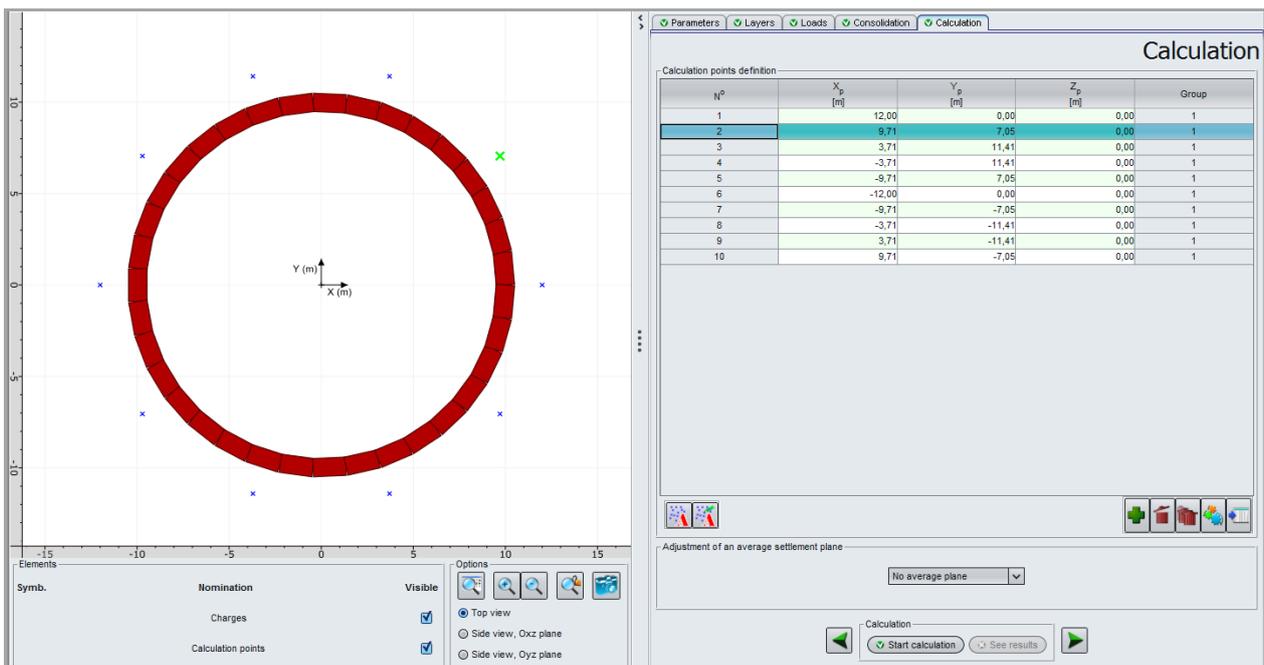


Figure D.25 : Calculated values: Calculation points situated along a horizontal circle

D.3.5.2.3. Calculation points distributed on a horizontal rectangle

This wizard is used to automatically define a mesh of calculation points distributed on a horizontal rectangle [A, B, C, D].

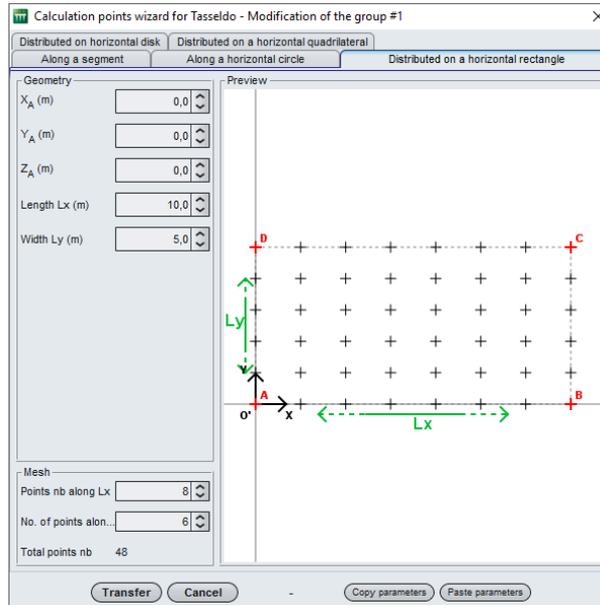


Figure D.26 : Calculation points distributed on a horizontal rectangle

The following parameters are to be filled out:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Point A (X_A, Y_A, Z_A)	m	-	Always	Yes	-
L_x : length of rectangle	m	-	Always	Yes	> 0
L_y : width of rectangle	m	-	Always	Yes	> 0
Number of points along L_x	-	7	Always	Yes	≥ 2
Number of points along L_y	-	7	Always	Yes	≥ 2

Table D.10 : Parameters for definition of calculation points distributed on a horizontal rectangle

Once the wizard data have been completed, click the **Transfer** button: the generated points are then automatically copied into the calculation points table in the "Calculation" tab:

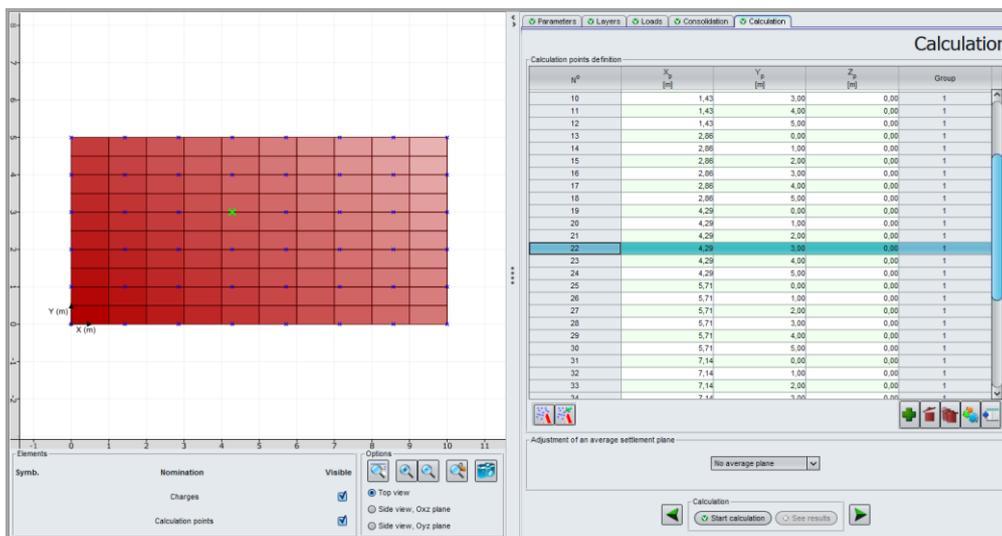


Figure D.27 : Calculated values: Calculation points distributed on a horizontal rectangle

D.3.5.2.4. Calculation points distributed on a horizontal quadrilateral

This wizard is used to automatically define calculation points distributed on a horizontal quadrilateral [A, B, C, D].

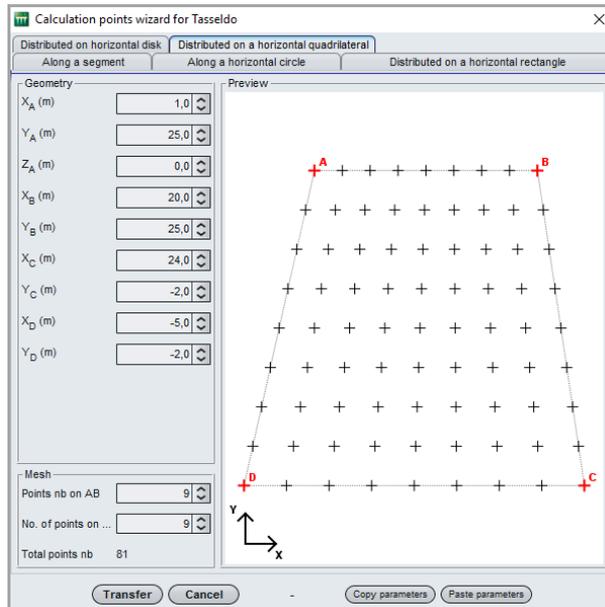


Figure D.28 : Calculation points distributed on a horizontal quadrilateral

The following parameters are to be filled out:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Point A (X_A, Y_A, Z_A)	m	-	Always	Yes	The 4 points must be distinct
Point B (X_B, Y_B)	m	-	Always	Yes	
Point C (X_C, Y_C)	m	-	Always	Yes	
Point D (X_D, Y_D)	m	-	Always	Yes	
Number of points on AB, including ends A and B	-	7	Always	Yes	≥ 2
Number of points on AD, including ends A and D	-	7	Always	Yes	≥ 2

Table D.11 : Parameters for definition of calculation points distributed on a horizontal quadrilateral

Once the wizard data have been completed, click the **Transfer** button: the points generated are then automatically copied into the table in the “Calculation” tab:

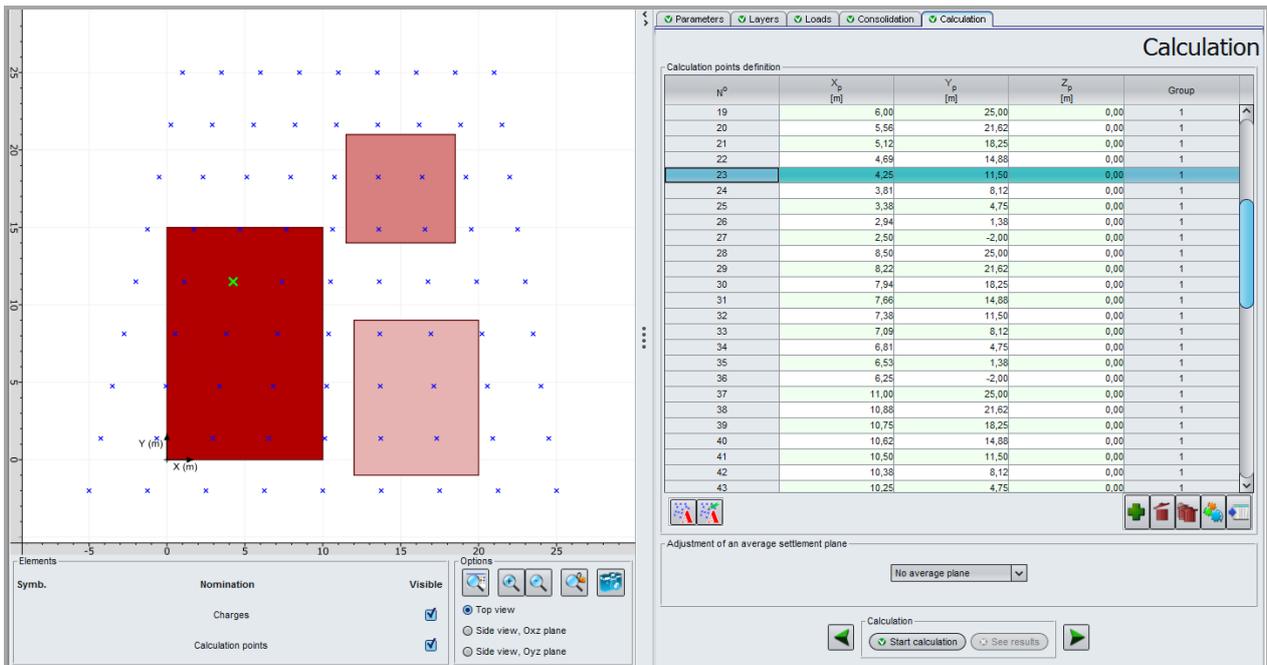


Figure D.29 : Calculated values: Calculation points distributed on a horizontal quadrilateral

D.3.5.2.5. Calculation points distributed on a horizontal disk

This wizard is used to automatically define calculation points distributed on a disk with centre A.

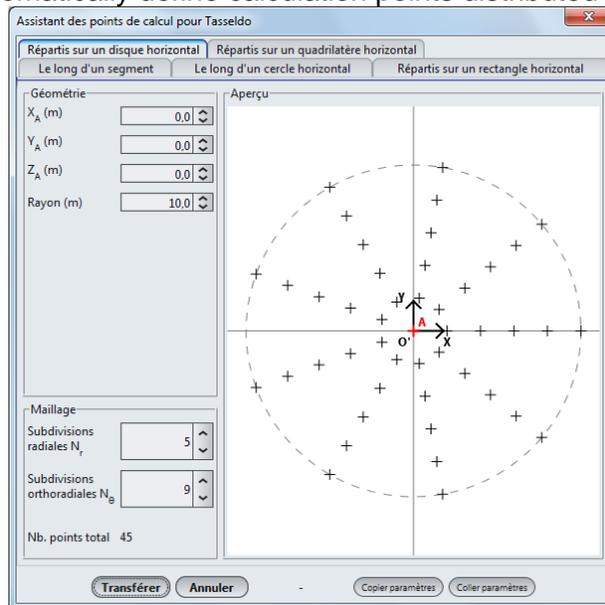


Figure D.30 : Calculation points distributed on a horizontal disk

The following parameters are to be filled out:

Designation	Unit	Default value	Display condition	Mandatory value	Local checks
Point A (X_A, Y_A, Z_A)	m	-	Always	Yes	
Radius of disk	m	-	Always	Yes	> 0
N_r : number of radial subdivisions (number of circles)	-	5	Always	Yes	≥ 1
N_θ : number of orthoradial subdivisions (number of points on each circle)	-	10	Always	Yes	≥ 2

Table D.12 : Parameters for definition of calculation points distributed on a horizontal disk

Once the wizard data have been completed, click the **Transfer** button: the points generated are then automatically copied into the calculation points table in the "Calculation" tab:

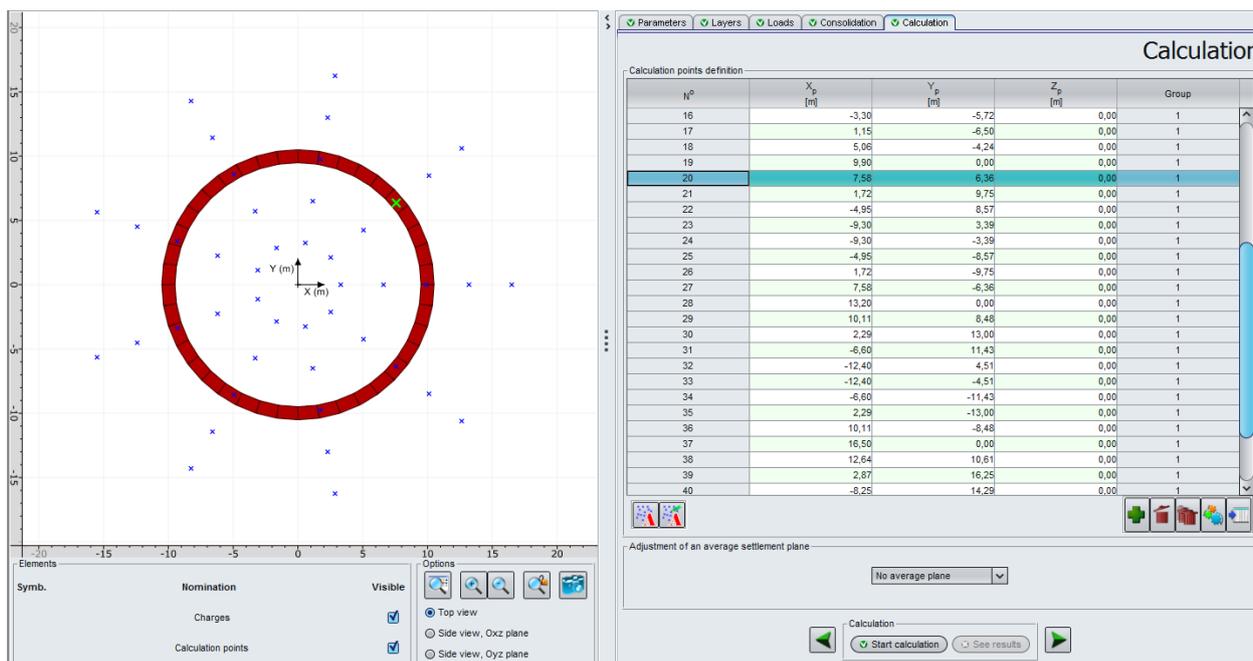


Figure D.31 : Calculated values: Calculation points situated on a horizontal disk

D.3.5.3. Adjustment of an average settlement plane

The drop-down list may be used to request calculation of an average settlement plane by selecting the appropriate choice. The possible choices are as follows:

- **No average plane;**
- **1D average plane:** calculation of average plane on the basis of 1D elastic settlement and the defined calculation points;
- **3D average plane:** calculation of average plane on the basis of 3D elastic settlement and the defined calculation points;
- **Oedo average plane:** calculation of average plane on the basis of oedometric settlement and the calculation points defined.

D.3.6. Calculation and results

D.3.6.1. Calculation

The calculation can be started from any tab, provided that the tabs have been correctly filled out, in other words when they are all marked with a green cross (for example: **Layers**).

They are marked with a red cross (for example: **Layers**) until they are correctly filled out (data missing or not conforming to expected values).

To start the calculation, click the **Start calculation** button.

D.3.6.2. Results

To display the calculation results, click the **See results** button.

The following window then appears and proposes the different types of results accessible after a TasselDO calculation:

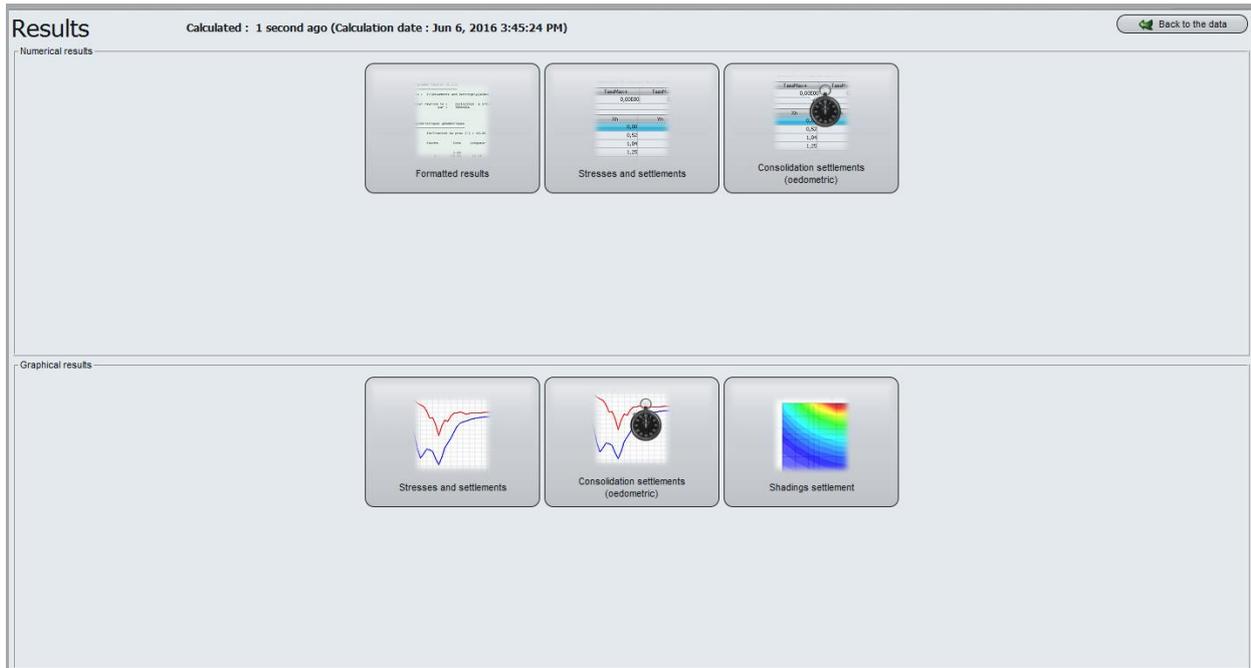


Figure D.32 : Numerical and graphical results

- 3 types of numerical results: formatted results, stresses and settlements, and consolidation settlements (oedometric);
- 3 types of graphical results: stresses and settlements, consolidation settlements (oedometric) and settlement shadings.

Click the required button according to the data format.

The following chapters describe these different types of results in detail.

D.3.6.2.1. Formatted numerical results

This window contains a summary of the calculation data and results:

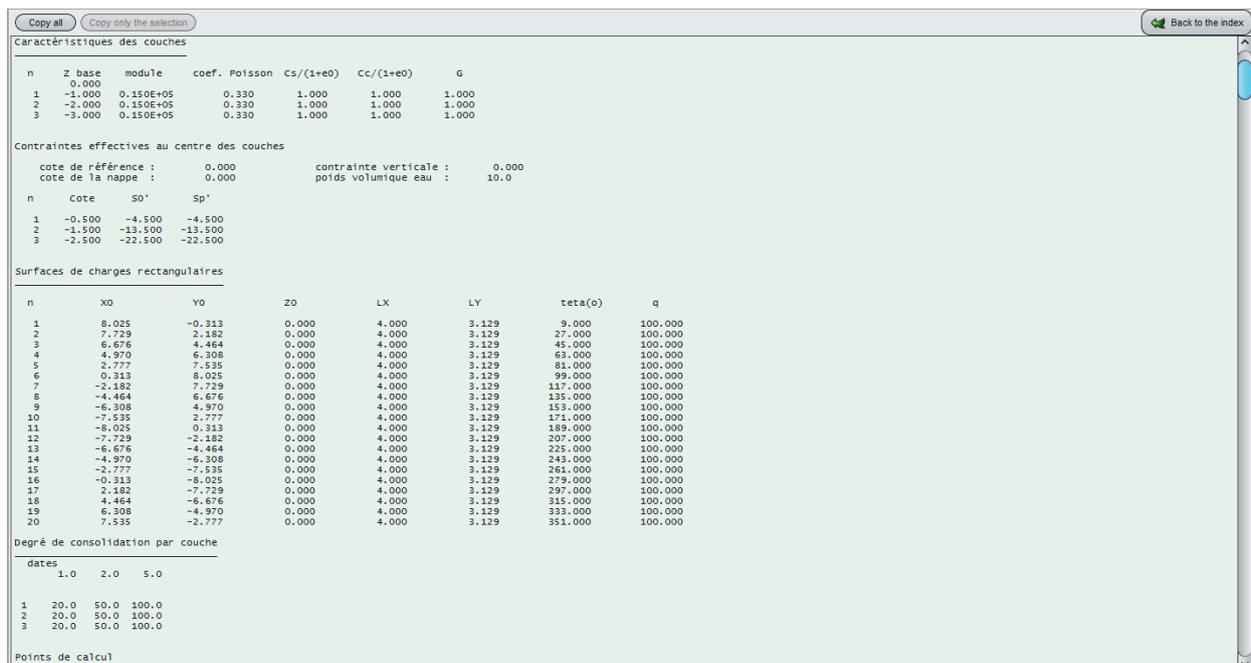


Figure D.33 : Numerical results: Formatted results – Data reminder

The formatted results contain:

- A reminder of the data (Figure D.33): general parameters, soil data, loads, etc. This section also includes a table giving the effective stresses σ'_0 and σ'_p in the centre of each sub-layer (taking account of discretisation of the layers for definition of the sub-layers);
- Results in normal printing mode:
 - ✓ The summary table of results for the various calculation points (Figure D.34):
 - Coordinates (X, Y, Z) of calculation point (m)
 - T1d: value of 1D elastic settlement calculated for this point
 - T3d: value of 3D elastic settlement calculated for this point
 - Toedo: value of oedometric settlement calculated (only if oedometric calculation had been requested. If not, the column comprises only nil values).

Note: positive settlement values correspond to actual settlements (downwards). Negative values correspond to heaving.

```

Programme TasseIdo v2.2.0                                (c) TERRASOL 2013
File : R:\Logiciels\Foxta\Foxta v3\Manuels et exemples\Manuels Foxta v3\D - TasseIdo\TRaduction ENG\Exemples\TASSELDO EXEMPLE 1_\TasseIdo Exemple 1_[TD].A11
Calcul réalisé le : 07/06/2016 à 14h14
by : Terrasol
Calculation title : Exemple 1

Caractéristiques des couches
n   Z base   module   coef. Poisson   Cs/(1+e0)   Cc/(1+e0)   G
1   -1.000   0.150E+05  0.330          0.000       0.000       2.000
2   -2.000   0.150E+05  0.330          0.000       0.000       2.000
3   -3.000   0.150E+05  0.330          0.000       0.000       2.000

Contraintes effectives au centre des couches
cote de référence : 0.000          contrainte verticale : 0.000
cote de la nappe : -1000.000       poids volumique eau : 1.0

n   Cote   S0'   Sp'
1   -0.500  1.000  1.000
2   -1.500  3.000  3.000
3   -2.500  5.000  5.000

Surfaces de charges rectangulaires
n   X0       Y0       Z0       LX       LY       teta(o)   q
1   1.000     1.000    0.000    10.000   1.000   0.000     100.000

Tassements calculés
Point  X       Y       Z       T1d     T3d     Toedo
1      0.000   0.000   0.000   0.0003  0.0001  0.0000
2      0.000   1.000   0.000   0.0005  0.0004  0.0000
3      0.000   2.000   0.000   0.0005  0.0004  0.0000
4      0.000   3.000   0.000   0.0003  0.0001  0.0000
5      0.000   4.000   0.000   0.0001  0.0000  0.0000
6      0.000   5.000   0.000   0.0001  -0.0001  0.0000
7      1.429   0.000   0.000   0.0008  0.0006  0.0000
8      1.429   1.000   0.000   0.0036  0.0043  0.0000
9      1.429   2.000   0.000   0.0036  0.0043  0.0000
10     1.429   3.000   0.000   0.0008  0.0006  0.0000
11     1.429   4.000   0.000   0.0003  0.0001  0.0000
    
```

Figure D.34 : Numerical results: Formatted results – Results (normal printing)

- Or results in detailed printing mode:
 - ✓ A table of results for each calculation point (Figure D.35):
 - Calculation level (m)
 - Vertical stress at mid-thickness of the (sub-)layer
 - T1d: value of 1D elastic settlement calculated for this point
 - T3d: value of 3D elastic settlement calculated for this point
 - Toedo: value of oedometric settlement calculated for this point (only if oedometric calculation had been requested. If not, the column comprises only nil values).

This results display mode can in particular be used to easily check the contribution of a layer to settlement at a given point.

Note: in the same way as above, positive settlement values correspond to actual settlement (downwards), while negative values correspond to heaving.

- The average plane, if requested (Figure D.36). This section:
 - ✓ Gives the equation of the calculated average plane;
 - ✓ Recalls the coordinates (XP, YP) of each calculation point;

- ✓ In the “calculated” column, for each calculation point, recalls the calculated settlement using the calculation method adopted for the average plane (display of 3D elastic settlement if the 3D elastic average plane was requested, for example);
- ✓ In the “adjusted” column, gives the settlement value, at the same calculation point, corresponding to the position of the settlement average plane.

point 1		X = 2.000	Y = 0.000			
Cote	sigma-z mi-couche	tassement 1D	tassement 3D	tassement oedo		
0.000	0.600E-01	0.270E-05	-0.948E-04	0.248E-03		
-1.000	0.128E+01	0.574E-04	-0.160E-03	0.172E-02		
-2.000	0.394E+01	0.177E-03	-0.275E-04	0.315E-02		
-3.000	0.669E+01	0.251E-03	0.151E-03	0.114E-01		
-4.000	0.860E+01	0.322E-03	0.300E-03	0.121E-01		
-5.000	0.958E+01	0.359E-03	0.397E-03	0.121E-01		
-6.000	0.985E+01	0.369E-03	0.448E-03	0.114E-01		
-7.000	0.965E+01	0.310E-03	0.399E-03	0.337E-02		
-8.000	0.920E+01	0.296E-03	0.395E-03	0.292E-02		
-9.000	0.861E+01	0.277E-03	0.380E-03	0.250E-02		
-10.000	0.861E+01	0.000E+00	0.000E+00	0.000E+00		
Total		0.242E-02	0.219E-02	0.610E-01		
date	tassement					
1.0	0.05181					
2.0	0.05752					
5.0	0.06444					
point 2		X = 1.532	Y = 1.286			
Cote	sigma-z mi-couche	tassement 1D	tassement 3D	tassement oedo		
0.000	0.600E-01	0.270E-05	-0.948E-04	0.248E-03		
-1.000	0.128E+01	0.574E-04	-0.160E-03	0.172E-02		
-2.000	0.394E+01	0.177E-03	-0.275E-04	0.315E-02		
-3.000	0.669E+01	0.251E-03	0.151E-03	0.114E-01		
-4.000	0.860E+01	0.322E-03	0.300E-03	0.121E-01		
-5.000	0.958E+01	0.359E-03	0.397E-03	0.121E-01		
-6.000	0.985E+01	0.369E-03	0.448E-03	0.114E-01		
-7.000	0.965E+01	0.310E-03	0.399E-03	0.337E-02		
-8.000	0.920E+01	0.296E-03	0.395E-03	0.292E-02		
-9.000	0.861E+01	0.277E-03	0.380E-03	0.250E-02		
-10.000	0.861E+01	0.000E+00	0.000E+00	0.000E+00		
Total		0.242E-02	0.219E-02	0.610E-01		
date	tassement					
1.0	0.05181					
2.0	0.05752					
5.0	0.06444					

Figure D.35 : Numerical results: Formatted results (detailed printing)

Plan ajusté sur la déformée

$$T1d = -0.137E-08 \cdot Xp + 0.826E-13 \cdot Yp + 0.379E-02$$

azimuth /axe X (°): 0.00
 pente maxi : -0.137E-08

Point	Xp	Yp	calculé	ajusté
1	2.000	0.000	0.0024	0.0038
2	1.532	1.286	0.0024	0.0038
3	0.347	1.970	0.0024	0.0038
4	-1.000	1.732	0.0024	0.0038
5	-1.879	0.684	0.0024	0.0038
6	-1.879	-0.684	0.0024	0.0038
7	-1.000	-1.732	0.0024	0.0038
8	0.347	-1.970	0.0024	0.0038
9	1.532	-1.286	0.0024	0.0038
10	4.000	0.000	0.0037	0.0038
11	3.064	2.571	0.0037	0.0038
12	0.695	3.939	0.0037	0.0038
13	-2.000	3.464	0.0037	0.0038
14	-3.759	1.368	0.0037	0.0038
15	-3.759	-1.368	0.0037	0.0038
16	-2.000	-3.464	0.0037	0.0038
17	0.695	-3.939	0.0037	0.0038
18	3.064	-2.571	0.0037	0.0038
19	6.000	0.000	0.0095	0.0038
20	4.596	3.857	0.0095	0.0038
21	1.042	5.909	0.0095	0.0038
22	-3.000	5.196	0.0095	0.0038
23	-5.638	2.052	0.0095	0.0038
24	-5.638	-2.052	0.0095	0.0038
25	-3.000	-5.196	0.0095	0.0038
26	1.042	-5.909	0.0095	0.0038
27	4.596	-3.857	0.0095	0.0038
28	8.000	0.000	0.0025	0.0038
29	6.128	5.142	0.0025	0.0038
30	1.389	7.878	0.0025	0.0038
31	-4.000	6.928	0.0025	0.0038
32	-7.518	2.736	0.0025	0.0038
33	-7.518	-2.736	0.0025	0.0038
34	-4.000	-6.928	0.0025	0.0038
35	1.389	-7.878	0.0025	0.0038
36	6.128	-5.142	0.0025	0.0038
37	10.000	0.000	0.0010	0.0038
38	7.660	6.428	0.0010	0.0038
39	1.736	9.848	0.0010	0.0038
40	-5.000	8.660	0.0010	0.0038
41	-9.397	3.420	0.0010	0.0038
42	-9.397	-3.420	0.0010	0.0038
43	-5.000	-8.660	0.0010	0.0038
44	1.736	-9.848	0.0010	0.0038
45	7.660	-6.428	0.0010	0.0038
46	0.000	0.000	0.0021	0.0038

Figure D.36 : Numerical results: Formatted results – Results (adjusted plane)

D.3.6.2.2. Numerical results – Stresses and Settlements

This table contains the stresses and settlements at the calculation points, as a function of the elevation Z (m):

Designation	Unit	Display condition
N° calculation point (point coordinates)	-	Always
Z: elevation	m	Always
$\Delta\sigma_v$: Supplementary vertical stress	kPa	Always
1D Settlement: one-dimensional elastic settlement	m	Always
3D Settlement: three-dimensional elastic settlement	m	Always
Oedo(metric) Settlement	m	Only if oedometric calculation was requested

Table D.13 : Details of numerical results (stresses and settlements)

Calculation point #	Z [m]	$\Delta\sigma_v$ [kPa]	Settlement 1D [m]	Settlement 3D [m]	Oedo settlement [m]
1 (2,00;0,00;0,00)	0,00	0,06	2,42E-03	2,19E-03	5,22E-02
1 (2,00;0,00;0,00)	-1,00	0,06	2,42E-03	2,28E-03	5,20E-02
1 (2,00;0,00;0,00)	-1,00	1,28	2,42E-03	2,28E-03	5,20E-02
1 (2,00;0,00;0,00)	-2,00	1,28	2,38E-03	2,44E-03	5,02E-02
1 (2,00;0,00;0,00)	-2,00	3,94	2,38E-03	2,44E-03	5,02E-02
1 (2,00;0,00;0,00)	-3,00	3,94	2,18E-03	2,47E-03	4,71E-02
1 (2,00;0,00;0,00)	-3,00	6,69	2,18E-03	2,47E-03	4,71E-02
1 (2,00;0,00;0,00)	-4,00	6,69	1,93E-03	2,32E-03	3,57E-02
1 (2,00;0,00;0,00)	-4,00	8,60	1,93E-03	2,32E-03	3,57E-02
1 (2,00;0,00;0,00)	-5,00	8,60	1,61E-03	2,02E-03	2,35E-02
1 (2,00;0,00;0,00)	-5,00	9,58	1,61E-03	2,02E-03	2,35E-02
1 (2,00;0,00;0,00)	-6,00	9,58	1,28E-03	1,62E-03	1,14E-02
1 (2,00;0,00;0,00)	-6,00	9,85	1,28E-03	1,62E-03	1,14E-02
1 (2,00;0,00;0,00)	-7,00	9,85	8,83E-04	1,17E-03	3,47E-18
1 (2,00;0,00;0,00)	-7,00	9,65	8,83E-04	1,17E-03	3,47E-18
1 (2,00;0,00;0,00)	-8,00	9,65	5,72E-04	7,74E-04	3,47E-18
1 (2,00;0,00;0,00)	-8,00	9,20	5,72E-04	7,74E-04	3,47E-18
1 (2,00;0,00;0,00)	-9,00	9,20	2,77E-04	3,80E-04	3,47E-18
1 (2,00;0,00;0,00)	-9,00	8,61	2,77E-04	3,80E-04	3,47E-18
1 (2,00;0,00;0,00)	-10,00	8,61	5,42E-20	-3,25E-19	3,47E-18
2 (1,53;1,29;0,00)	0,00	0,06	2,42E-03	2,19E-03	5,22E-02
2 (1,53;1,29;0,00)	-1,00	0,06	2,42E-03	2,28E-03	5,20E-02
2 (1,53;1,29;0,00)	-1,00	1,28	2,42E-03	2,28E-03	5,20E-02
2 (1,53;1,29;0,00)	-2,00	1,28	2,38E-03	2,44E-03	5,02E-02
2 (1,53;1,29;0,00)	-2,00	3,94	2,38E-03	2,44E-03	5,02E-02
2 (1,53;1,29;0,00)	-3,00	3,94	2,18E-03	2,47E-03	4,71E-02
2 (1,53;1,29;0,00)	-3,00	6,69	2,18E-03	2,47E-03	4,71E-02
2 (1,53;1,29;0,00)	-4,00	6,69	1,93E-03	2,32E-03	3,57E-02
2 (1,53;1,29;0,00)	-4,00	8,60	1,93E-03	2,32E-03	3,57E-02
2 (1,53;1,29;0,00)	-5,00	8,60	1,61E-03	2,02E-03	2,35E-02
2 (1,53;1,29;0,00)	-5,00	9,58	1,61E-03	2,02E-03	2,35E-02
2 (1,53;1,29;0,00)	-6,00	9,58	1,28E-03	1,62E-03	1,14E-02
2 (1,53;1,29;0,00)	-6,00	9,85	1,28E-03	1,62E-03	1,14E-02
2 (1,53;1,29;0,00)	-7,00	9,85	8,83E-04	1,17E-03	6,94E-18
2 (1,53;1,29;0,00)	-7,00	9,65	8,83E-04	1,17E-03	6,94E-18
2 (1,53;1,29;0,00)	-8,00	9,65	5,72E-04	7,74E-04	6,94E-18
2 (1,53;1,29;0,00)	-8,00	9,20	5,72E-04	7,74E-04	6,94E-18
2 (1,53;1,29;0,00)	-9,00	9,20	2,77E-04	3,80E-04	6,94E-18
2 (1,53;1,29;0,00)	-9,00	8,61	2,77E-04	3,80E-04	6,94E-18

Figure D.37 : Numerical results: Stresses and settlements

D.3.6.2.3. Numerical results – Consolidation settlement (oedometric)

The table only contains results if an oedometric calculation with consolidation has been carried out.

Calculation point #	Dates t_i	Oedo settlement [m]
1 (2,00;0,00;0,00)	0	0,00E00
1 (2,00;0,00;0,00)	1	2,92E-02
1 (2,00;0,00;0,00)	2	4,31E-02
1 (2,00;0,00;0,00)	5	5,22E-02
2 (1,53;1,29;0,00)	0	0,00E00
2 (1,53;1,29;0,00)	1	2,92E-02
2 (1,53;1,29;0,00)	2	4,31E-02
2 (1,53;1,29;0,00)	5	5,22E-02
3 (0,35;-1,97;0,00)	0	0,00E00
3 (0,35;-1,97;0,00)	1	2,92E-02
3 (0,35;-1,97;0,00)	2	4,31E-02
3 (0,35;-1,97;0,00)	5	5,22E-02
4 (-1,00;-1,73;0,00)	0	0,00E00
4 (-1,00;-1,73;0,00)	1	2,92E-02
4 (-1,00;-1,73;0,00)	2	4,31E-02
4 (-1,00;-1,73;0,00)	5	5,22E-02
5 (-1,88;-0,68;0,00)	0	0,00E00
5 (-1,88;-0,68;0,00)	1	2,92E-02
5 (-1,88;-0,68;0,00)	2	4,31E-02
5 (-1,88;-0,68;0,00)	5	5,22E-02
6 (-1,88;-0,68;0,00)	0	0,00E00
6 (-1,88;-0,68;0,00)	1	2,92E-02
6 (-1,88;-0,68;0,00)	2	4,31E-02
6 (-1,88;-0,68;0,00)	5	5,22E-02
7 (-1,00;-1,73;0,00)	0	0,00E00
7 (-1,00;-1,73;0,00)	1	2,92E-02
7 (-1,00;-1,73;0,00)	2	4,31E-02
7 (-1,00;-1,73;0,00)	5	5,22E-02
8 (0,35;-1,97;0,00)	0	0,00E00
8 (0,35;-1,97;0,00)	1	2,92E-02
8 (0,35;-1,97;0,00)	2	4,31E-02
8 (0,35;-1,97;0,00)	5	5,22E-02
9 (1,53;-1,29;0,00)	0	0,00E00
9 (1,53;-1,29;0,00)	1	2,92E-02
9 (1,53;-1,29;0,00)	2	4,31E-02
9 (1,53;-1,29;0,00)	5	5,22E-02
10 (4,00;0,00;0,00)	0	0,00E00
10 (4,00;0,00;0,00)	1	5,85E-02
10 (4,00;0,00;0,00)	2	8,75E-02

Figure D.38 : Numerical results: Consolidation settlements (oedometric)

Designation	Unit	Display condition
N° calculation point (coordinates of point)	-	Always
Date t_i : consolidation dates (as input in the data)	-	Always
Oedo settlement: oedometric settlement on the date considered (as a function of the consolidation rates of the various layers)	m	Always

Table D.14 : Details of numerical results: Consolidation settlements (oedometric)

D.3.6.2.4. Graphical results – Stresses and settlements

The curves present the same results as those described in the corresponding table (numerical results, chapter D.3.6.2.2).

It is possible to select/deselect several calculation points in the left-hand list: the curves corresponding to the selected points are then superposed over the graphics. The “Shift” key on the keyboard should be used to select several points.

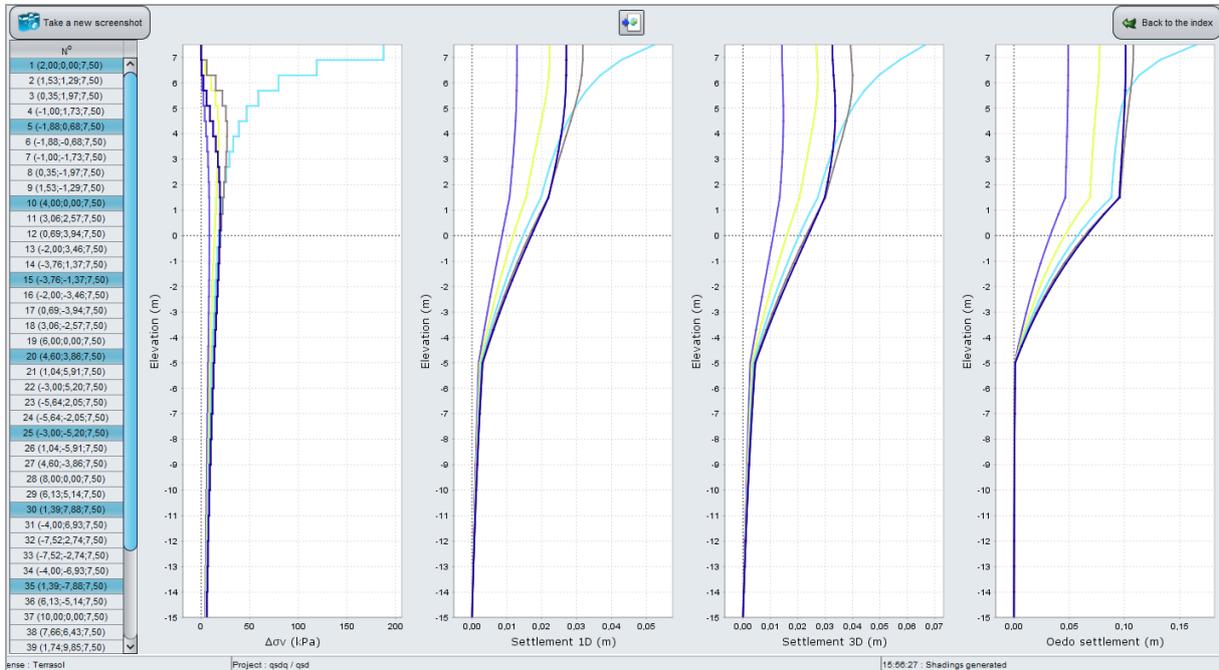


Figure D.39 : Graphical results: Stresses and settlements

D.3.6.2.5. Graphical results - Consolidation settlements (oedometric)

The curves show the same results as those described in the corresponding table (numerical results, chapter D.3.6.2.3).

Here again, it is possible to select/deselect several calculation points in the left-hand list: the curves corresponding to the selected points are then superposed over the graphic.

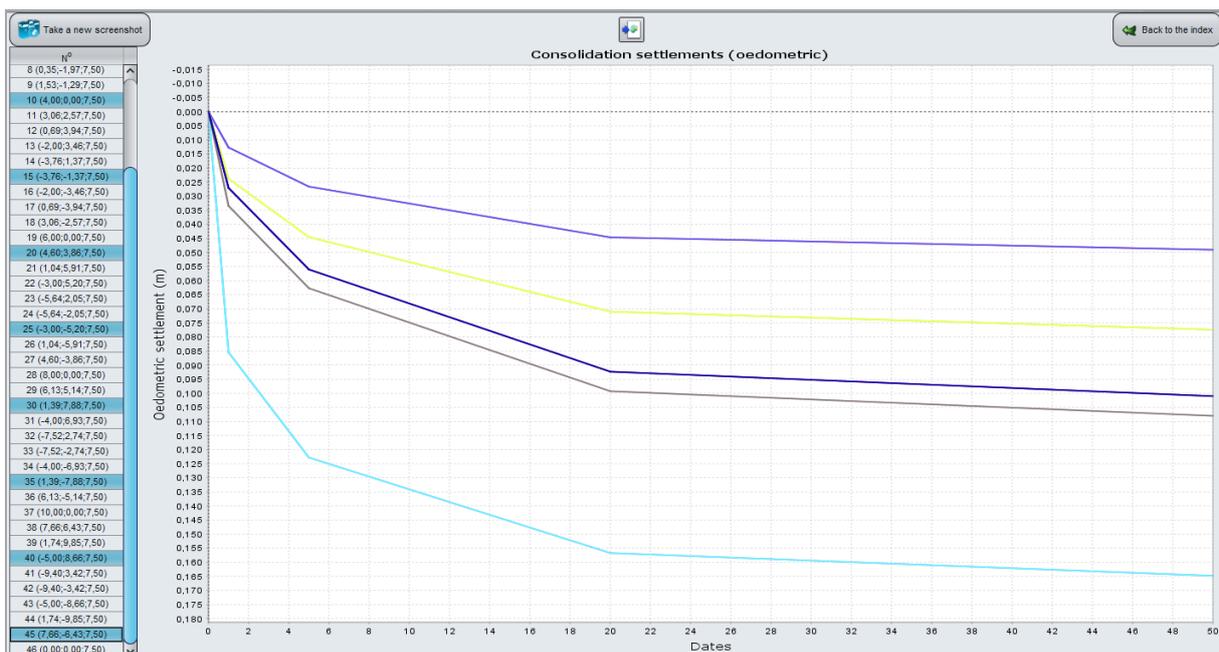


Figure D.40 : Graphical results: Oedometric consolidation settlement

D.3.6.2.6. Graphical results – Settlements shadings

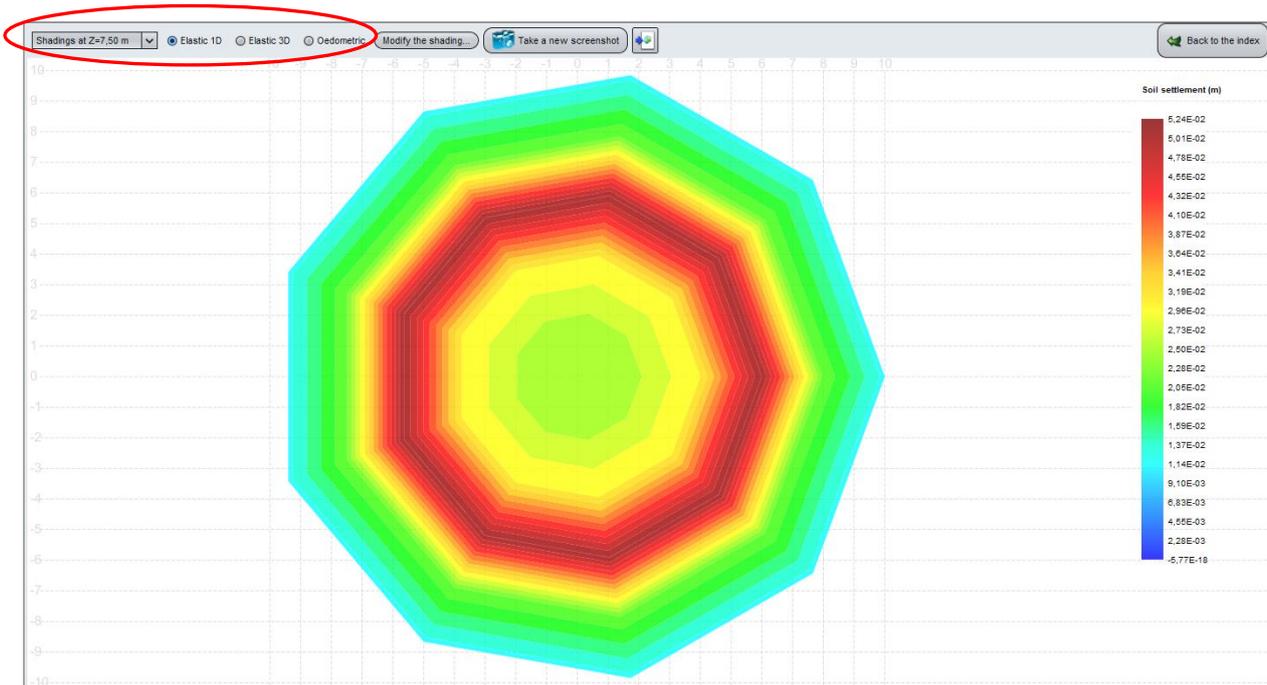


Figure D.41 : Graphical results : Settlements at given Z

This window can be used to show the settlement intensity for a given level Z.

The following can be selected in the strip at the top of the window:

- The chosen level
- The type of settlement to be displayed: Elastic 1D, Elastic 3D or Oedometric (if available).

In the example presented above, the colours illustrate the distribution of 1D elastic settlement values in plane (OXY) at elevation Z = 0.00.

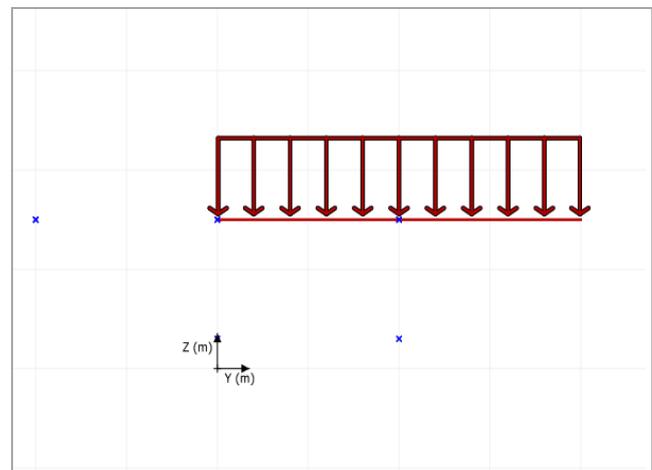
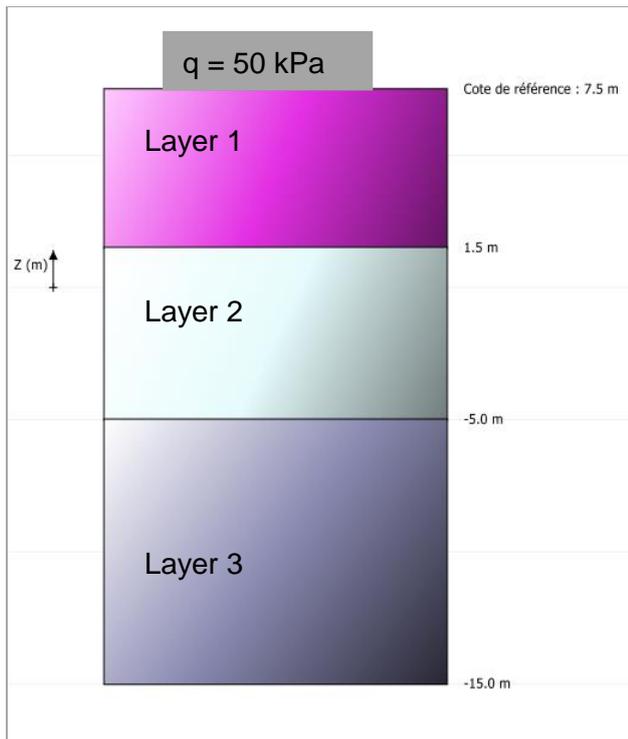
D.4. CALCULATION EXAMPLES

D.4.1. Example 1

D.4.1.1. Introduction

The first example comprises two parts:

- Calculation of one-dimensional and three-dimensional settlement of three soil layers under the effect of a rectangular load
- Then calculation of the oedometric settlement in the same conditions.



D.4.1.2. Data input

At opening of the application, Foxta proposes:

- creating a new project;
- opening an existing project;
- automatically opening the last project used.

In the case of this example:

- choose to create a new project by selecting the **New project** radio-button;
- click the button.

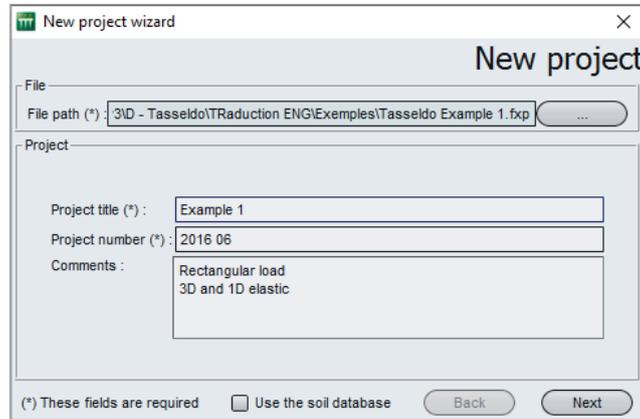
D.4.1.2.1. New project wizard: New project

“File” frame

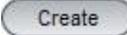
- Fill out the project path by clicking the button;
- Give a name to the file and save it.

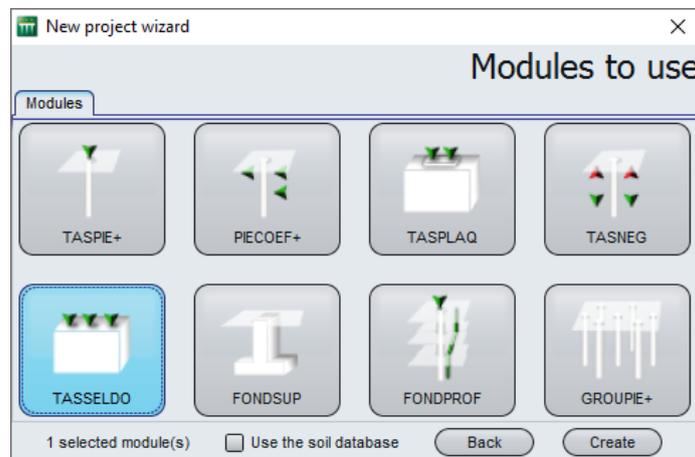
“Project” frame

- Give a title to the project;
- Enter a project number;
- Complete with comments if necessary;
- Leave the “Use the soil database” unticked (we will not use the database for this example), and click the  button.



D.4.1.2.2. New project wizard: Choice of modules

In the “Modules” window, select the Tasseldo module then click the  button.



The Tasseldo window appears.

The various data tabs proposed should be filled out.

D.4.1.2.3. Parameters tab

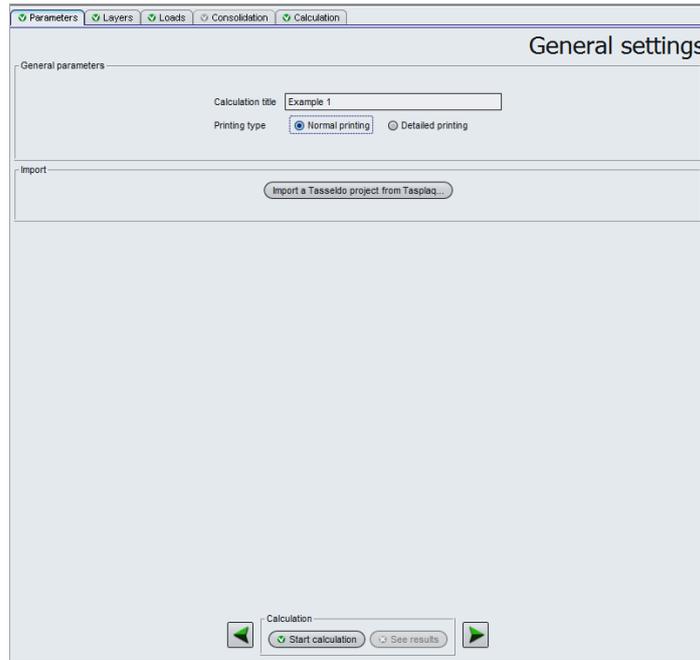
This tab contains two frames:

“General parameters” tab:

- Tasseldo calculation title: for this example, we will for example enter "Example 1";
- Type of printing (normal or detailed): for this example, normal printing will be sufficient.

“Import” frame:

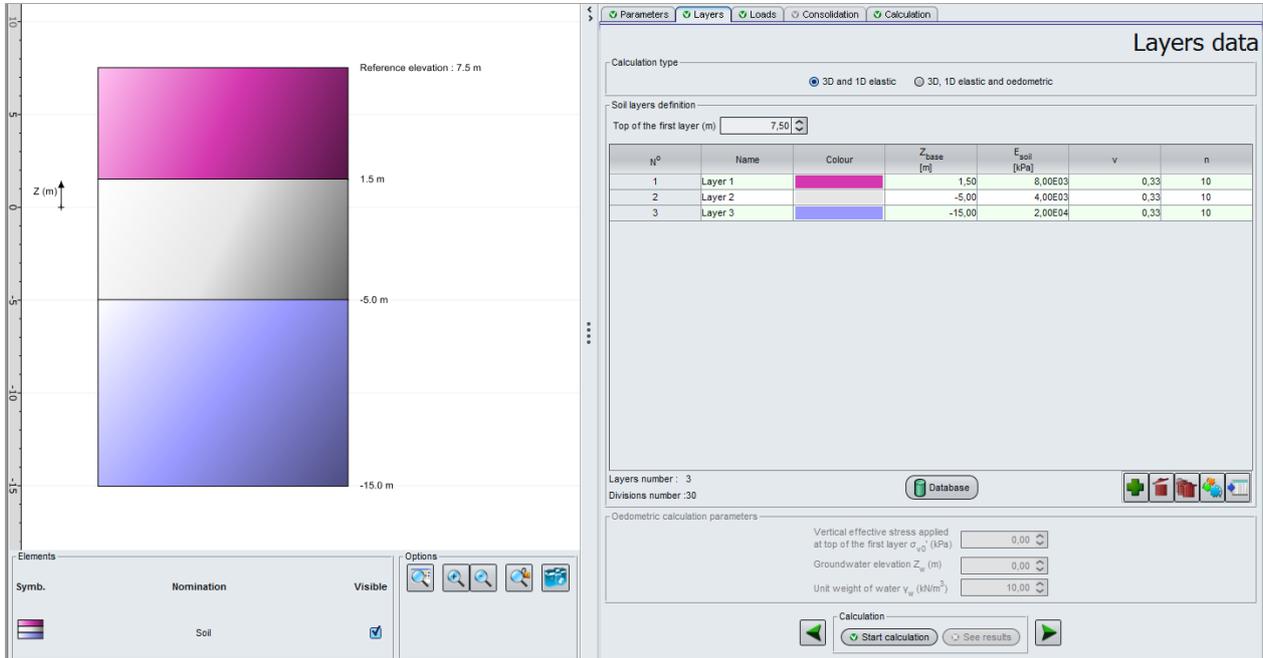
A project can be imported from the Tasplaq module, but we will not use this option for this example.



To move onto the next tab, click either the name of the “Layers” tab or the  button.

D.4.1.2.4. “Layers” tab

This tab concerns the definition of soil layers.



“Calculation type” frame:

Retain the default choice “3D and 1D elastic”.

“Soil layers definition” frame:

Define the top of the first layer at level 7.50 m.

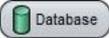
Then create three soil layers by clicking the  button to add each of the layers.

The data to be input are as follows:

Name	Z _{base} (m)	E _{soil} (kPa)	v	n
Layer 1	1.5	8000	0.33	10
Layer 2	-5.0	4000	0.33	10
Layer 3	-15	20000	0.33	10

Note: the discretisation chosen makes it possible here to create “sub-layers” from 50 cm to one metre thick.

The drawing in the left-hand part of the screen shows the layers defined.

TasselDO can be used to save these soil layers in the project database and/or in the global soils database by clicking the  button.

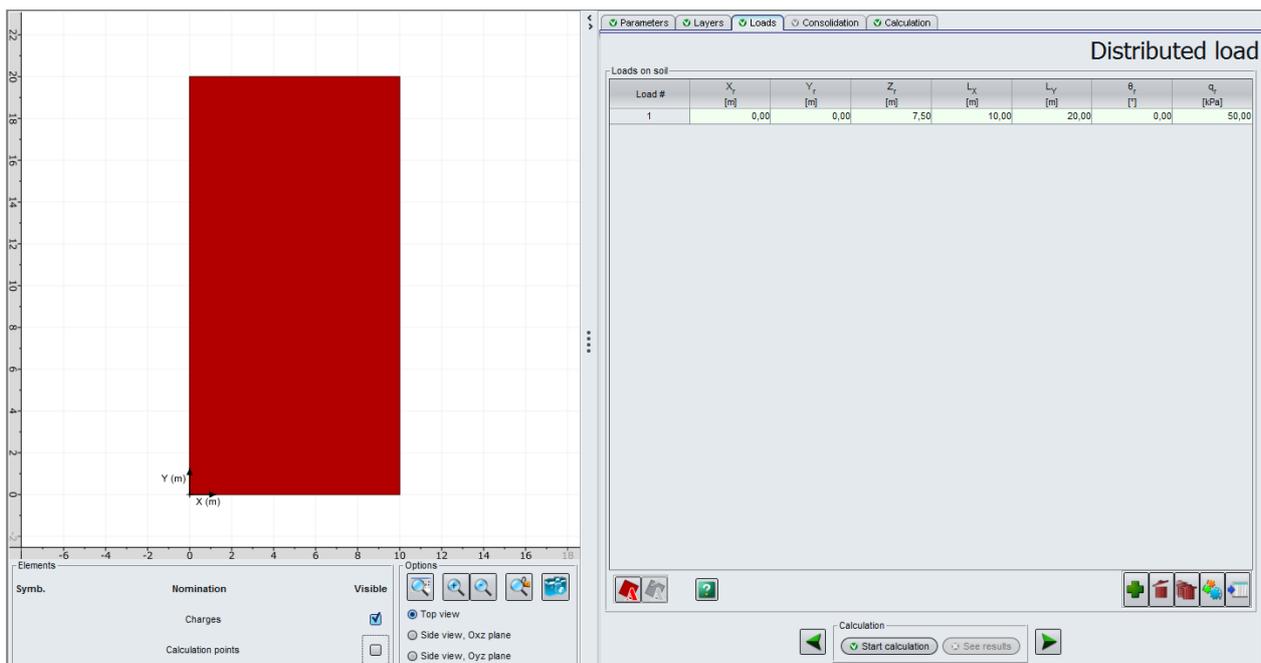
This makes it possible to save soil layers with their parameters, to avoid having to input them again when using another module for the same Foxta project, or when creating another Foxta project.

The database will not be used in this example, but part C of the manual describes its use in detail.

“Oedometric calculation parameters”:

This is not accessible here because in this first part we simply deal with elastic calculations (see choice of calculation type above).

D.4.1.2.5. “Loads” tab



“Loads on soil” frame:

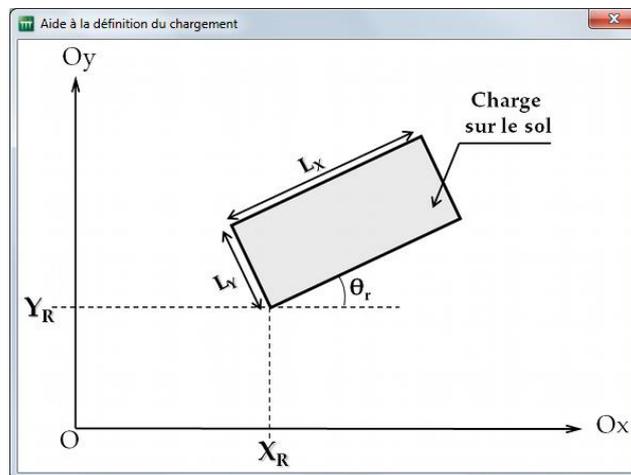
This “Loads” tab is used to define the loads applied at groundlevel. Here we use a single simple rectangle with the following characteristics:

X_r (m)	Y_r (m)	Z_r (m)	L_x (m)	L_y (m)	θ_r (°)	q_r (kPa)
0.00	0.00	7.50	10	20	0	50

Click the  button to add a line and input the above values.

Note: in the examples covered in the manual, the loads are always applied at surface level. However, it should be noted that it is also possible to define loads at depth.

A help diagram can be accessed by clicking the  button and illustrates the meaning of parameters L_x , L_y and θ_r .



The “Loads wizard”  is not used in this example because the load only consists of a simple rectangle. This wizard will be used in example 2.

The drawing in the left-hand part of the screen now shows the defined load.

D.4.1.2.6. "Consolidation" tab

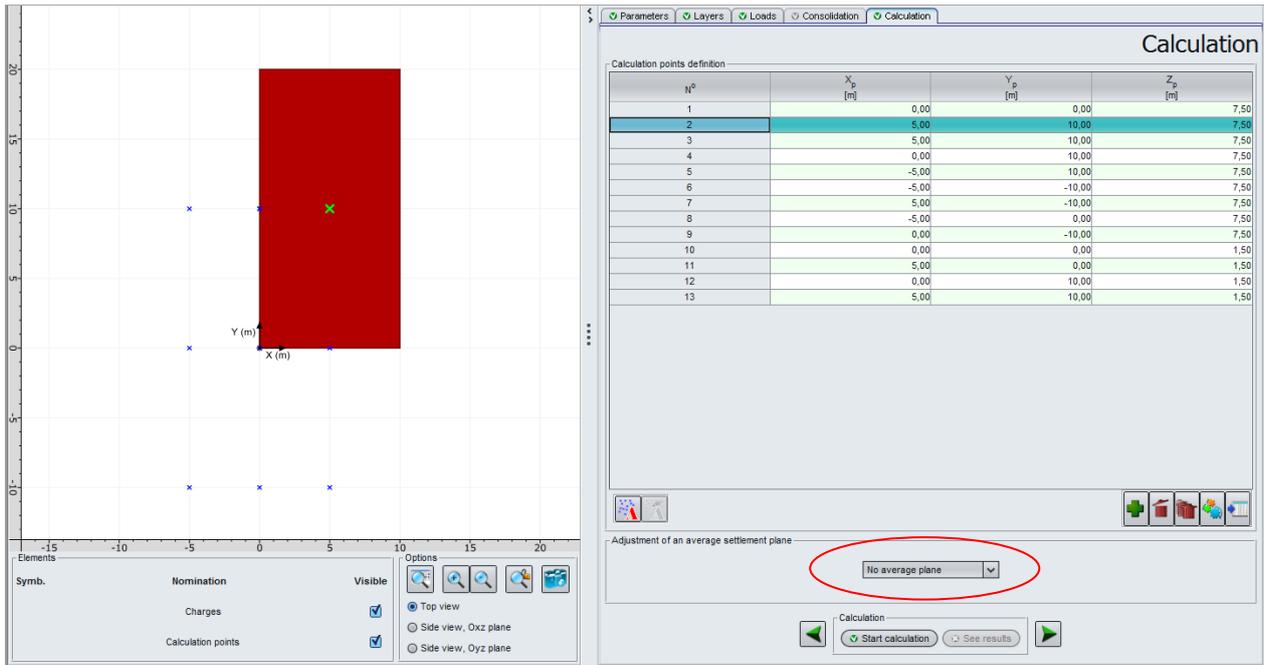
This tab is not accessible here: it is only available in the case of an oedometric calculation.

D.4.1.2.7. "Calculation" tab

This tab is used to define the points for calculation of settlement.

These points must be chosen depending on the requirements of the project: these points are those for which detailed results will be provided. They are also the points which are used to calculate the average settlement plane when this is requested (this is not the case in this example).

Here we have chosen points on the surface and at a depth of 2 m, both under the applied load (under one quarter of the foundation, representative of the whole, owing to the symmetry of the project) and outside it (1 point defined outside the load footprint).



"Calculation points definition" frame:

Click the  button to add a line and repeat this operation for all the points to be defined.

Note: here we define the calculation points manually. Use of the "Calculation points" wizard will be illustrated in example 2.

After defining these points, they appear in the left-hand part of the window as blue points (the point corresponding to the line selected in the table appears as a green cross).

N°	X _p (m)	Y _p (m)	Z _p (m)
1	0.00	0.00	7.50
2	5.00	10.00	7.50
3	5.00	0.00	7.50
4	0.00	10.00	7.50
5	-5.00	10.00	7.50
6	-5.00	-10.00	7.50
7	5.00	-10.00	7.50
8	-5.00	0.00	7.50
9	0.00	-10.00	7.50
10	0.00	0.00	1.50
11	5.00	0.00	1.50
12	0.00	10.00	1.50
13	5.00	10.00	1.50

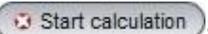
"Adjustment of an average settlement plane" frame:

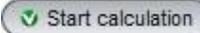
We will not use an average plane for this example

Data input for this example is now completed.

D.4.1.3. Calculation and results

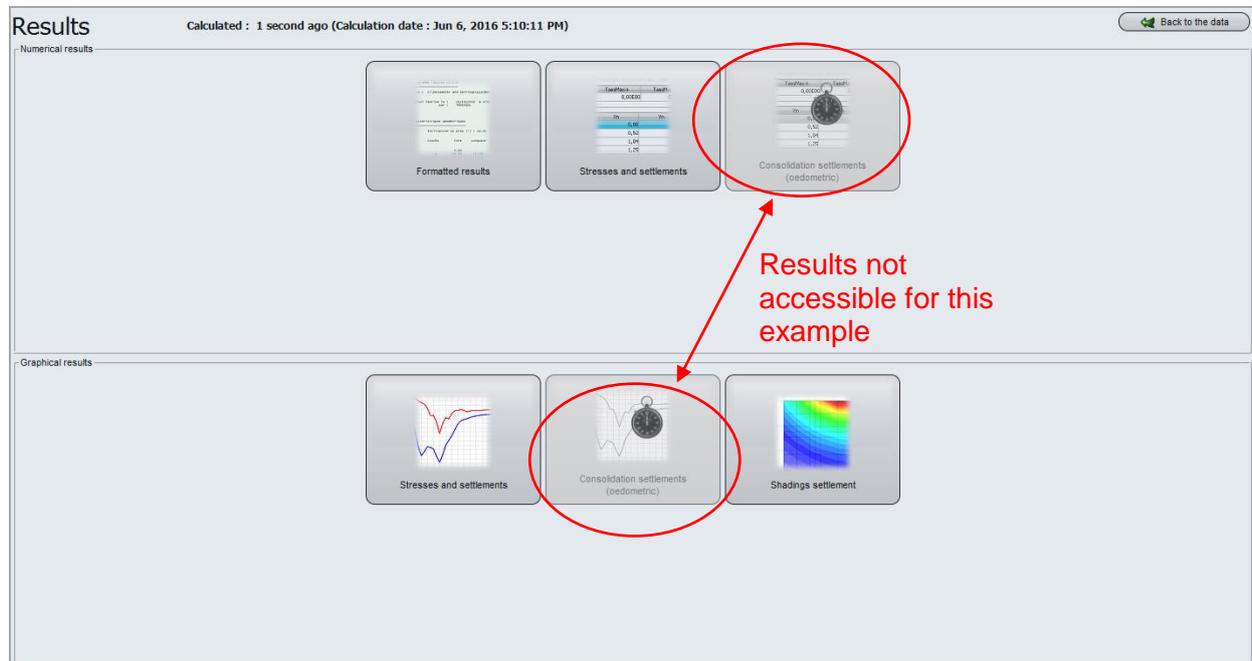
D.4.1.3.1. Calculation

As long as all the tabs have not been correctly filled out, the button used to start the calculation is marked with a red cross: .

Once all the data have been correctly input, the  button (accessible from all the tabs) is active.

Clicking this button will start the calculation.

To access the results in the form of tables and graphics, click the  button.



"Numerical results" frame:

- "Formatted results" and "Stresses and settlements" are accessible by clicking the corresponding button.
- The "Consolidation settlements (oedometric)" results are not accessible because the "3D, 1D elastic (oedometric)" option was not selected for this example.

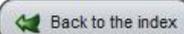
"Graphical results" frame:

- The "Stresses and settlements" and "Settlements shadings" results are accessible by clicking the corresponding button.
- The "Consolidation settlements (oedometric)" results are not accessible because the "3D, 1D elastic (oedometric)" option was not selected for this example.

D.4.1.3.2. Results

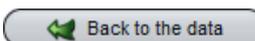
The main available results (in particular the settlements for the 9 calculation points) are presented on the following page.

The results given in terms of settlements are the 1D and 3D elastic settlements. The oedometric results are not available because the oedometric calculation was not requested for this example.

Select a type of results to be displayed then click the  button to return to the result types selection screen.

It should be noted that for each elevation (7.5 or 1.5), maximum settlement is obtained as planned in the centre of the loaded zone (points 2 and 13). Maximum settlement obtained on the surface is thus at point 2, with a value of 7.07 cm for 3D elastic settlement at this point. Settlement at point 13 (also at the centre of the loaded zone, but at elevation 1.5 m) is of 4.64 cm.

As oedometric calculation was not selected, the Toedo column is displayed, but contains only nil values.

To quit the results display, click the  button.

Contraintes effectives au centre des couches

cote de référence :	7.500	contrainte verticale :	0.000
cote de la nappe :	-1000.000	poids volumique eau :	1.0

n	Cote	S0'	Sp'
1	7.200	0.600	0.600
2	6.600	1.800	1.800
3	6.000	3.000	3.000
4	5.400	4.200	4.200
5	4.800	5.400	5.400
6	4.200	6.600	6.600
7	3.600	7.800	7.800
8	3.000	9.000	9.000
9	2.400	10.200	10.200
10	1.800	11.400	11.400
11	1.175	12.650	12.650
12	0.525	13.950	13.950
13	-0.125	15.250	15.250
14	-0.775	16.550	16.550
15	-1.425	17.850	17.850
16	-2.075	19.150	19.150
17	-2.725	20.450	20.450
18	-3.375	21.750	21.750
19	-4.025	23.050	23.050
20	-4.675	24.350	24.350
21	-5.500	26.000	26.000
22	-6.500	28.000	28.000
23	-7.500	30.000	30.000
24	-8.500	32.000	32.000
25	-9.500	34.000	34.000
26	-10.500	36.000	36.000
27	-11.500	38.000	38.000
28	-12.500	40.000	40.000
29	-13.500	42.000	42.000
30	-14.500	44.000	44.000

Surfaces de charges rectangulaires

n	X0	Y0	Z0	LX	LY	teta(o)	q
1	0.000	0.000	7.500	10.000	20.000	0.000	50.000

Contraintes effectives au centre des couches

cote de référence :	7.500	contrainte verticale :	0.000
cote de la nappe :	-1000.000	poids volumique eau :	1.0

n	Cote	S0'	Sp'
1	7.200	0.600	0.600
2	6.600	1.800	1.800
3	6.000	3.000	3.000
4	5.400	4.200	4.200
5	4.800	5.400	5.400
6	4.200	6.600	6.600
7	3.600	7.800	7.800
8	3.000	9.000	9.000
9	2.400	10.200	10.200
10	1.800	11.400	11.400
11	1.175	12.650	12.650
12	0.525	13.950	13.950
13	-0.125	15.250	15.250
14	-0.775	16.550	16.550
15	-1.425	17.850	17.850
16	-2.075	19.150	19.150
17	-2.725	20.450	20.450
18	-3.375	21.750	21.750
19	-4.025	23.050	23.050
20	-4.675	24.350	24.350
21	-5.500	26.000	26.000
22	-6.500	28.000	28.000
23	-7.500	30.000	30.000
24	-8.500	32.000	32.000
25	-9.500	34.000	34.000
26	-10.500	36.000	36.000
27	-11.500	38.000	38.000
28	-12.500	40.000	40.000
29	-13.500	42.000	42.000
30	-14.500	44.000	44.000

Surfaces de charges rectangulaires

n	X0	Y0	Z0	LX	LY	teta(o)	q
1	0.000	0.000	7.500	10.000	20.000	0.000	50.000

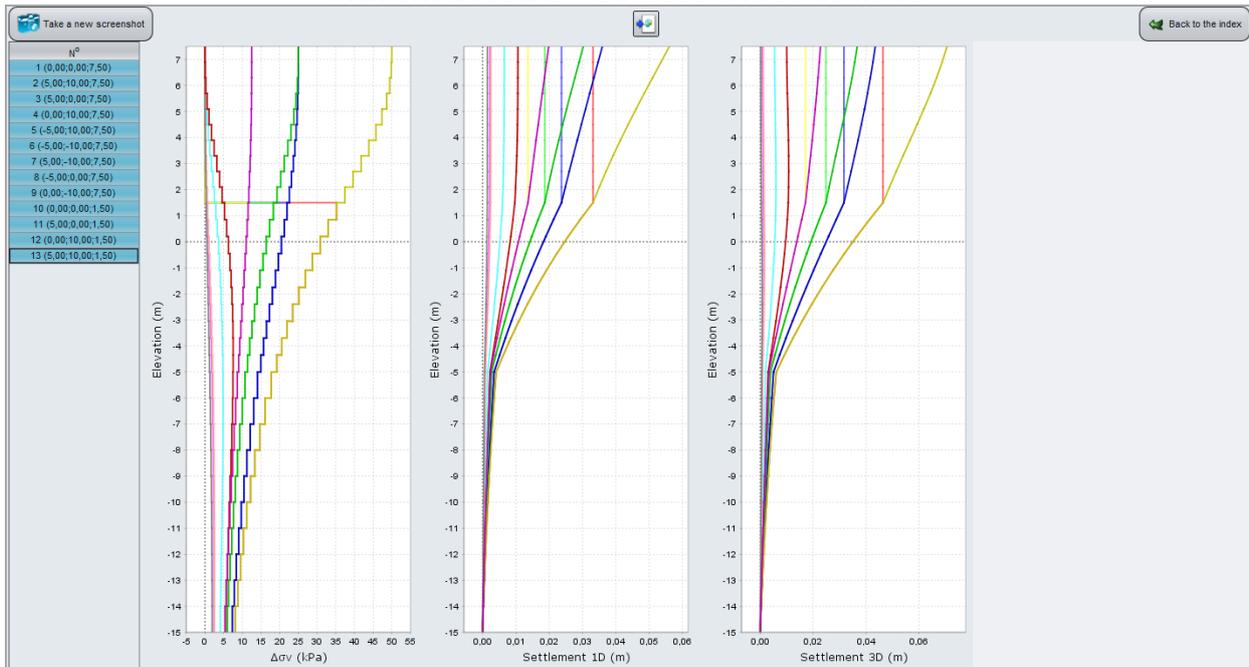
Tassements calculés

Point	X	Y	Z	T1d	T3d	Toedo
1	0.000	0.000	7.500	0.0199	0.0228	0.0000
2	5.000	10.000	7.500	0.0562	0.0707	0.0000
3	5.000	0.000	7.500	0.0303	0.0367	0.0000
4	0.000	10.000	7.500	0.0360	0.0435	0.0000
5	-5.000	10.000	7.500	0.0106	0.0100	0.0000
6	-5.000	-10.000	7.500	0.0015	0.0002	0.0000
7	5.000	-10.000	7.500	0.0025	0.0012	0.0000
8	-5.000	0.000	7.500	0.0065	0.0054	0.0000
9	0.000	-10.000	7.500	0.0022	0.0008	0.0000
10	0.000	0.000	1.500	0.0136	0.0171	0.0000
11	5.000	0.000	1.500	0.0187	0.0249	0.0000
12	0.000	10.000	1.500	0.0237	0.0217	0.0000
13	5.000	10.000	1.500	0.0332	0.0464	0.0000

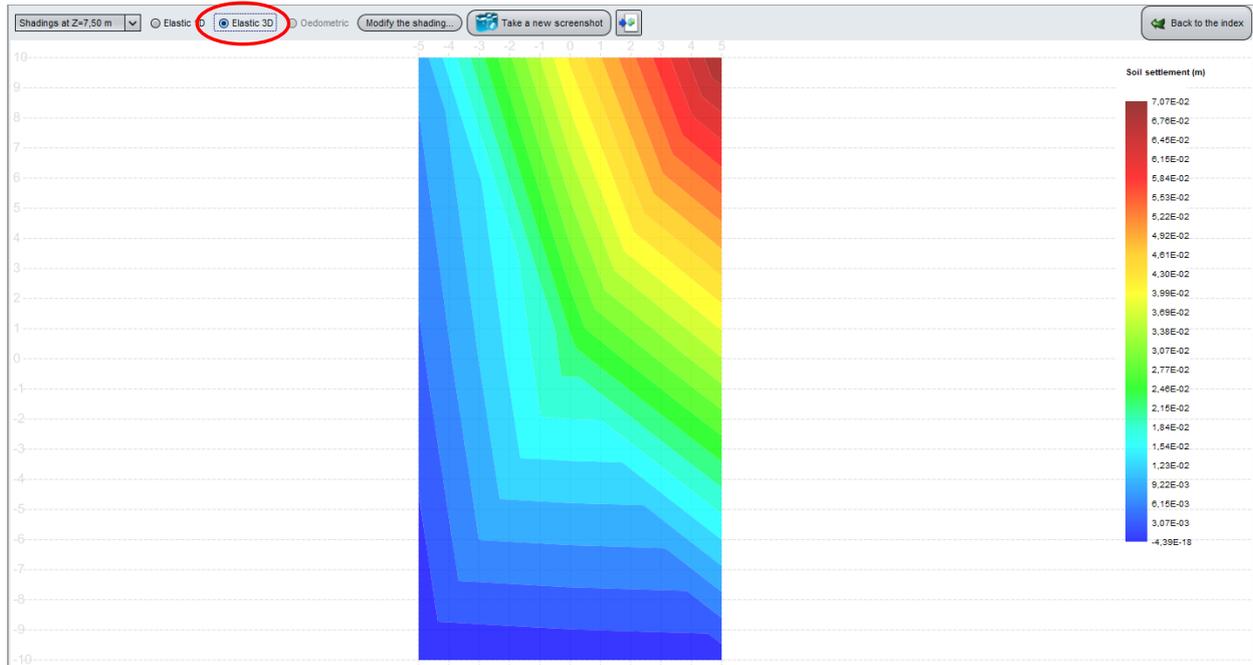
Numerical results – Formatted results

Calculation point #	Z [m]	$\Delta\sigma_v$ [kPa]	Settlement 1D [m]	Settlement 3D [m]
1 (0.00;0.00;7.50)	7.50	12.50	1.98E-02	2.28E-02
1 (0.00;0.00;7.50)	6.90	12.50	1.92E-02	2.23E-02
1 (0.00;0.00;7.50)	6.90	12.50	1.92E-02	2.23E-02
1 (0.00;0.00;7.50)	6.30	12.50	1.86E-02	2.19E-02
1 (0.00;0.00;7.50)	6.30	12.48	1.86E-02	2.19E-02
1 (0.00;0.00;7.50)	5.70	12.48	1.80E-02	2.14E-02
1 (0.00;0.00;7.50)	5.70	12.45	1.80E-02	2.14E-02
1 (0.00;0.00;7.50)	5.10	12.45	1.73E-02	2.08E-02
1 (0.00;0.00;7.50)	5.10	12.40	1.73E-02	2.08E-02
1 (0.00;0.00;7.50)	4.50	12.40	1.67E-02	2.03E-02
1 (0.00;0.00;7.50)	4.50	12.32	1.67E-02	2.03E-02
1 (0.00;0.00;7.50)	3.90	12.32	1.61E-02	1.97E-02
1 (0.00;0.00;7.50)	3.90	12.22	1.61E-02	1.97E-02
1 (0.00;0.00;7.50)	3.30	12.22	1.55E-02	1.90E-02
1 (0.00;0.00;7.50)	3.30	12.09	1.55E-02	1.90E-02
1 (0.00;0.00;7.50)	2.70	12.09	1.48E-02	1.84E-02
1 (0.00;0.00;7.50)	2.70	11.93	1.48E-02	1.84E-02
1 (0.00;0.00;7.50)	2.10	11.93	1.42E-02	1.78E-02
1 (0.00;0.00;7.50)	2.10	11.75	1.42E-02	1.78E-02
1 (0.00;0.00;7.50)	1.50	11.75	1.37E-02	1.71E-02
1 (0.00;0.00;7.50)	1.50	11.54	1.37E-02	1.71E-02
1 (0.00;0.00;7.50)	0.85	11.54	1.24E-02	1.57E-02
1 (0.00;0.00;7.50)	0.85	11.29	1.24E-02	1.57E-02
1 (0.00;0.00;7.50)	0.20	11.29	1.11E-02	1.43E-02
1 (0.00;0.00;7.50)	0.20	11.03	1.11E-02	1.43E-02
1 (0.00;0.00;7.50)	-0.45	11.03	9.93E-03	1.28E-02
1 (0.00;0.00;7.50)	-0.45	10.76	9.93E-03	1.28E-02
1 (0.00;0.00;7.50)	-1.10	10.76	8.75E-03	1.14E-02
1 (0.00;0.00;7.50)	-1.10	10.48	8.75E-03	1.14E-02
1 (0.00;0.00;7.50)	-1.75	10.48	7.60E-03	9.98E-03
1 (0.00;0.00;7.50)	-1.75	10.19	7.60E-03	9.98E-03
1 (0.00;0.00;7.50)	-2.40	10.19	6.48E-03	8.58E-03
1 (0.00;0.00;7.50)	-2.40	9.89	6.48E-03	8.58E-03
1 (0.00;0.00;7.50)	-3.05	9.89	5.40E-03	7.21E-03
1 (0.00;0.00;7.50)	-3.05	9.60	5.40E-03	7.21E-03
1 (0.00;0.00;7.50)	-3.70	9.60	4.35E-03	5.85E-03
1 (0.00;0.00;7.50)	-3.70	9.31	4.35E-03	5.85E-03
1 (0.00;0.00;7.50)	-4.35	9.31	3.32E-03	4.53E-03
1 (0.00;0.00;7.50)	-4.35	9.01	3.32E-03	4.53E-03

Numerical results – Stresses and settlements



Graphical results – Stresses and settlements



Graphical results – Settlements shading

D.4.1.3.3. Data modification

If necessary, it is possible to modify the data input in the same file and restart the calculation.

For example we here wish to supplement the previous calculation with the oedometric settlement calculation: click the **Back to the index** button, then the **Back to the data** button to return to data input. Then select the "Layers" tab, tick the "3D, 1D elastic and oedometric" option and fill out:

- the new columns displayed in the soil characteristics table;
- the "Oedometric calculation parameters" frame at the bottom of the same tab;
- the "Consolidation" tab, which is now accessible: however we will not use this feature for this example. It will be illustrated in example 2.

N°	Name	Colour	Z _{base} [m]	E _{soil} [kPa]	v	Cs/(1+e0)	tc	Cc/(1+e0)	γ	n
1	Layer 1		1.50	8,00E03	0,33	0,012	-50,00	0,080	20,00	10
2	Layer 2		-5,00	4,00E03	0,33	0,025	1,00	2,000	19,00	10
3	Layer 3		-15,00	2,00E04	0,33	0,005	1,30	0,030	20,00	10

Oedometric calculation parameters:

- Vertical effective stress applied at top of the first layer σ_{v0} (kPa): 0.00
- Groundwater elevation Z_w (m): 6.50
- Unit weight of water γ_w (kN/m³): 10.00

“Soil layers definition” frame:

The values to be input for the oedometric calculation are as follows:

Name	$C_s/(1+e_0)$	t_c	$C_v/(1+e_0)$	γ (kN/m ³)
Layer 1	0.012	-50 (kPa)	0.080	20.00
Layer 2	0.025	1.00	0.200	19.00
Layer 3	0.005	1.30	0.030	20.00

Note on the values of t_c :

- when positive: they correspond by convention to overconsolidation ratios (OCR). See chapter D.3.2.2.
- when negative, they correspond by convention to overconsolidation pressures (in kPa). See chapter D.3.2.2.

“Oedometric calculation parameters” frame:

The additional values to be input are as follows:

σ_{vo}' (kPa)	Z_w (m)	γ_w (kN/m ³)
0.00	6.50	10.00

“Consolidation” tab:

Do not tick the “Consideration of consolidation” box (this feature will be illustrated in example 2).

Save the project under another name (TASSEL01bis for example) and restart the calculation. For analysis of the results, use the same method as before.

The numerical and graphical results of “Consolidation settlements (oedometric)” are still not always accessible: this is because although we activated oedometric calculation, the “Consolidation” feature for calculation of settlements with time is not used.

Formatted numerical results:

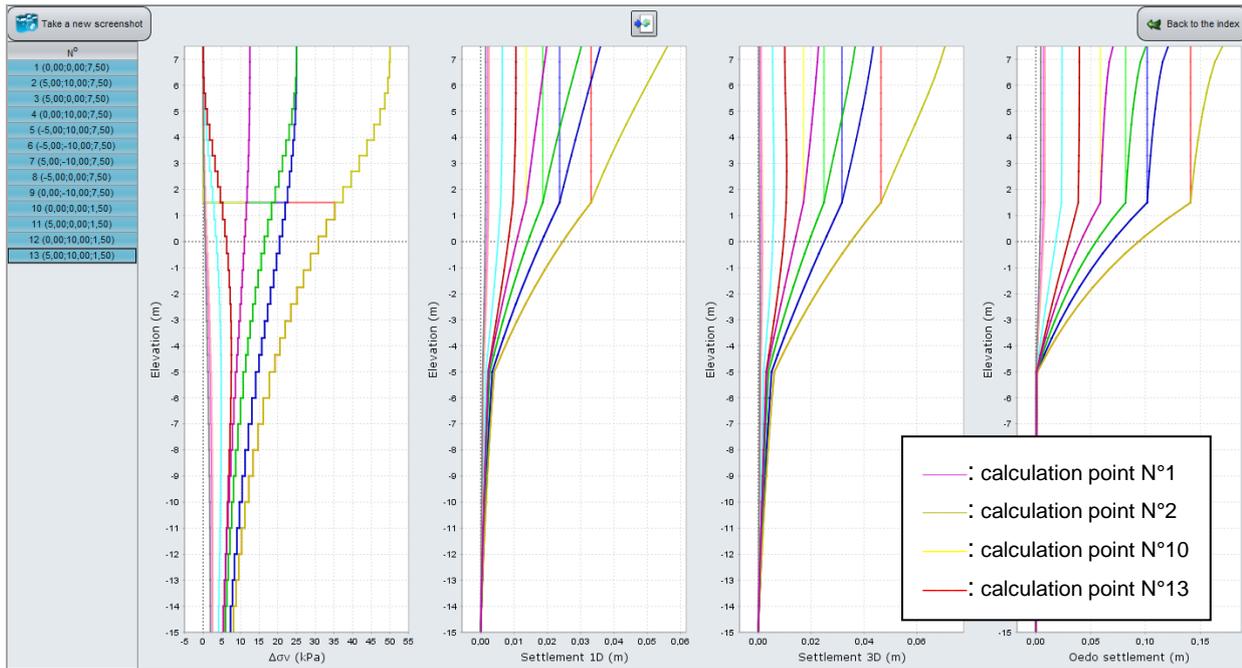
Logically, the T1d and T3d settlements are exactly the same as for the 1st calculation (the data concerning the elastic calculation were not modified).

This time we also obtain the calculated values for oedometric settlement (column T_{oedo}): these are far greater than the values resulting from the 2 elastic calculations: maximum oedometric settlement (point 2) of 17.0 cm instead of 7.07 cm for the same point with 3D elastic settlement.

If necessary, the comparison between these elastic and oedometric values enable the elastic modulus to be fitted with the oedometric characteristics of each soil layer.

Programme Tasselido v2.0.4		(C) TERRASOL 2011					
File : R:\Logiciels\Foxta v3\Manuels et exemples\Manuels Foxta v3\D - Tasselido\exemples\TASSELDO EXEMPLE 1A.DD							
Calcul réalisé le : 23/08/2012 à 11h56							
par : Terrasol							
Titre du calcul : Exemple 1							
Caractéristiques des couches							
n	Z base	module	coef. Poisson	Cs/(1+e0)	Cc/(1+e0)	G	
1	6.900	0.800E+04	0.330	0.012	0.080	20.000	
2	6.300	0.800E+04	0.330	0.012	0.080	20.000	
3	5.700	0.800E+04	0.330	0.012	0.080	20.000	
4	5.100	0.800E+04	0.330	0.012	0.080	20.000	
5	4.500	0.800E+04	0.330	0.012	0.080	20.000	
6	3.900	0.800E+04	0.330	0.012	0.080	20.000	
7	3.300	0.800E+04	0.330	0.012	0.080	20.000	
8	2.700	0.800E+04	0.330	0.012	0.080	20.000	
9	2.100	0.800E+04	0.330	0.012	0.080	20.000	
10	1.500	0.800E+04	0.330	0.012	0.080	20.000	
11	0.850	0.400E+04	0.330	0.025	0.200	19.000	
12	0.200	0.400E+04	0.330	0.025	0.200	19.000	
13	-0.450	0.400E+04	0.330	0.025	0.200	19.000	
14	-1.100	0.400E+04	0.330	0.025	0.200	19.000	
15	-1.750	0.400E+04	0.330	0.025	0.200	19.000	
16	-2.400	0.400E+04	0.330	0.025	0.200	19.000	
17	-3.050	0.400E+04	0.330	0.025	0.200	19.000	
18	-3.700	0.400E+04	0.330	0.025	0.200	19.000	
19	-4.350	0.400E+04	0.330	0.025	0.200	19.000	
20	-5.000	0.400E+04	0.330	0.025	0.200	19.000	
21	-6.000	0.200E+05	0.330	0.005	0.030	20.000	
22	-7.000	0.200E+05	0.330	0.005	0.030	20.000	
23	-8.000	0.200E+05	0.330	0.005	0.030	20.000	
24	-9.000	0.200E+05	0.330	0.005	0.030	20.000	
25	-10.000	0.200E+05	0.330	0.005	0.030	20.000	
26	-11.000	0.200E+05	0.330	0.005	0.030	20.000	
27	-12.000	0.200E+05	0.330	0.005	0.030	20.000	
28	-13.000	0.200E+05	0.330	0.005	0.030	20.000	
29	-14.000	0.200E+05	0.330	0.005	0.030	20.000	
30	-15.000	0.200E+05	0.330	0.005	0.030	20.000	
Contraintes effectives au centre des couches							
cote de référence :		7.500		contrainte verticale :		0.000	
cote de la nappe :		6.500		poids volumique eau :		10.0	
n	Cote	S0'	Sp'				
1	7.200	6.000	56.000				
2	6.600	18.000	68.000				
3	6.000	25.000	75.000				
4	5.400	31.000	81.000				
5	4.800	37.000	87.000				
6	4.200	43.000	93.000				
7	3.600	49.000	99.000				
8	3.000	55.000	105.000				
9	2.400	61.000	111.000				
10	1.800	67.000	117.000				
11	1.175	72.925	72.925				
12	0.525	78.775	78.775				
13	-0.125	84.625	84.625				
14	-0.775	90.475	90.475				
15	-1.425	96.325	96.325				
16	-2.075	102.175	102.175				
17	-2.725	108.025	108.025				
18	-3.375	113.875	113.875				
19	-4.025	119.725	119.725				
20	-4.675	125.575	125.575				
21	-5.500	133.500	173.550				
22	-6.500	143.500	186.550				
23	-7.500	153.500	199.550				
24	-8.500	163.500	212.550				
25	-9.500	173.500	225.550				
26	-10.500	183.500	238.550				
27	-11.500	193.500	251.550				
28	-12.500	203.500	264.550				
29	-13.500	213.500	277.550				
30	-14.500	223.500	290.550				
Surfaces de charges rectangulaires							
n	X0	Y0	Z0	LX	LY	teta(o)	q
1	0.000	0.000	7.500	10.000	20.000	0.000	50.000
Tassements calculés							
Point	X	Y	Z	T1d	T3d	Toedo	
1	0.000	0.000	7.500	0.0199	0.0238	0.0704	
2	5.000	10.000	7.500	0.0562	0.0707	0.1701	
3	5.000	0.000	7.500	0.0303	0.0367	0.1004	
4	0.000	10.000	7.500	0.0360	0.0435	0.1206	
5	-5.000	10.000	7.500	0.0106	0.0100	0.0398	
6	-5.000	-10.000	7.500	0.0015	0.0002	0.0045	
7	5.000	-10.000	7.500	0.0025	0.0012	0.0085	
8	-5.000	0.000	7.500	0.0065	0.0054	0.0239	
9	0.000	-10.000	7.500	0.0022	0.0008	0.0072	
10	0.000	0.000	1.500	0.0136	0.0171	0.0588	
11	5.000	0.000	1.500	0.0187	0.0249	0.0819	
12	0.000	10.000	1.500	0.0227	0.0217	0.1015	
13	5.000	10.000	1.500	0.0332	0.0464	0.1410	

Graphical curves: Stresses and settlements



Maximum surface settlement is indeed at point 2 (17.0 cm for oedometric settlement and 7.1 cm for 3D elastic settlement).

For points outside the footprint of the loaded zone, the $\Delta\sigma_v$ term is nil on the surface and increases with depth.

Note:

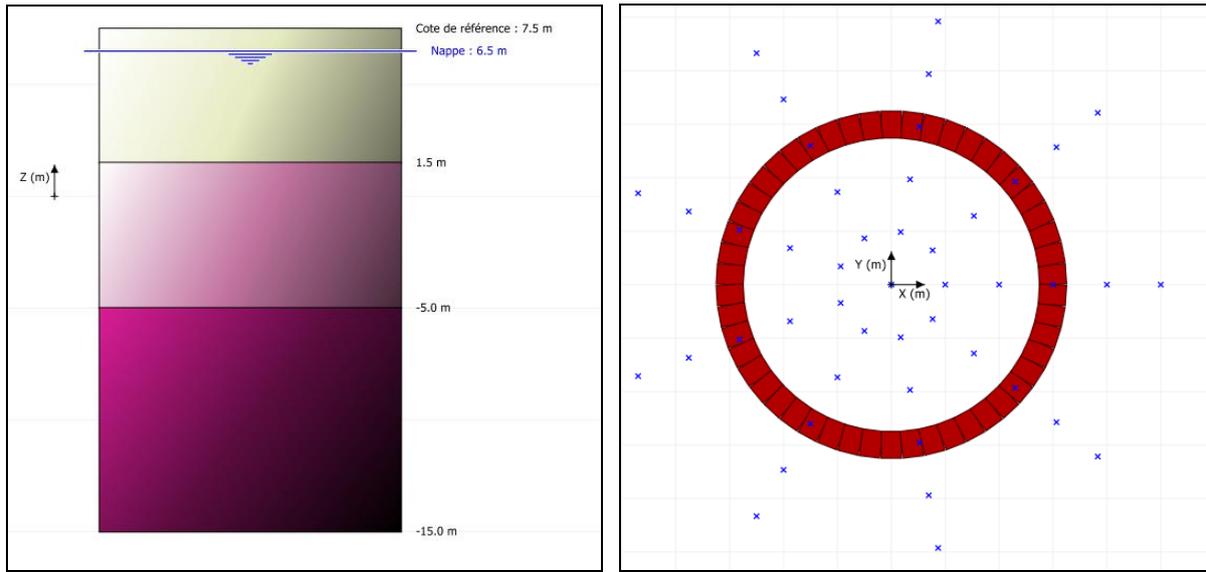
- Move the mouse over a curve to obtain the values corresponding to the points on the curve;
- The settlement curves for the calculation points situated at elevation 1.5 m are extended vertically between levels 1.5 and 7.5 m (no settlement calculated above the calculation point).

D.4.2. Example 2

D.4.2.1. Presentation of the problem

This example uses the same soil profile as before. However, the load here is annular and the calculation points will be chosen so that they are distributed over a disk with a radius greater than that of the load.

This example also uses a 3D average settlement plane and oedometric settlement of the soil is observed as a function of time.



D.4.2.2. Data input

When the application opens, Foxta proposes:

- creating a new project;
- opening an existing project;
- automatically opening the last project used.

In the case of this example:

- choose to create a new project by selecting the New project radio-button;
- click the button.

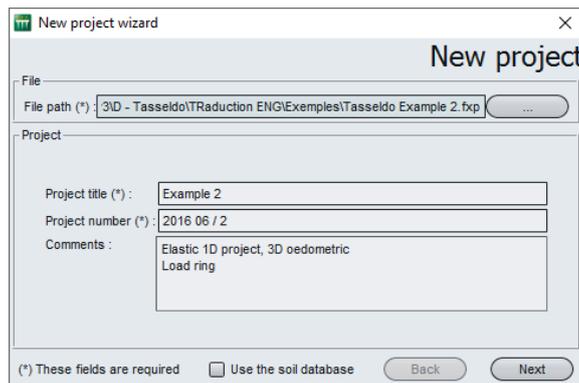
D.4.2.2.1. New Project Wizard: New project

“File” frame:

- Enter the project path by clicking the button;
- Give the file a name and save it.

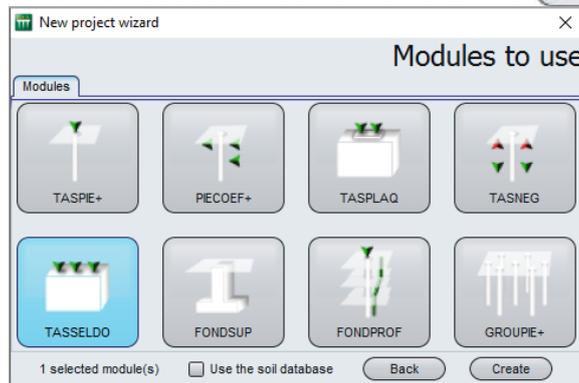
“Project” frame:

- Give the project a title;
- Enter a project number;
- Add comments if necessary;
- Leave the “Use the soils database” box unticked (we will not use the database for this example) and click the button.



D.4.2.2.2. New Project Wizard: Choice of modules

In the “Modules” window, select the Tasselido module then click the **Create** button.



The Tasselido window appears.

The various data tabs proposed must be filled out.

D.4.2.2.3. “Parameters” tab

Apart from the project title, the first tab is filled out in the same way as for example 1.

D.4.2.2.4. “Layers” tab

“Calculation type” frame:

This time the “3D, 1D elastic and oedometric” option is ticked directly.

“Soil layers definition” frame:

The following data are to be input (the same as for example 1: it is possible to go back to example 1, export soil layers to the general database and then import them when creating example 2, to avoid having to re-enter the same data. See part C of the manual):

Top of first layer: 7.50 m.

Name	Z _{base} (m)	E _{soil} (kPa)	v	C _s /(1+e ₀)	t _c	C _c /(1+e ₀)	γ (kN/m ³)	n
Layer 1	1.50	8000	0.33	0.012	-50 (kPa)	0.08	20.00	10
Layer 2	-5	4000	0.33	0.025	1.00	0.20	19.00	10
Layer 3	-15	20000	0.33	0.005	1.30	0.03	20.00	10

The screenshot shows the 'Layers data' panel with the following table:

γ ^o	Name	Colour	Z _{base} [m]	E _{soil} [kPa]	v	Cs/(1+e0)	tc	Cc/(1+e0)	γ	n
1	Couche 1	Blue	1.50	8,00E03	0,33	0,012	-50,00	0,080	20,00	10
2	Couche 2	Pink	-5,00	4,00E03	0,33	0,025	1,00	0,200	19,00	10
3	Couche 3	Green	-15,00	2,00E04	0,33	0,005	1,30	0,030	20,00	10

Below the table, the 'Oedometric calculation parameters' are set as follows:

- Vertical effective stress applied at top of the first layer σ'_{vo} (kPa): 0,00
- Groundwater elevation Z_w (m): 6,50
- Unit weight of water γ_w (kN/m³): 10,00

“Oedometric calculation parameters” frame:

The following data are to be input:

σ'_{vo} (kPa)	Z_w (m)	γ_w (kN/m ³)
0.00	6.50	10.00

D.4.2.2.5. “Loads” tab

The screenshot shows the 'Distributed load' panel with the following table:

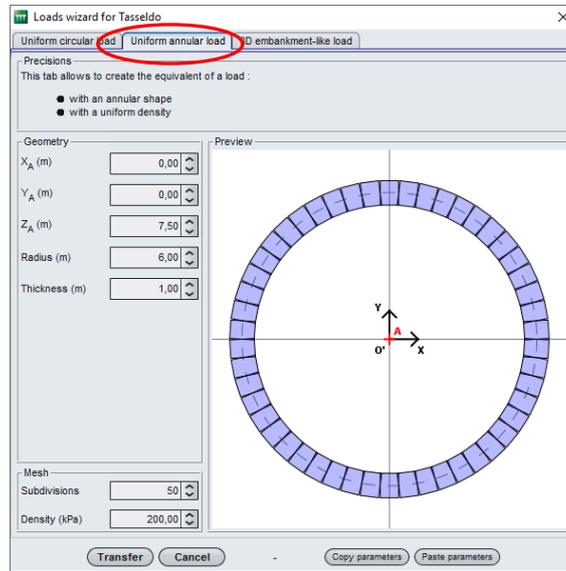
Load #	X _i [m]	Y _i [m]	Z _i [m]	L _x [m]	L _y [m]	θ _i [°]	q _i [kPa]	Group
1	5.50	-0.03	7.50	1.00	0.75	3.60	200.00	1
2	5.46	0.66	7.50	1.00	0.75	10.80	200.00	1
3	5.34	1.34	7.50	1.00	0.75	18.00	200.00	1
4	5.13	2.00	7.50	1.00	0.75	25.20	200.00	1
5	4.84	2.62	7.50	1.00	0.75	32.40	200.00	1
6	4.47	3.21	7.50	1.00	0.75	39.60	200.00	1
7	4.03	3.74	7.50	1.00	0.75	46.80	200.00	1
8	3.53	4.22	7.50	1.00	0.75	54.00	200.00	1
9	2.97	4.63	7.50	1.00	0.75	61.20	200.00	1
10	2.37	4.96	7.50	1.00	0.75	68.40	200.00	1
11	1.73	5.22	7.50	1.00	0.75	75.60	200.00	1
12	1.06	5.40	7.50	1.00	0.75	82.80	200.00	1
13	0.38	5.49	7.50	1.00	0.75	90.00	200.00	1
14	-0.31	5.49	7.50	1.00	0.75	97.20	200.00	1
15	-1.00	5.41	7.50	1.00	0.75	104.40	200.00	1
16	-1.67	5.24	7.50	1.00	0.75	111.60	200.00	1
17	-2.31	4.99	7.50	1.00	0.75	118.80	200.00	1
18	-2.92	4.66	7.50	1.00	0.75	126.00	200.00	1
19	-3.48	4.26	7.50	1.00	0.75	133.20	200.00	1
20	-3.99	3.79	7.50	1.00	0.75	140.40	200.00	1
21	-4.43	3.26	7.50	1.00	0.75	147.60	200.00	1
22	-4.81	2.68	7.50	1.00	0.75	154.80	200.00	1
23	-5.10	2.05	7.50	1.00	0.75	162.00	200.00	1
24	-5.32	1.40	7.50	1.00	0.75	169.20	200.00	1
25	-5.45	0.72	7.50	1.00	0.75	176.40	200.00	1
26	-5.50	0.03	7.50	1.00	0.75	183.60	200.00	1
27	-5.46	-0.66	7.50	1.00	0.75	190.80	200.00	1
28	-5.34	-1.34	7.50	1.00	0.75	198.00	200.00	1
29	-5.13	-2.00	7.50	1.00	0.75	205.20	200.00	1

In the “Loads” tab, use the "Load Wizard" button (bottom-left of tab) and select the “Uniform annular load” tab.

The following data are to be input:

X_A (m)	Y_A (m)	Z_A (m)	R (m)	e (m)	Subdivisions	q (kPa)
0.00	0.00	7.50	6.00	1.00	50	200.00

The radius to be input is the average radius of the ring. In the case of this example, the inside radius of the ring is 5.5 m and the outside radius is 6.5 m.



Once the data are input, click the **Transfer** button to create the corresponding load rectangles in the loads table: it is possible to check that the wizard has actually generated 50 rectangles to represent the ring.

The rectangle selected from the list is surrounded by a green frame on the drawing.

D.4.2.2.6. "Consolidation" tab

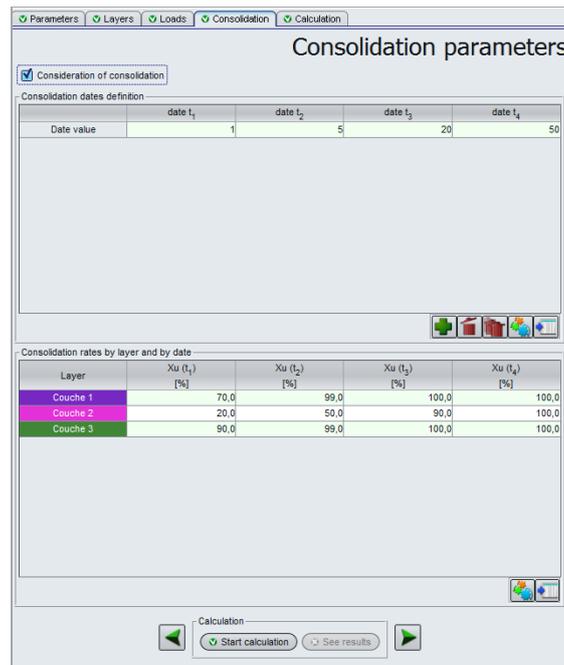
Tick the "Consideration of consolidation" box and then fill out the tab:

"Consolidation dates definition" frame:

To add date values (that is columns in the table), click the  button.

The values to be input are as follows:

t_1	t_2	t_3	t_4
1	5	20	50



“Consolidation rates by layer and by date” frame:

3 lines corresponding to the 3 soil layers were automatically created.

For the three soil layers, their respective degrees of consolidation must be defined, expressed as a percentage, as a function of the dates.

The values to be input for this example are as follows:

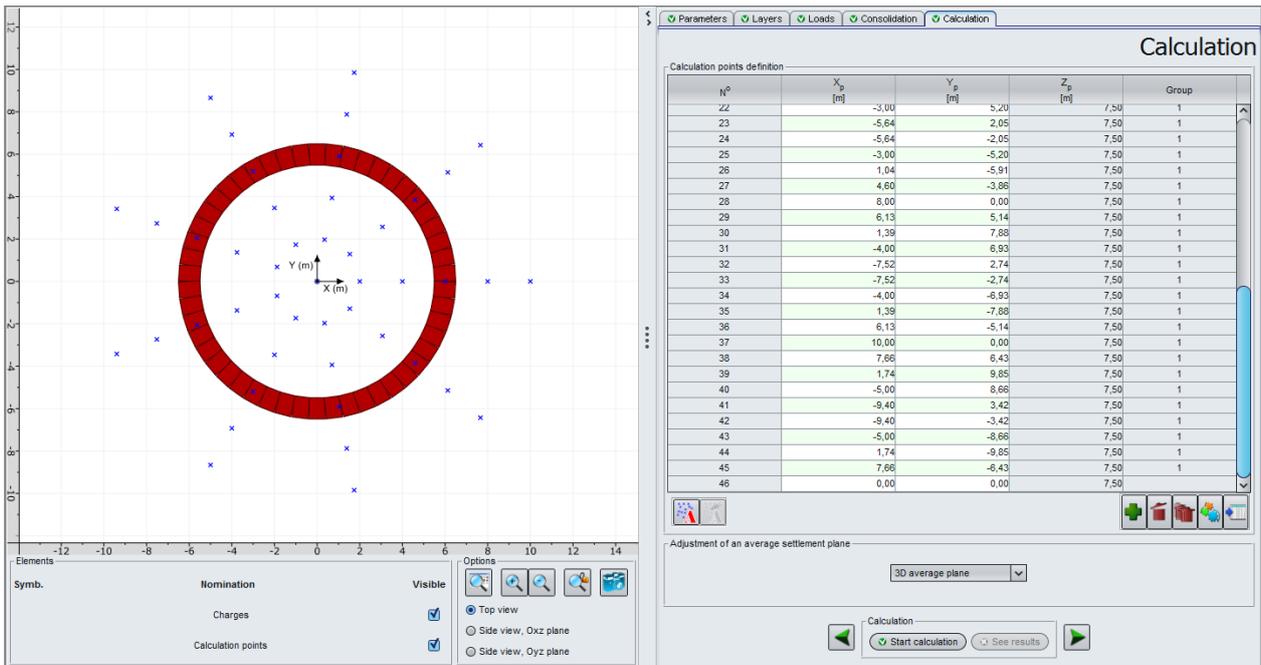
Layers	$X_u(t_1)$ (%)	$X_u(t_2)$ (%)	$X_u(t_3)$ (%)	$X_u(t_4)$ (%)
Layer 1	70	99	100	100
Layer 2	20	50	90	100
Layer 3	90	99	100	100

D.4.2.2.7. "Calculation" tab

It is now possible to generate the calculation points on the surface of a disk.

“Calculation points definition” frame:

These points will be those used to calculate the average settlement plane. It is therefore important to select points that are distributed uniformly and symmetrically with respect to the loaded zone, in order to obtain a representative average plane (use of the wizard guarantees this homogeneous distribution of points in the defined zone).



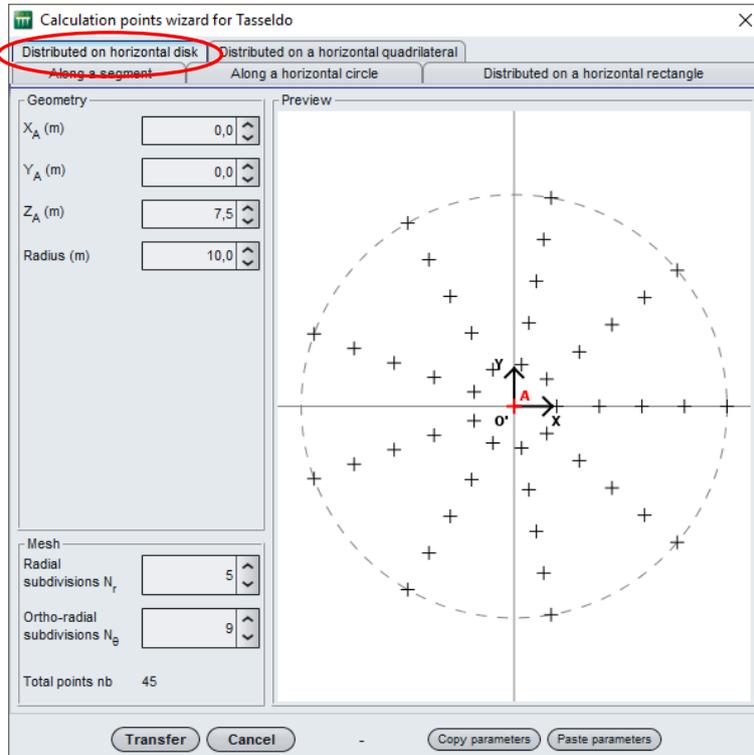
Similarly, the size of the disk chosen for defining these points will have an influence on the average plane calculated: here we intentionally opt to define a disk wider than the loaded zone.

Click the "Calculation points wizard" button , and select the “Distributed on horizontal disk” tab.

The data to be input are as follows:

X_A (m)	Y_A (m)	Z_A (m)	R (m)	N_r	N_θ
0.00	0.00	7.50	10.0	5	9

The wizard automatically calculates the total number of points generated: 45.



Click **Transfer** to create the 45 points in the project data.

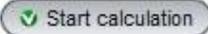
Here we decided to add a 46th point manually: add point (0, 0, 7.50) corresponding to the centre of the loaded zone.

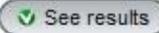
"Adjustment of an average settlement plane" frame:

In the drop-down menu, select the “3D average plane” option.

D.4.2.3. Calculation and results

D.4.2.3.1. Calculation

Click the  button to start the calculation.

To access the results in the form of tables and graphics, click the  button.

D.4.2.3.2. Results

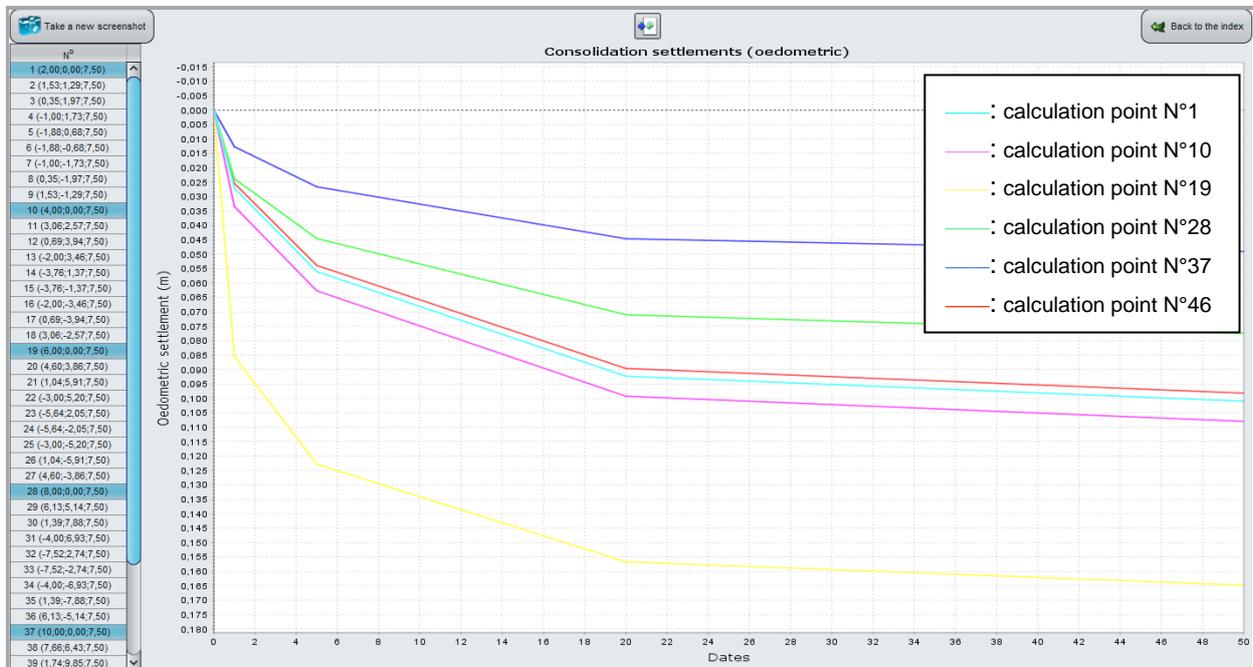
New types of results are accessible by comparison with example 1:

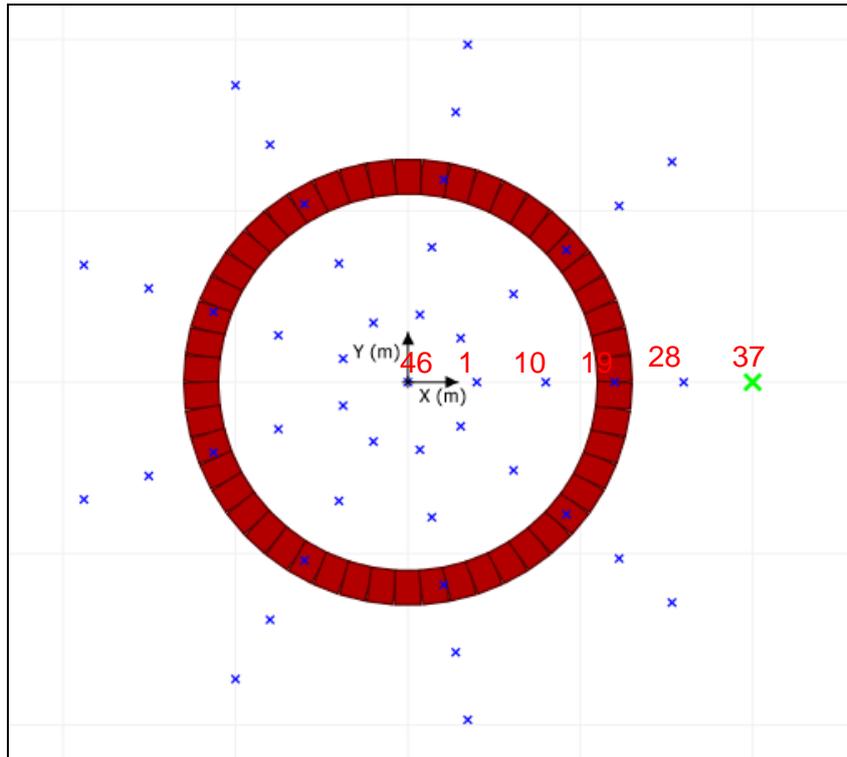
- The oedometric settlements at the different dates defined, for all calculation points (below is the display in graphic form, using the "Shift" key to select and thus superpose several curves on the graphic).

These results are available because we chose oedometric calculation with consolidation.

On the graphic below, we selected calculation points 46, 1, 10, 19, 28 and 37, aligned along a radius, with point 19 being situated under the mean fibre of the ring (the points selected are illustrated in the following figure).

It is logical that starting from point 46 (centre of the ring) and moving outwards, settlement begins to increase the closer one comes to the loaded ring and reaches its maximum under the ring (point 19, with oedometric settlement of close to 13 cm), and then decreases again as one moves away from the loaded ring.





- The 3D average plane equation, calculated on the basis of the 3D settlement of all the calculation points defined (average plane displayed below after the formatted numerical results).

It should be noted that the adjusted settlement (3D average plane for this example) is the same for all the calculation points: this corresponds to the uniform load case and a homogeneous distribution of calculation points under the loaded zone. The average plane settlement is here equal to 3.6 cm.

With regard to 3D elastic settlement, the “calculated” column tells us that it is maximal for the points situated below the loaded ring, as previously seen, with a value of 6.65 cm (point 19 for example). In addition and as expected, we see that settlement has the same value for all points situated on a given circle centred on the centre of the loaded ring, given that this is a uniform annular load.

Plan ajusté sur la déformée

T3d = -0.145E-07* Xp + 0.135E-11* Yp + 0.357E-01
azimuth /axe X (*): -0.01
pente maxi : -0.145E-07

Point	Xp	Yp	calculé	ajusté
1	2.000	0.000	0.0326	0.0357
2	1.532	1.286	0.0326	0.0357
3	0.347	1.970	0.0326	0.0357
4	-1.000	1.732	0.0326	0.0357
5	-1.879	0.684	0.0326	0.0357
6	-1.879	-0.684	0.0326	0.0357
7	-1.000	-1.732	0.0326	0.0357
8	0.347	-1.970	0.0326	0.0357
9	1.532	-1.286	0.0326	0.0357
10	4.000	0.000	0.0392	0.0357
11	3.064	2.571	0.0392	0.0357
12	0.695	3.939	0.0392	0.0357
13	-2.000	3.464	0.0392	0.0357
14	-3.759	1.368	0.0392	0.0357
15	-3.759	-1.368	0.0392	0.0357
16	-2.000	-3.464	0.0392	0.0357
17	0.695	-3.939	0.0392	0.0357
18	3.064	-2.571	0.0392	0.0357
19	6.000	0.000	0.0665	0.0357
20	4.596	3.857	0.0665	0.0357
21	1.042	5.909	0.0665	0.0357
22	-3.000	5.196	0.0665	0.0357
23	-5.638	2.052	0.0665	0.0357
24	-5.638	-2.052	0.0665	0.0357
25	-3.000	-5.196	0.0665	0.0357
26	1.042	-5.909	0.0665	0.0357
27	4.596	-3.857	0.0665	0.0357
28	8.000	0.000	0.0267	0.0357
29	6.128	5.142	0.0267	0.0357
30	1.389	7.878	0.0267	0.0357
31	-4.000	6.928	0.0267	0.0357
32	-7.518	2.736	0.0267	0.0357
33	-7.518	-2.736	0.0267	0.0357
34	-4.000	-6.928	0.0267	0.0357
35	1.389	-7.878	0.0267	0.0357
36	6.128	-5.142	0.0267	0.0357
37	10.000	0.000	0.0142	0.0357
38	7.660	6.428	0.0142	0.0357
39	1.736	9.848	0.0142	0.0357
40	-5.000	8.660	0.0142	0.0357
41	-9.397	3.420	0.0142	0.0357
42	-9.397	-3.420	0.0142	0.0357
43	-5.000	-8.660	0.0142	0.0357
44	1.736	-9.848	0.0142	0.0357
45	7.660	-6.428	0.0142	0.0357
46	0.000	0.000	0.0307	0.0357