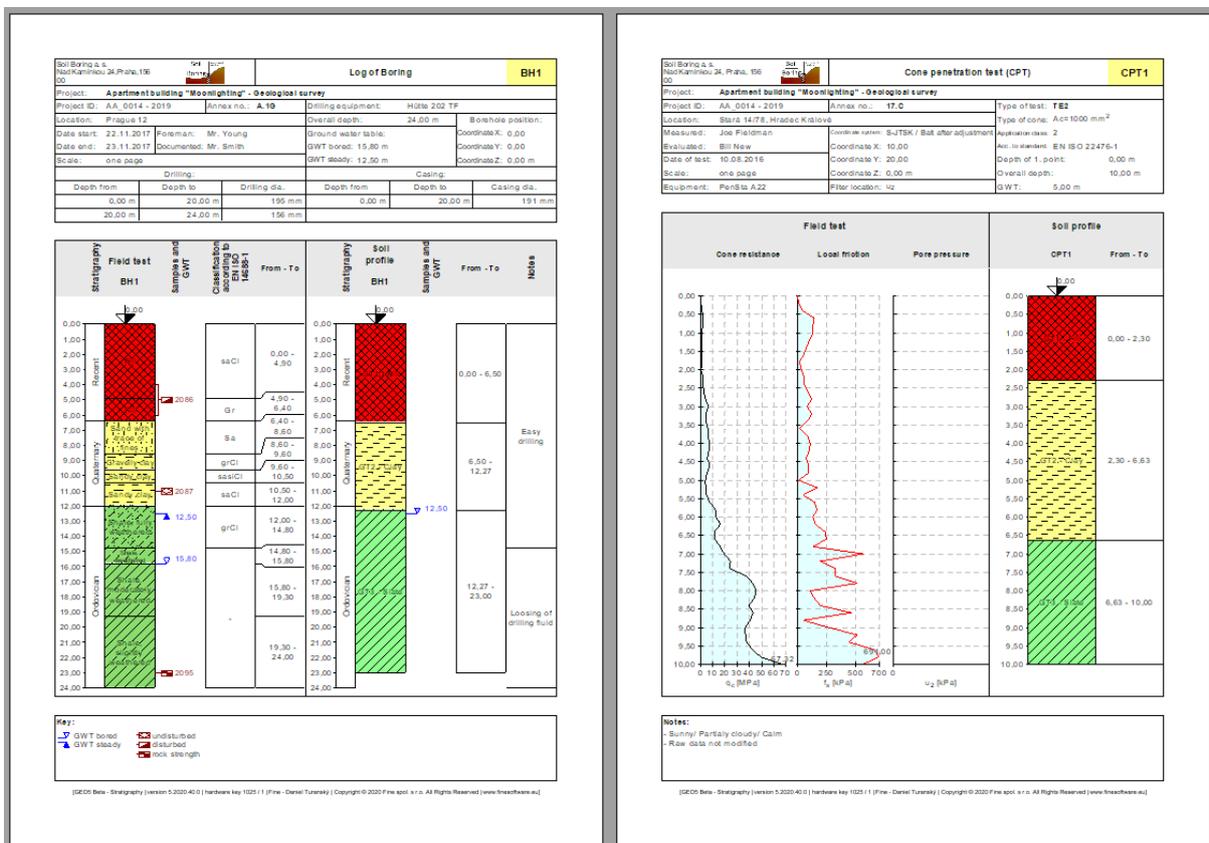


## Interpretation of Field Tests into the Soil Profiles

Program: Stratigraphy  
 File: Demo\_manual\_43\_1.gsg  
 Demo\_manual\_43\_2.gsg

Boreholes and some other field tests have to be simplified or interpreted for geotechnical design or the creation of a 3D subsoil model. It is necessary to create geotechnical types of soils, define the thicknesses of soil layers for each test.

**Assignment:** Interpret the field tests from Engineering Manual No. 42 into the soil profile.



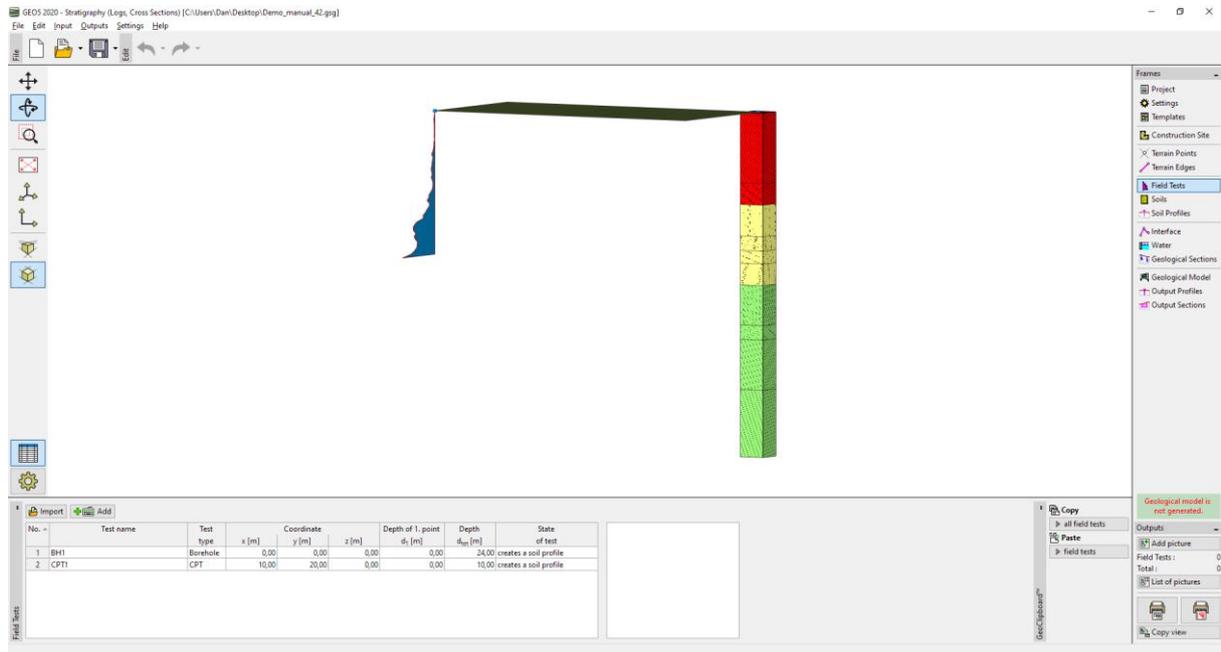
### Solution:

There are two ways we can proceed:

- Interpret the field tests separately in the "Soil Profile" frame
- Interpret the field tests when creating geological sections
- Combination of both ways

## Approach 1 – Interpretation of field tests in “Soil Profile” frame

We will open the Demo\_manual\_42.gsg file and look at the entered tests – borehole “BH1” and CPT “CPT1”.



First, we will look at the borehole protocol and think about which geotechnical soil types we want to create.

**Edit field test properties (borehole)**

— Test parameters

Test name:

Coordinate : x =  [m]    y =  [m]

Height :     z =  [m]

Depth of 1. point :    d<sub>1</sub> =  [m]

Overall depth :    d<sub>tot</sub> =  [m]

Field test generates soil profile

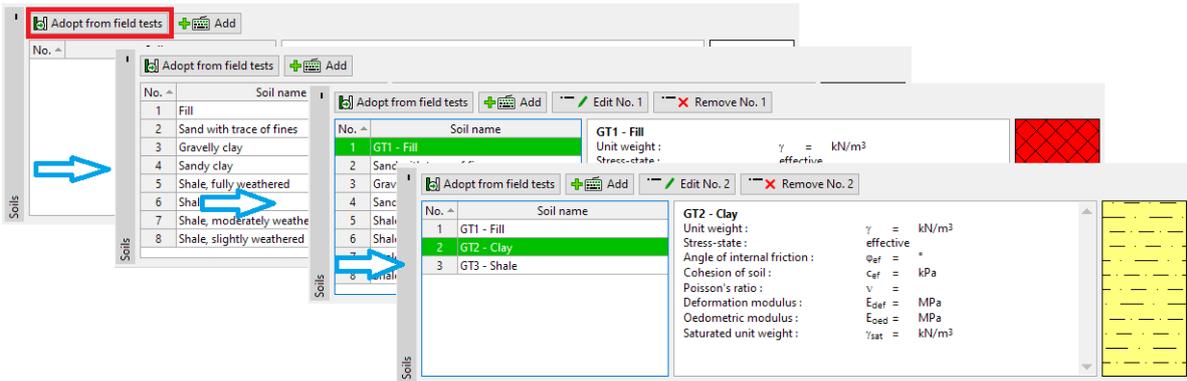
Layers	Samples	Table GWT	Data - Protocol	Data - Test	Attachments
No.	Thickness t [m]	Hloubka d [m]	Soil name	Soil pattern	Layer description
1	4,90	0,00 .. 4,90	Fill		fine grained SAND with some silt, dense, mixed with cobbles of concrete and pieces of bricks partly the size is larger than the borehole diameter, black colour of the soil
2	1,50	4,90 .. 6,40	Fill		coarse GRAVEL with some silt (clayey shale) and fresh angular cobbles up to 15 cm, dark grey colour
3	2,20	6,40 .. 8,60	Sand with trace of fines		medium grained with some fine soil, dense, rust-brown
4	1,00	8,60 .. 9,60	Gravelly clay		hard, gravel particles up to 10 mm (weathered shale), brown
5	0,90	9,60 .. 10,50	Sandy clay		hard, with some pieces of gravel (quartz) up to 50 mm dia., brown

**Soil profile**

The solution is never exactly clear; there are always different ways of simplification – for example:

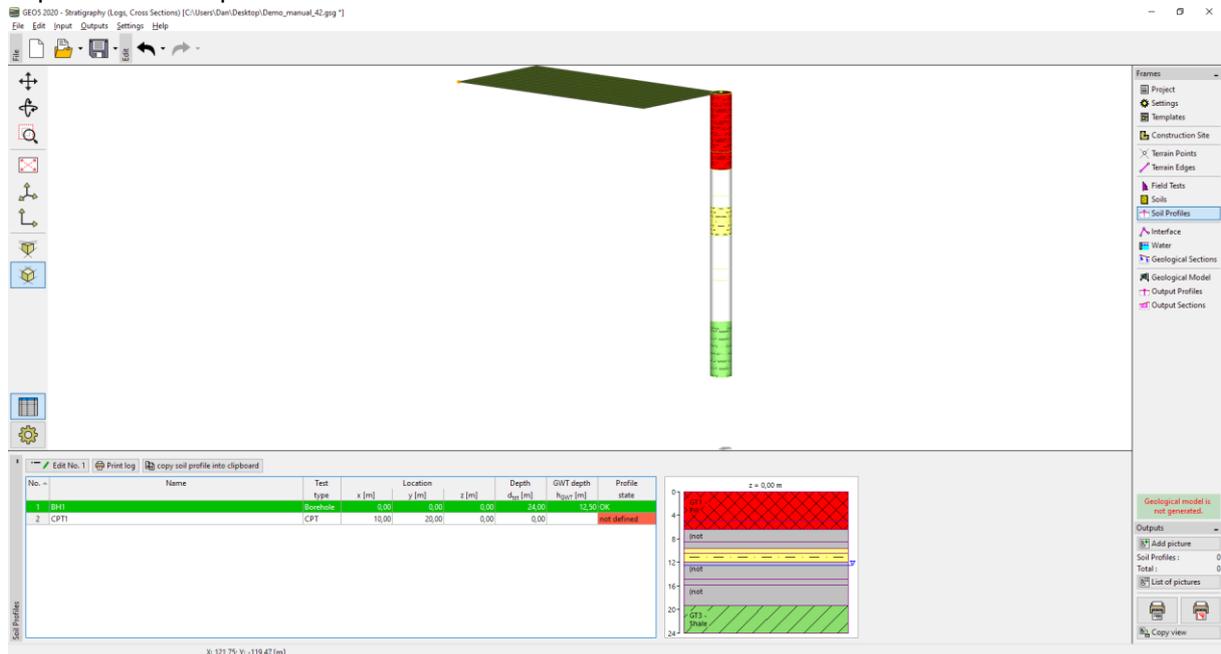
- GT1 Landfill, GT2 Sand, GT3 Clay, GT4 Weathered Slate, GT5 Slate
- GT1 Landfill, GT2 Fine-grained soils, GT3 Slate

In our example, we will choose a significant degree of simplification, and we will continue to work with three geotechnical types only. We will switch to the “Soils” frame. So that we do not have to input the names, samples, and colours of the soil again, we will take them from the tests. We will change the individual names of the soils and delete the other soils.



*Note: New soils can also be added when creating a Soil profile or Geological section; it is not necessary to return to this frame.*

We will select the borehole BH1 – we see, that the interface of layers and partly even the soils were copied from the specified borehole.



We will open the soil profile and edit it.

**Identification**  
Name: BH1  
Coordinate: x = 0,00 [m] y = 0,00 [m]  
z = 0,00 [m]  
Depth of the 1st point from original terrain: d<sub>1</sub> = 0,00 [m]

**Parameters**  
GWT depth: h<sub>GWT</sub> = 12,50 [m]  
 Soil profile is active for geological model generation

**View field test**  
GWT bored: GWT<sub>1</sub> = 15,80 m  
GWT steady: GWT<sub>1</sub> = 12,50 m

**Layers of soil profile**

No.	Thickness [m]	Depth [m]	Soil name
1	4,90	0,00 - 4,90	GT1 - Fill
2	1,50	4,90 - 6,40	GT1 - Fill
3	2,20	6,40 - 8,60	(not assigned)
4	1,00	8,60 - 9,60	(not assigned)
5	0,90	9,60 - 10,50	GT2 - Clay
6	1,50	10,50 - 12,00	GT2 - Clay
7	2,80	12,00 - 14,80	(not assigned)
8	1,00	14,80 - 15,80	(not assigned)
9	3,50	15,80 - 19,30	(not assigned)
10	4,70	19,30 - 24,00	GT3 - Shale

We will assign the soils to all layers.

**Layers of soil profile**

No.	Thickness [m]	Depth [m]	Soil name
1	4,90	0,00 - 4,90	GT1 - Fill
2	1,50	4,90 - 6,40	GT1 - Fill
3	2,20	6,40 - 8,60	GT2 - Clay
4	1,00	8,60 - 9,60	GT2 - Clay
5	0,90	9,60 - 10,50	GT2 - Clay
6	1,50	10,50 - 12,00	GT2 - Clay
7	2,80	12,00 - 14,80	GT3 - Shale
8	1,00	14,80 - 15,80	GT3 - Shale
9	3,50	15,80 - 19,30	GT3 - Shale
10	4,70	19,30 - 24,00	GT3 - Shale

Finally, we will remove the redundant interfaces – the easiest way is to merge the same layers into one by using the “Merge layers with the same soil” option in context menu (available using right mouse button).

**Layers of soil profile**

No.	Thickness [m]	Depth [m]	Soil name
1	6,40	0,00 - 6,40	GT1 - Fill
2	5,60	6,40 - 12,00	GT2 - Clay
3	12,00	12,00 - 24,00	GT3 - Shale

The result is a three-layer soil profile.

No.	Thickness [m]	Depth [m]	Soil name
1	6,40	0,00 - 6,40	GT1 - Fill
2	5,60	6,40 - 12,00	GT2 - Clay
3	12,00	12,00 - 24,00	GT3 - Shale

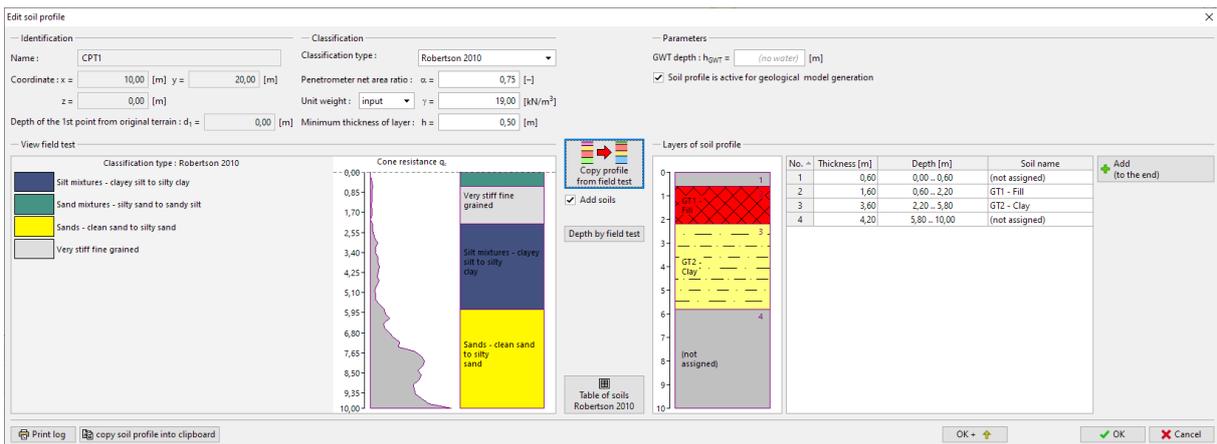
Next, we will interpret the CPT. When the dialog box opens, the program evaluates the CPT test by the Robertson method and will design the soil layers.

We can assign soil types, according to Robertson, to our geotechnical types. Press the “Table of soils Robertson 2010” button and try to assign the soils.

Table of soils (Robertson 2010) ✕

Soil description		Assigned soil	
Sensitive fine grained		(not assigned)	 Add soil
Organic soils - clay		GT2 - Clay ▼	 Add soil
Clay - silty clay to clay		GT2 - Clay ▼	 Add soil
Silt mixtures - clayey silt to silty clay		GT2 - Clay ▼	 Add soil
Sand mixtures - silty sand to sandy silt		(not assigned)	 Add soil
Sands - clean sand to silty sand		(not assigned)	 Add soil
Gravelly sand to dense sand		(not assigned)	 Add soil
Very stiff sand to clayey sand		GT1 - Fill ▼	 Add soil
Very stiff fine grained		GT1 - Fill ▼	 Add soil

We will change the size of the minimal layer to 0.5 m to reduce the number of layers and assign the created layers to the profile.



We will then modify the profile by assigning a layer of Slate and merging a layer of landfill.

**Edit soil profile**

**Identification**  
 Name: CPT1  
 Coordinate: x = 10,00 [m] y = 20,00 [m] z = 0,00 [m]

**Classification**  
 Classification type: Robertson 2010  
 Penetrometer net area ratio:  $\alpha = 0,75 [-]$   
 Unit weight: input  $\gamma = 19,00 [kN/m^3]$   
 Minimum thickness of layer: h = 0,50 [m]

**Parameters**  
 GW depth:  $h_{GW} = (no\ water) [m]$   
 Soil profile is active for geological model generation

**View field test**  
 Classification type: Robertson 2010  
 Legend:  
 - Silt mixtures - clayey silt to silty clay (dark blue)  
 - Sand mixtures - silty sand to sandy silt (yellow)  
 - Sands - clean sand to silty sand (light green)  
 - Very stiff fine grained (grey)

**Cone resistance  $q_c$**   
 Graph showing cone resistance vs depth (0,00 to 10,00 m). Labels: Very stiff fine grained, Silt mixtures - clayey silt to silty clay, Sands - clean sand to silty sand.

**Layers of soil profile**

No.	Thickness [m]	Depth [m]	Soil name
1	2,20	0,00 - 2,20	GT1 - Fill
2	3,60	2,20 - 5,80	GT2 - Clay
3	4,20	5,80 - 10,00	GT3 - Shale

Buttons: Copy profile from field test, Add soils, Depth by field test, Table of soils Robertson 2010, Add (to the end)

Buttons: Print log, copy soil profile into clipboard, OK, Cancel

Now the profile is created.

**GEOS 2020 - Stratigraphy (Logs, Cross Sections)**

File Edit Input Outputs Settings Help

**Soil Profiles**

Frames:  
 Project  
 Settings  
 Templates  
 Construction Site  
 Terrain Points  
 Terrain Edges  
 Field Tests  
**Soils**  
 Soil Profiles  
 Interface  
 Water  
 Geological Sections  
 Geological Model  
 Output Profiles  
 Output Sections

**Soil Profiles**

No.	Name	Test type	x [m]	y [m]	z [m]	Depth $d_{test}$ [m]	GW depth $h_{GW}$ [m]	Profile state
1	BH1	Borehole	0,00	0,00	0,00	24,00	12,50	OK
2	CPT1	CPT	10,00	-10,00	0,00	10,00		OK

**Soil Profile** (z = 0,00 m)  
 Legend:  
 - GT1 - Fill (red)  
 - GT2 - Clay (yellow)  
 - GT3 - Shale (green)

Buttons: Edit No. 2, Print log, copy soil profile into clipboard, Add picture, List of pictures, Copy view

Geological model is not generated.  
 Outputs: Add picture, Soil Profiles: 0, Total: 0

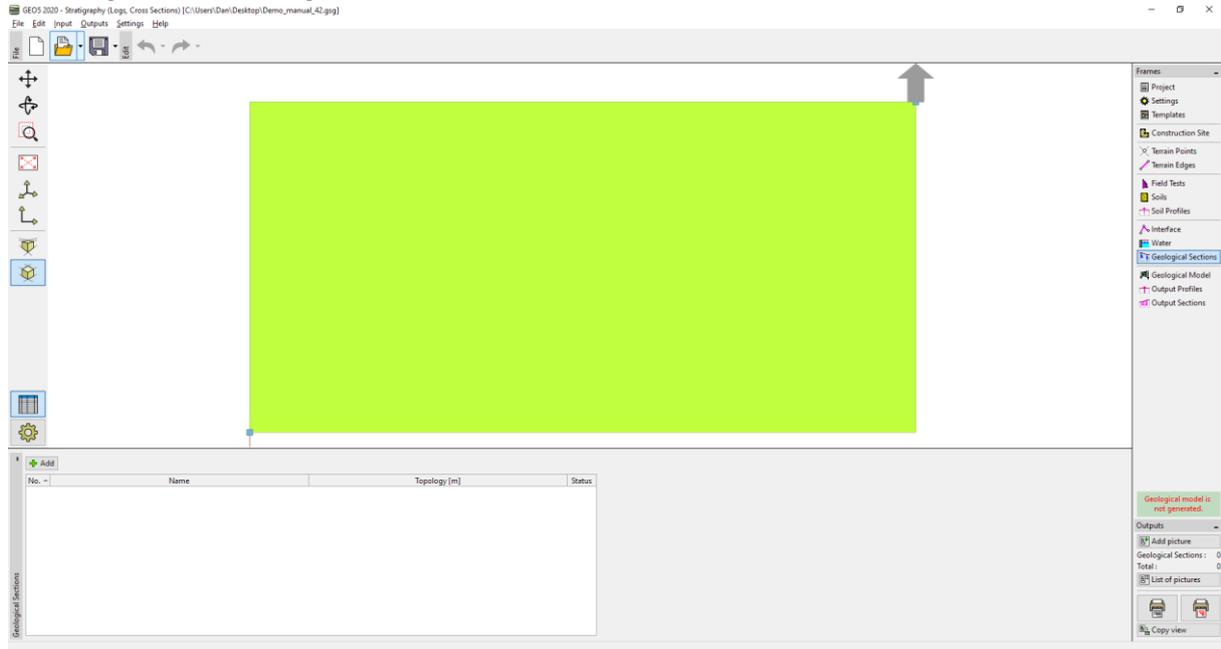
X: 36,45 Y: 37,50 [m]

## Approach 2 – creation of soil profiles using Geological Sections

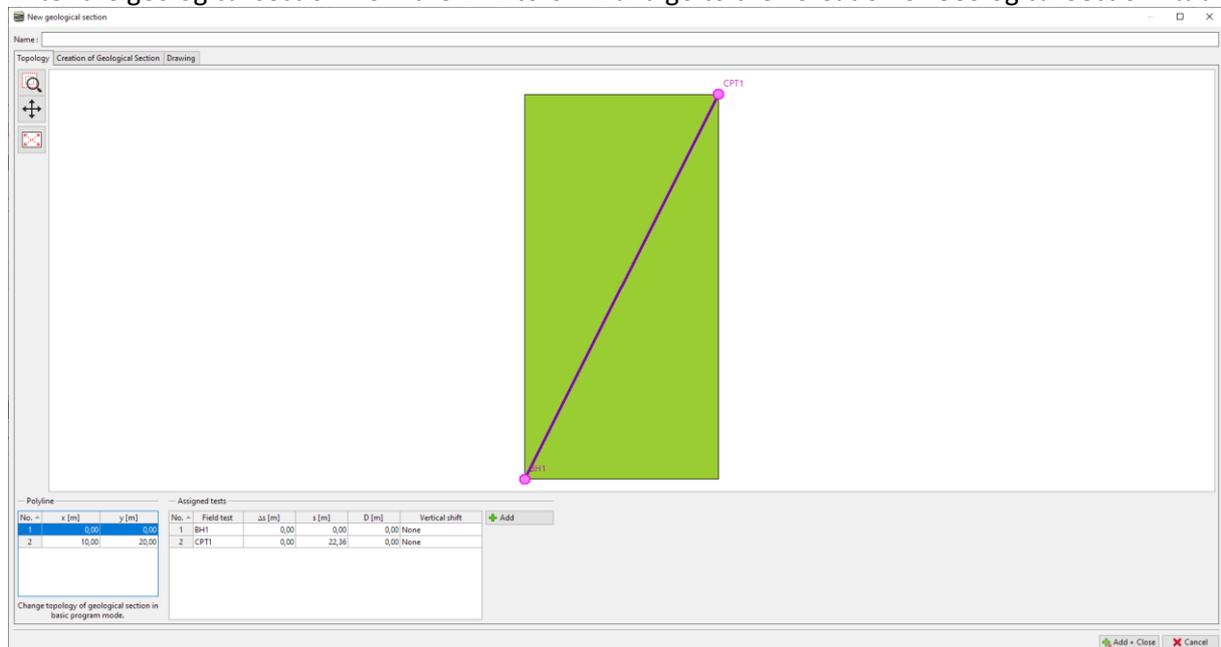
This method has the advantage that we can create our idea for multiple profiles at the same time. We can also leave the decision of which geotechnical types to create until the creation of the section.

Again, we open *Demo\_manual\_42.gsg* file.

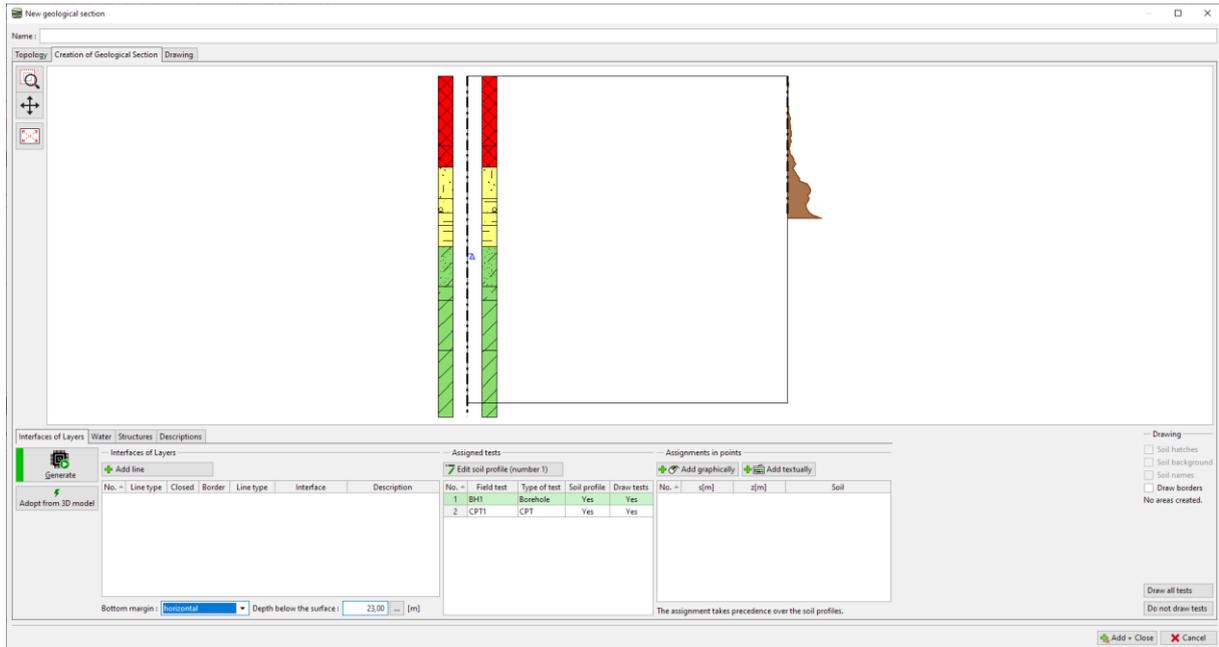
We will go to the “Geological Sections” frame.



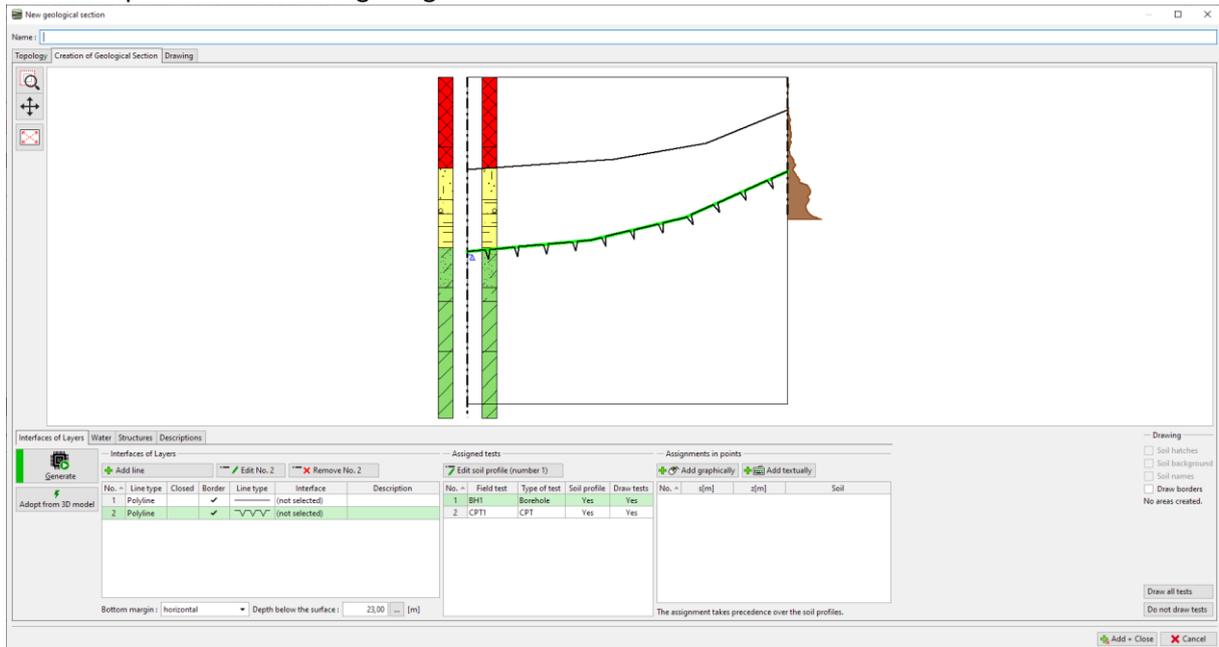
Enter the geological section from the BH1 to CPT1 and go to the “Creation of Geological Section” tab.



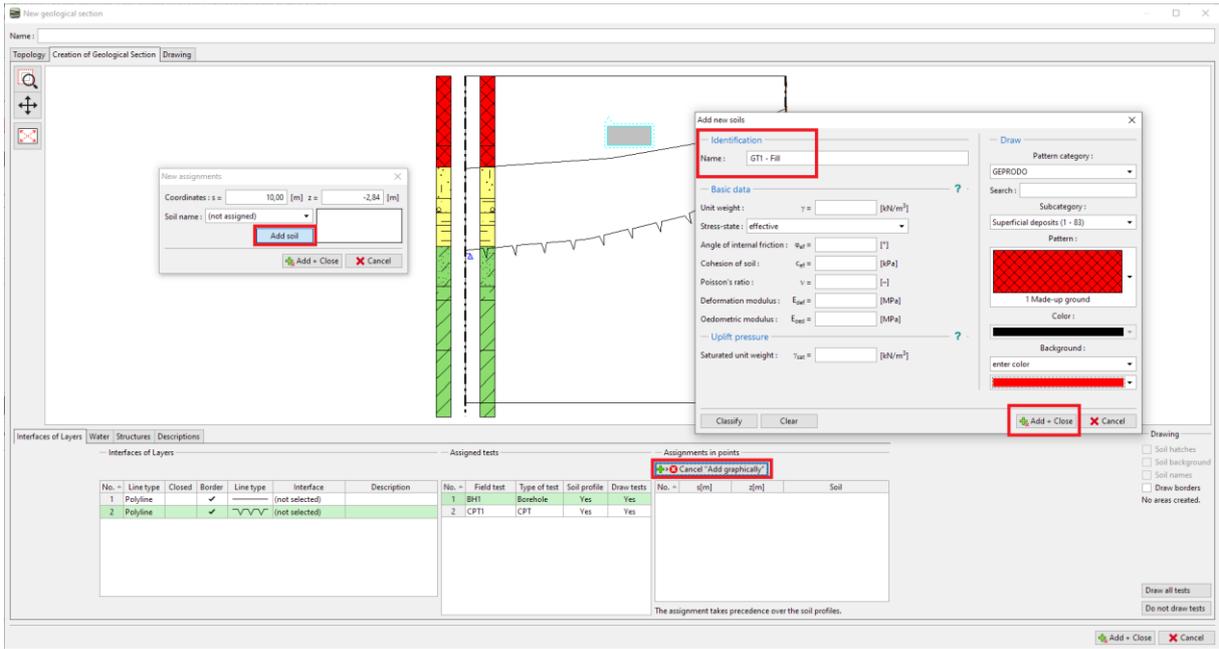
We see selected field tests. Soil profiles display on the axis of test, but they aren't created yet.



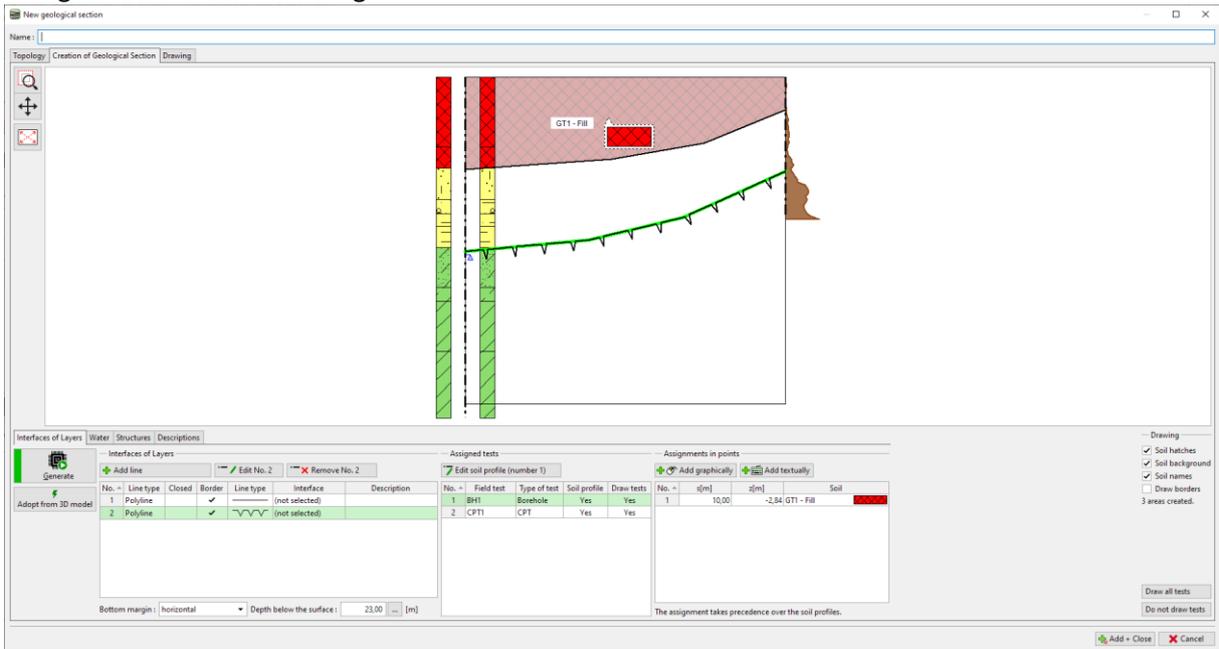
We will input our idea of the geological section.



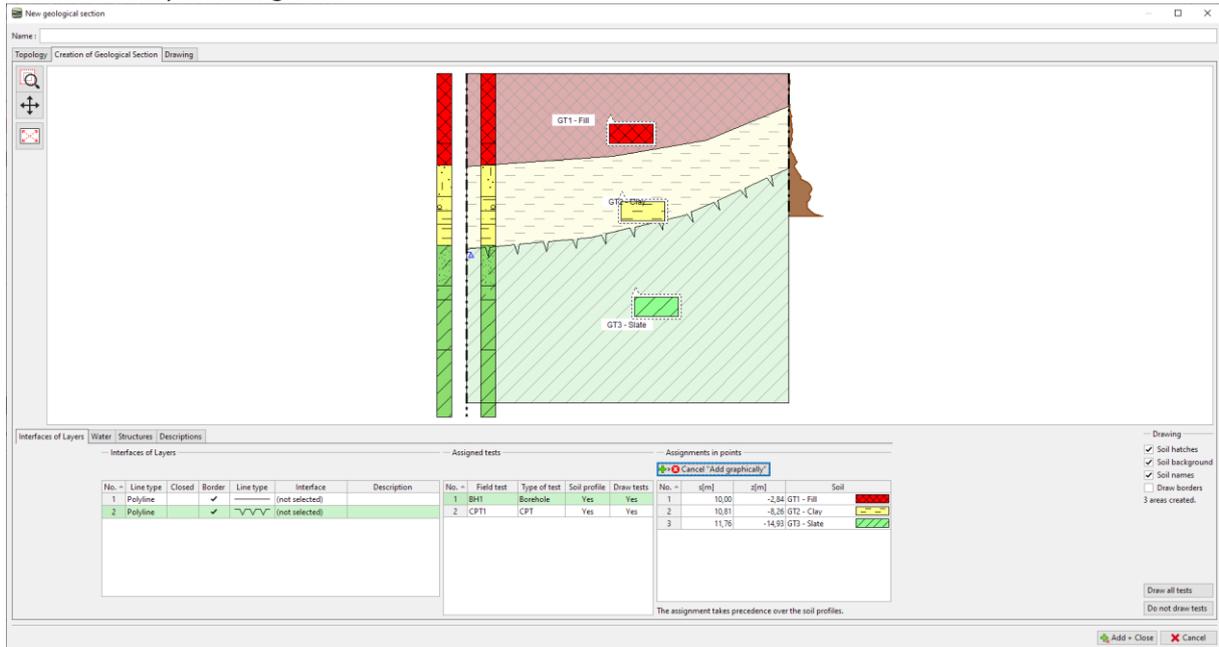
We input assignment points to the areas and assign soils, resp. geotechnical types. If the type is not created already, we can do it now.



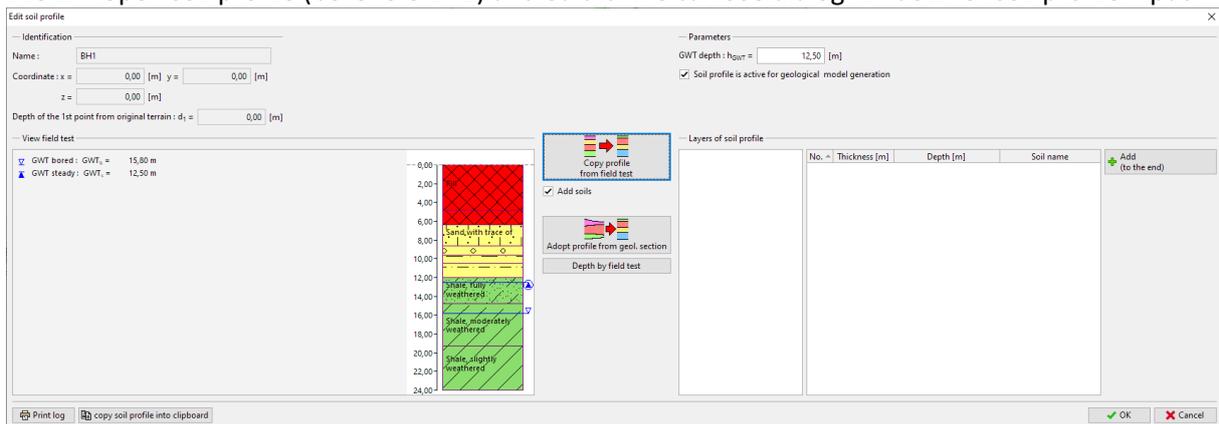
Using "Generate" button we generate area of fill.



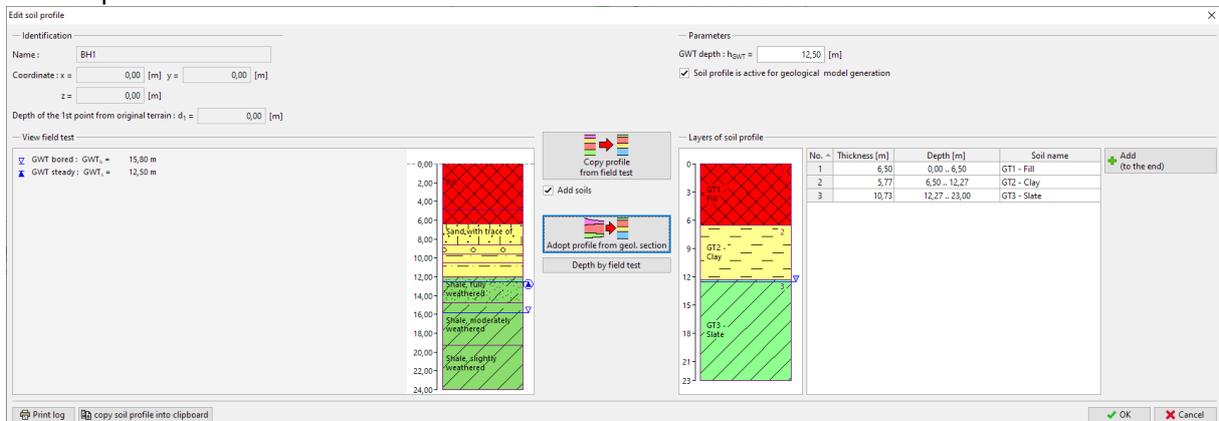
The same way we assign soils to other areas.



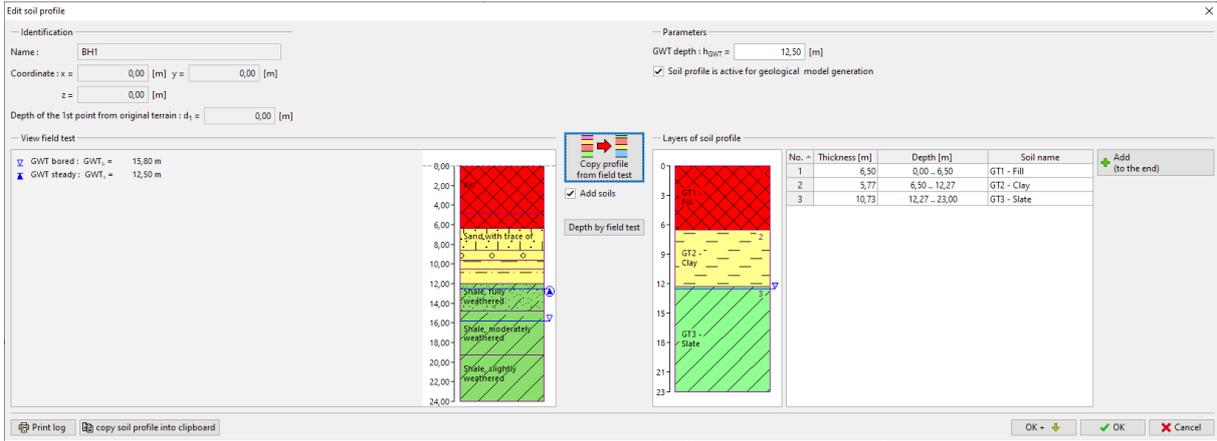
We will open soil profile (borehole BH1) and edit it. We can see dialog window for soil profile input.



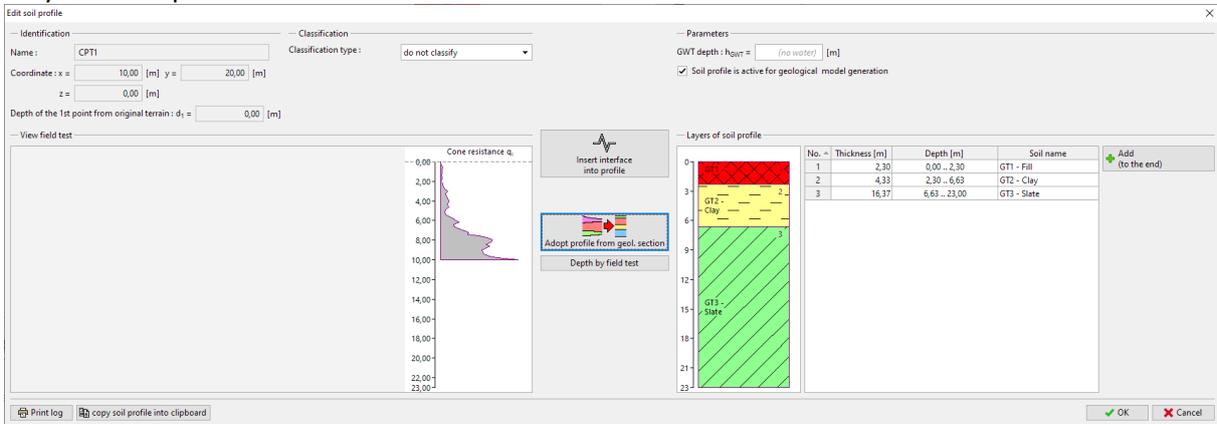
Using "Adopt profile from geol. section" button all data from geological section are transferred into the soil profile.



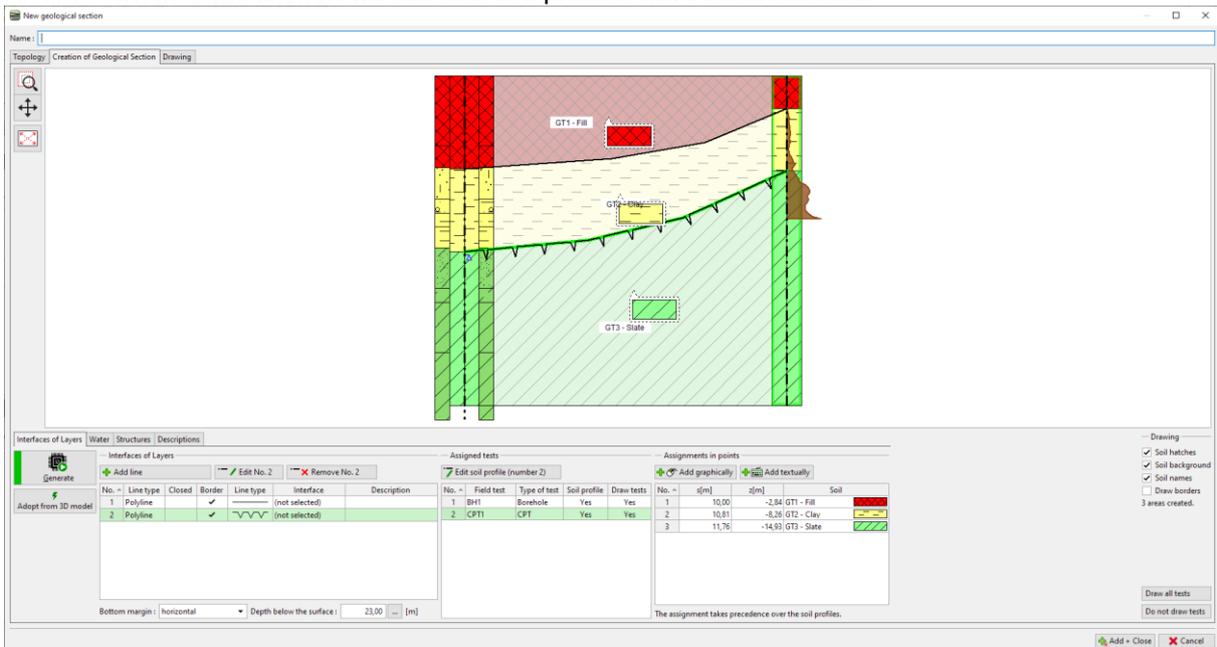
We will assign to the individual layers the corresponding geotechnical type – soil.



We will repeat the process for the CPT as well. It can be done to the depth of the model (below) or only to the depth of the field test.



After return into the section we see that soil profiles have been created.



## Working with Soil Profiles

The program, resp. the selected template contains protocols for printing the soil profiles – as a field test report and its interpretation.

Log of Boring						BH1
Project: Apartment building "Moonlighting" - Geological survey						
Location: Prilaz 12		Annex no.: A-10		Drilling equipment: Hako 262 TP		
Date start: 22.11.2017		Foreman: Mr. Young		Ground water table: 15.80 m		Borehole position: Coordinate X: 0.00
Date end: 23.11.2017		Documented: Mr. Smith		GWT bored: 15.80 m		Coordinate Y: 0.00
Scale: one page				GWT ready: 12.50 m		Coordinate Z: 0.00 m
Drilling:			Casing:			
Depth from	Depth to	Drilling dia.	Depth from	Depth to	Casing dia.	
0.00 m	20.00 m	195 mm	0.00 m	20.00 m	191 mm	
20.00 m	24.00 m	198 mm				

Stratigraphy	Field test	Sample and GWT	Remarks according to BH ISO 15845-1	From - To	Stratigraphy	Soil profile	Sample and GWT	From - To	Notes
Recent	20.86			0.00 - 4.90	Recent			0.00 - 6.50	Easy drilling
Quaternary	20.87	12.00		4.90 - 6.40	Quaternary			6.50 - 12.27	
Olduvayan		15.80		6.40 - 8.60	Olduvayan			12.27 - 23.00	
				8.60 - 9.60					
				9.60 - 9.80					
				9.80 - 10.50					
				10.50 - 12.00					
				12.00 - 14.80					
				14.80 - 15.80					
				15.80 - 19.30					
				19.30 - 21.00					
				21.00 - 23.00					

Cone penetration test (CPT)				CPT1
Project: Apartment building "Moonlighting" - Geological survey				
Location: Prilaz 12		Annex no.: 17-C		Type of test: FE2
Measured: Joe Fieldman		Coordinate system: SUTSK / Balk after adjustment		Type of cone: Acn 1000 mm <sup>2</sup>
Evaluated: Bill New		Coordinate X: 10.00		Aspirator class: 2
Date of test: 10.08.2016		Coordinate Y: 20.00		Aspirator class: EN ISO 22476-1
Scale: one page		Coordinate Z: 0.00 m		Depth of 1. point: 0.00 m
Equipment: PenSta A22		Pillar location: w		Overall depth: 10.00 m
				GWT: 5.00 m

**Field test**

**Soil profile**

Next, we can generate a 3D model of the subsoil from the created soil profiles.

The screenshot shows the GEO5 2020 - Stratigraphy software interface. The main window displays a 3D model of the subsoil, showing a vertical cross-section with different soil layers represented by different colors and textures. The layers are: a top red layer (Recent), a yellow layer (Quaternary), and a green layer (Olduvayan). The 3D model is shown in a perspective view, with a grid on the ground surface.

Below the 3D model, there is a table with the following columns: No., Name, Master, Active, Status. The table contains two rows:

No.	Name	Master	Active	Status
1	BH1		<input checked="" type="checkbox"/>	Original
2	CPT1		<input checked="" type="checkbox"/>	Original

Below the table, there is a section for "Soil above interface" with the following columns: Assigned interface, Group order, Smoothing, Creates fault. The table contains two rows:

Assigned interface	Group order	Smoothing	Creates fault
1	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

At the bottom of the interface, there is a "Geological Model" section with a "Generate" button and a "Model again" button. The "Geological Model" section also shows "Geological model is generated." and "Outputs" section with "Add picture", "Geological Model: 0", "Total: 0", "List of pictures", and "Copy view" buttons.