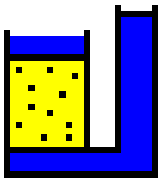
Calculation of buoyancy safety and safety against hydraulic failure

GGU-UPLIFT

VERSION 7



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1 Preface

The **GGU-UPLIFT** program allows analysis of buoyancy safety and safety against hydraulic failure. In addition, the hydraulic heave safety can be analysed using the Aulbach/Ziegler method (Aulbach, Benjamin; Ziegler, Martin: Simplified design of excavation support and shafts for safety against hydraulic heave (*Einfache Bemessung von Baugruben und Schächten im Hinblick auf die Sicherheit gegen hydraulischen Grundbruch*). In: Geomechnics and Tunnelling 6 (2013), No. 4, p. 362-374, ISSN 1865-7362).

Data input is in accordance with conventional WINDOWS operations and can therefore be learned almost entirely without the use of a manual. Graphic output supports the true-type fonts supplied with WINDOWS, so that excellent layout is guaranteed. Colour output and any graphics (e.g. files in formats BMP, JPG, PSP, TIF, etc.) are supported. PDF and DXF files can also be imported by means of the integrated **Mini-CAD** module (see the "**Mini-CAD**" manual).

The program has been thoroughly tested. No faults have been found. Nevertheless, liability for completeness and correctness of the program and the manual, and for any damage resulting from incompleteness or incorrectness, cannot be accepted.

2 Licence protection

GGU software is provided with the WIBU-Systems CodeMeter software protection system. For this purpose the GGU-Software licences are linked to a USB dongle, the WIBU-Systems CmStick, or as CmActLicense to the respective PC hardware.

It is required for licence access that the CodeMeter runtime kit (CodeMeter software protection driver) is installed. Upon start-up and during running, the **GGU-UPLIFT** program checks that a licence on a CmStick or as CmActLicense is available.

3 Language selection

GGU-UPLIFT is a bilingual program. The program always starts with the language setting applicable when it was last ended.

The language preferences can be changed at any time in the "**Info**" menu, using the menu item "**Spracheinstellung**" (for German) or "**Language preferences**" (for English).

4 Starting the program

After starting the program, you will see two menus at the top of the window:

- File
- Info

By going to the "**File**" menu, a previously analysed system can be loaded by means of the "**Load**" menu item, or a new one created using "**New**". The program allows simple input procedures by moving directly to a dialog box after "**New**" is clicked; this can also be reached by pointing to the "**File/new**" menu item (see Section 7.1.1) or "**Edit/Analysis options**" menu item. After confirming your inputs, six menus then appear at the top of the window:

- File
- Edit
- System
- Output preferences
- Graphics preferences
- Info

After clicking one of these menus, the so-called menu items roll down, allowing you access to all program functions.

The program works on the principle of ***What you see is what you get***. This means that the screen presentation represents, overall, what you will see on your printer. In the last consequence, this would mean that the screen presentation would have to be refreshed after every alteration you make. For reasons of efficiency and as this can take several seconds for complex screen contents, the **GGU-UPLIFT** screen is not refreshed after every alteration.

If you would like to refresh the screen contents, press either [**F2**] or [**Esc**]. The [**Esc**] key additionally sets the screen visualisation back to your current zoom, which has the default value 1.0, corresponding to an A4 format sheet.

5 Theoretical principles

5.1 La Place differential equation

For calculation of buoyancy safety and safety against hydraulic failure, knowledge of the potential line is necessary. For this, the program solves the La Place differential equation for one-dimensional groundwater flow.

$$k \cdot \frac{d^2 h}{dx^2} = 0$$

5.2 Buoyancy

5.2.1 Buoyancy safety using global safety factors

The buoyancy safety for each soil layer is determined via a comparison of the soil weights to the water pressures at the respective layer bases. Friction forces are not considered.

$$\eta_N = \frac{\sum_{i=1}^{N} G_i}{P_N}$$

- η_N = buoyancy safety of layer N
- G_i = self-weight of layer i
- P_N = water pressure at base of layer N
- layer 1 (i = 1) is the uppermost layer

The minimum value of all η_N is the buoyancy safety of the system.

5.2.2 Utilisation factor (buoyancy) using partial safety factors

Using the partial safety factor concept the following must be verified:

$$A_k \cdot \gamma_{g,dst} \leq \sum_{i=1}^{N} G_{k,stb}^{i} \cdot \gamma_{g,stb}$$

- A_k = the characteristic hydrostatic buoyant force acting on the lower surface of the complete structure, the soil layer in question or the excavation structure
- $\gamma_{g,dst}$ = partial factor for destabilising permanent actions in the UPL (EC 7) limit state
- $G_{k,stb}$ = lower characteristic value of stabilising permanent actions
- $\gamma_{g,stb}$ = partial factor for stabilising permanent actions in the UPL (EC 7) limit state
- layer 1 (i = 1) is the uppermost layer

The so-called utilisation factor μ can also be calculated from this relationship.

$$\mu_N = \frac{A_k \cdot \gamma_{g,dst}}{\sum_{i=1}^{N} G_{k,stb}^{i} \cdot \gamma_{g,stb}}$$

- μ_N = utilisation factor of layer N

Utilisation factors ≤ 1.0 mean that sufficient safety is given.

5.3.1 Hydraulic failure safety using global safety factors

The hydraulic heave safety for each layer below the excavation base is determined via a comparison of the soil weights to the flow forces at the respective layer bases.

$$\eta_N = \frac{\sum_{i=1}^{N} G'_i}{S_N}$$

- η_N = hydraulic failure safety of the layer N
- G'_i = buoyant self-weight of layer i
- S_N = flow force of layer N
- layer 1 (i = 1) is the uppermost layer

The minimum value of all η_N is the hydraulic failure safety of the system.

5.3.2 Utilisation factor (hydraulic failure) using partial safety factors

Using the partial safety factor concept the following must be verified:

$$S'_k \cdot \gamma_H \leq \sum_{i=1}^{N} G'^{i}_k \cdot \gamma_{g,stb}$$

- S'_k = characteristic flow force on the percolated soil mass
- γ_H = partial factor for the flow force in favourable or unfavourable subsoil in the HYD (EC 7) limit state
- G'_k = characteristic dead load of the buoyant percolated soil mass
- $\gamma_{g,stb}$ = partial factor for stabilising permanent actions in the HYD (EC 7) limit state
- layer 1 (i = 1) is the uppermost layer

The so-called utilisation factor μ can also be calculated from this relationship.

$$\mu_N = \frac{S'_k \cdot \gamma_H}{\sum_{i=1}^{N} G'^{i}_k \cdot \gamma_{g,stb}}$$

- μ_N = utilisation factor of layer N

Utilisation factors ≤ 1.0 mean that sufficient safety is given.

5.3.3 Analysis of hydraulic heave after Aulbach/Ziegler

In 2013, Aulbach performed extensive investigations and derived a relationship for homogeneous ground conditions (Aulbach, Benjamin: *Hydraulischer Grundbruch - Zur erforderlichen Einbindetiefe bei Baugruben in nichtbindigem Baugrund*, dissertation, RWTH Aachen, 2013, URN: urn:nbn:de:hbz:82-opus-46909). The hydraulic heave safety can thus be directly determined.

The relationship for the three-dimensional case is shown below (abstract from Aulbach & Ziegler (2013)[1]):

$$\frac{T}{H} = Be \cdot \left[0{,}32 \cdot A + (1{,}244 - 0{,}32 \cdot A) \cdot e^{\left(\frac{\frac{B}{H}}{U \cdot \left(0{,}541 + 0{,}395 \cdot \left(1 - e^{\left(1 - \frac{S}{H} \right)} \right) \right) \cdot \left(1 + \left(\frac{B}{L} - 0{,}3 \right) \cdot (3{,}156 - 1{,}564 \cdot U) \right)} \right)} \right] \cdot \left(\frac{\gamma'_{ref}}{\gamma_i \cdot 0{,}902 + 1{,}078} \cdot \frac{\eta_i}{\eta_{ref}} \right)^{\sqrt{2}}$$

Equation (6) in Aulbach & Ziegler (2013)[1] applies for the plane case:

$$\frac{T}{H} = 0{,}32 \cdot A + (1{,}244 - 0{,}32 \cdot A) \cdot e^{\left(\frac{\frac{B}{H}}{U \cdot \left(0{,}541 + 0{,}395 \cdot \left(1 - e^{\left(1 - \frac{S}{H} \right)} \right) \right)} \right)}$$

The result of the analysis is the necessary embedment depth.

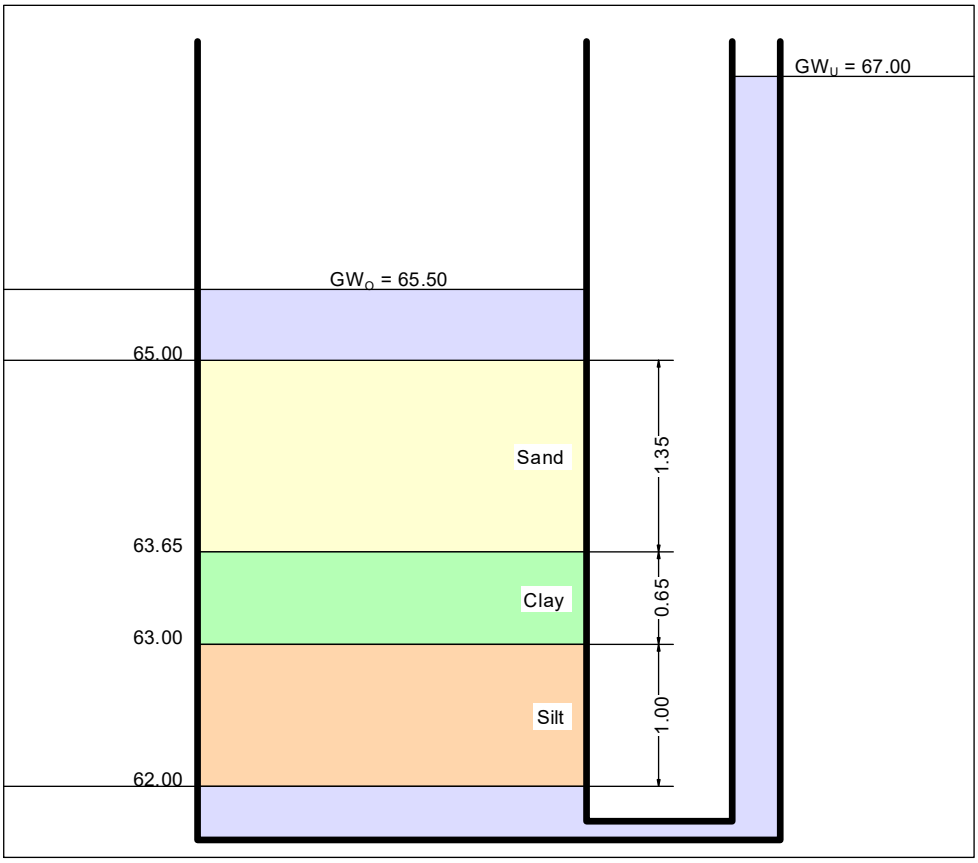
[1] Aulbach, Benjamin; Ziegler, Martin:
Simplified design of excavation support and shafts for safety against hydraulic heave = *Einfache Bemessung von Baugruben und Schächten im Hinblick auf die Sicherheit gegen hydraulischen Grundbruch.*
In: Geomechnics and Tunnelling 6 (2013), No. 4, p. 362-374, ISSN 1865-7362.

6 Worked examples

6.1 Example 1: Analysis using partial factors

6.1.1 Description of the system (Ex. 1)

The following system is to be calculated:



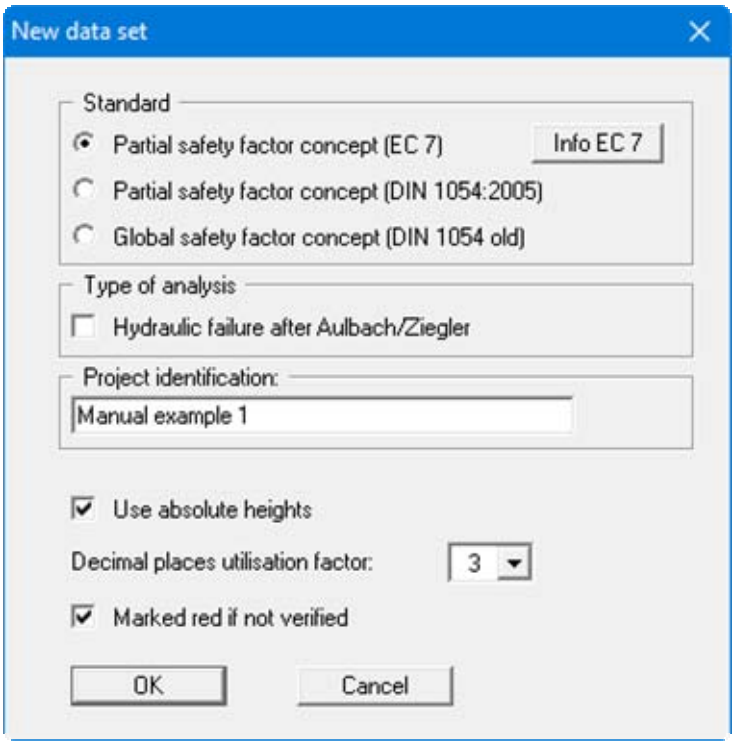
The following data are given:

- Base of excavation = 65.00 m AD
- Water level at top of system = GW_T = 65.50 m AD
- Water level at bottom of system = GW_B = 67.00 m AD

Soil	Base [m AD]	Permeability [m/s]	γ / γ' [kN/m³]
Sand	63.65	10^{-4}	19/10
Clay	63.00	10^{-8}	20/11
Silt	62.00	10^{-7}	19/10

6.1.2 Create new data set (Ex. 1)

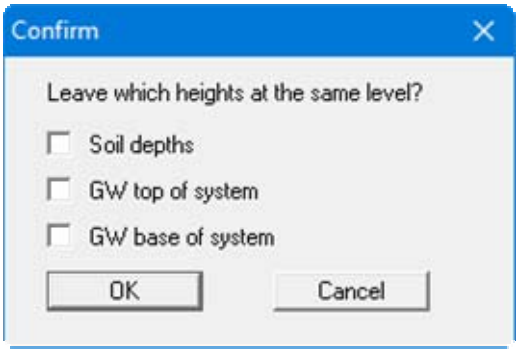
Starting the program afresh you will be directly shown the dialog box of the menu item "**File/New**". You can enter a project identification, which will then be displayed in the ***General legend*** on the screen.



If the "**Use absolute heights** check box is activated (program default), the height input of soil layers and groundwater will be in absolute coordinates (e.g. in m AD). Otherwise, "**Top of system**" corresponds to 0.0 m and all height input is positive downwards.

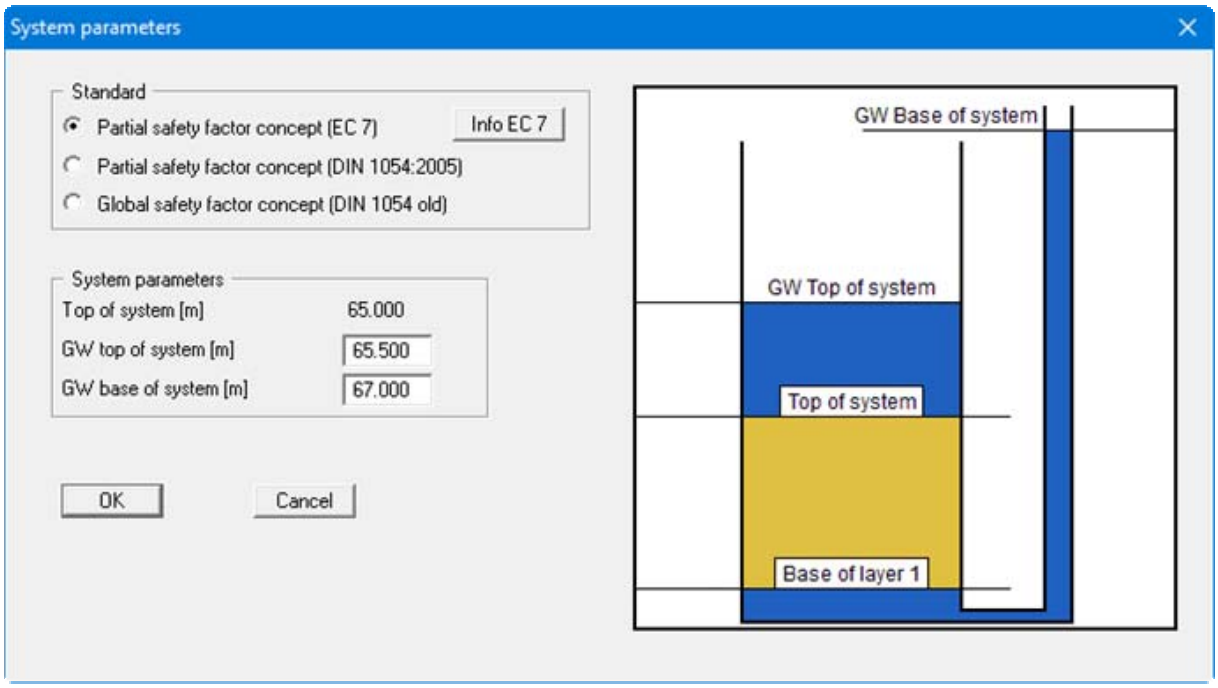
After clicking the "**OK**" button, the system is represented in section on the screen and the general and soil properties legends displayed, showing default values.

Using the "**Edit/Top of system**" menu item, you now enter the excavation base at 65.00 m AD as the top of the system. After clicking "**OK**", you will first see a query asking how the existing elevation soil strata and groundwater data should be handled. Deactivate all check boxes and exit the dialog box by pressing "**OK**".



6.1.3 System data input (Ex. 1)

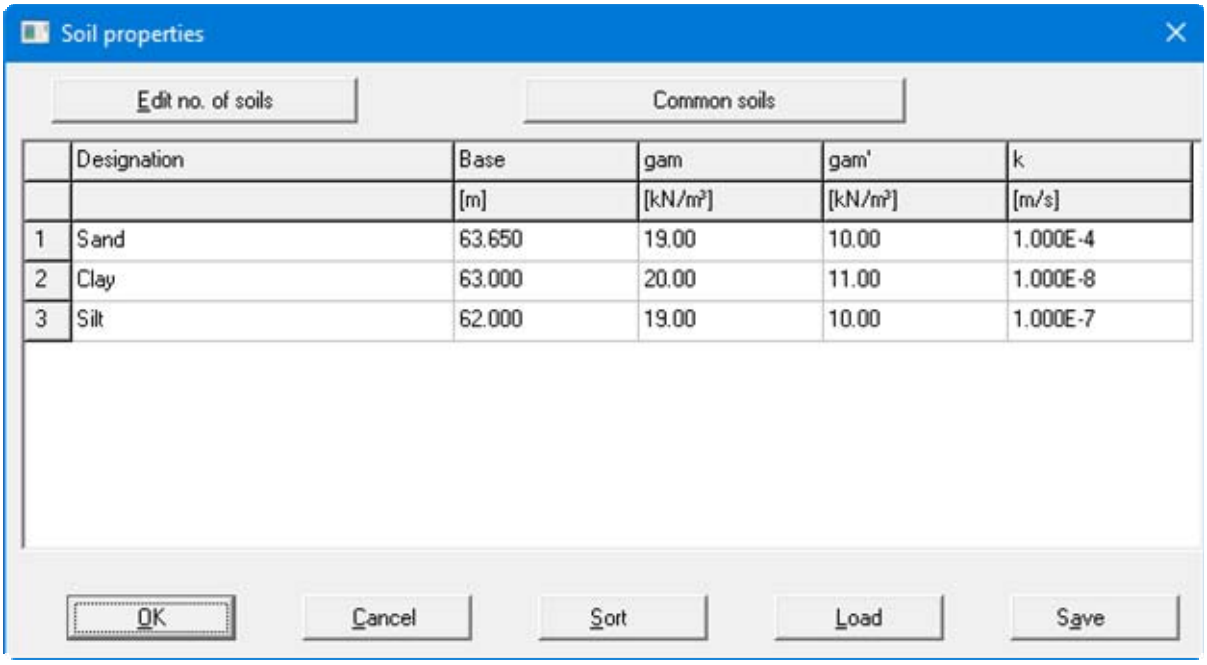
Go to the "**Edit/System parameters**" menu item and enter the data from the following dialog box:



6.1.4 Edit soils (Ex. 1)

Select the menu item "**Edit/Soils**". You will see an input dialog box, containing the program default values, namely a silt soil layer with the corresponding soil properties.

The example system has three soils. So, first, press the "**Edit no. of soils**" button and enter "**3**" as the new number of soils. Confirm with "**OK**". Then edit the values for the three soils according to the table in Section 6.1.1, "**Description of the system (Ex. 1)**".

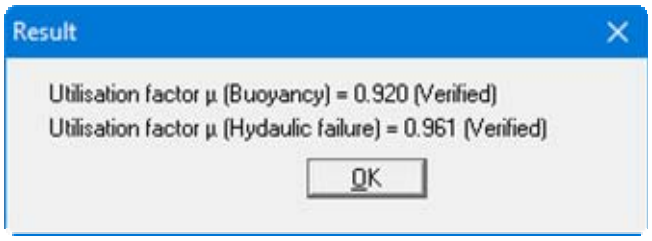


	Designation	Base	gam	gam'	k
		[m]	[kN/m³]	[kN/m³]	[m/s]
1	Sand	63.650	19.00	10.00	1.000E-4
2	Clay	63.000	20.00	11.00	1.000E-8
3	Silt	62.000	19.00	10.00	1.000E-7

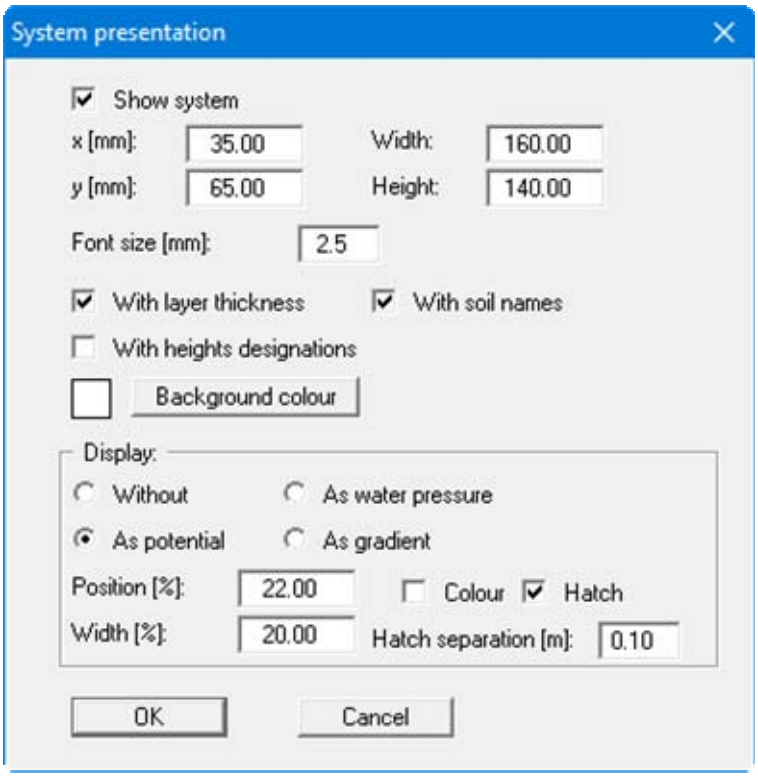
Confirm with "**OK**". The screen presentation will be refreshed accordingly.

6.1.5 Analyse system (Ex. 1)

Now select the menu item "**System/Analyse**". After a short time the calculation results appear.



The water pressure course is now additionally displayed in the system section. If you would rather see the potential course instead, select the menu item "**Output preferences/System presentation**" and activate the "**As potential**" switch in the "**Display:**" group box.



After leaving the dialog box with "**OK**" the potential course is displayed in your system section.

6.1.6 Layout of the output sheet (Ex. 1)

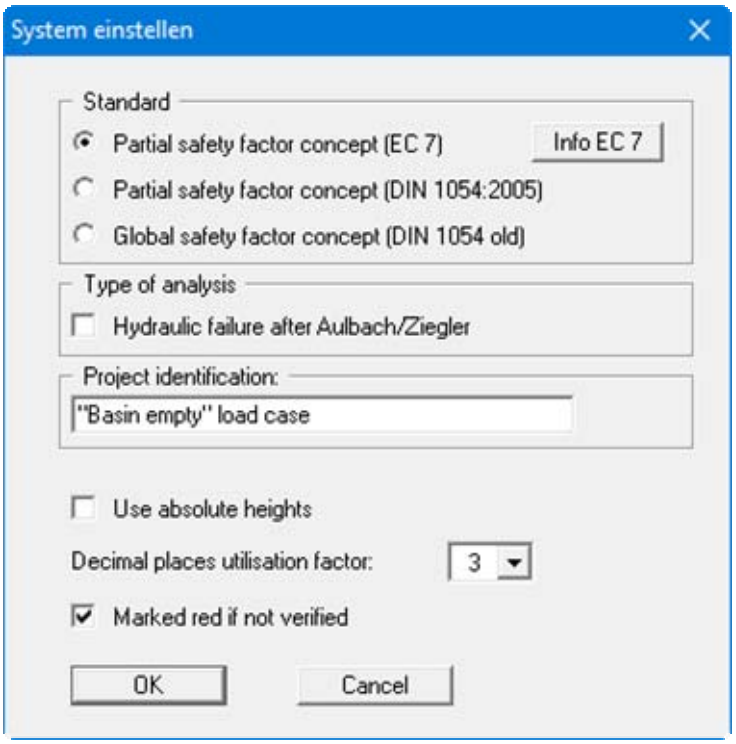
Once the system has been calculated, a further legend to the soil properties legend is displayed, containing the results for buoyancy safety, together with a legend containing the results for safety against hydraulic failure. Position and format these legends according to your wishes (menu items "**Output preferences/General legend, System presentation, etc.**") and send the results to your printer (menu item "**File/Print and export**").

Enter a company letterhead. To do this, activate the **Mini-CAD** system by pointing to "**Graphics preferences/Mini-CAD toolbar**" and load the example file "**GGU-UPLIFT-e.kpf**" using the "**Load**" icon in the **Mini-CAD** pop-up menu. If desired, save the file to your hard drive (menu item "**File/Save as**"). If you would like to have a different sheet format to A4 (default), select the menu item "**Output preferences/Page size and margins**". If you do not want the outside borders to be displayed, click the "**Graphics preferences/Margins and borders**" menu item and remove the tick in the "**With borders**" check box.

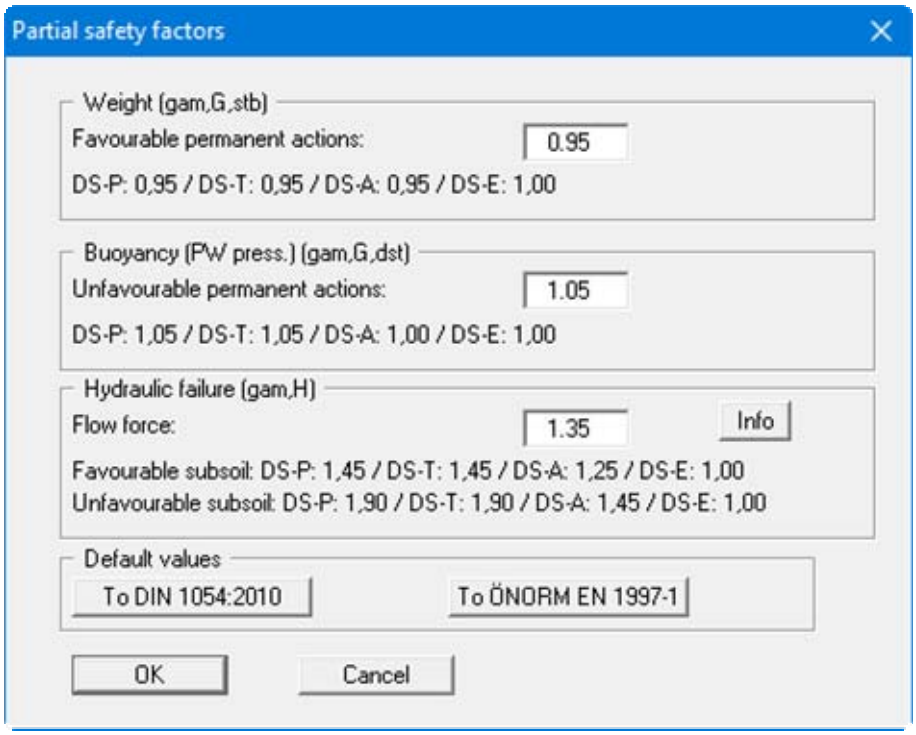
At any editing stage of your problem (including if the system has not been calculated), you can have the current screen contents sent to the printer. Select the menu item "**Print and export**" from the "**File**" menu. A dialog box appears, in which you select the "**Printer**" button. If necessary, alter the printer alignment in the dialog box from "**Portrait**" to "**Landscape**" by clicking on the appropriate button. If you are using a printer that cannot take a complete A4 page, then click on the "**Fit in**" button. This will calculate a reduction factor (zoom factor), ensuring complete page output to the printer. Otherwise, several pages will be printed. After this, select the "**OK**" button, in order to start printer output. You will then get a graphic output in submission quality.

6.2.1 Create new data set (Ex. 2)

Within the framework of a damage assessment case, you need to assess the buoyancy safety of a basin floor for the "**Basin empty**" load case. At the bottom of the basin there is a 0.8 m thick clay liner. The groundwater level below the liner is at 1.0 m below the top of the liner. Input is ***not*** to be with absolute heights. Select the "**File/New**" menu item:

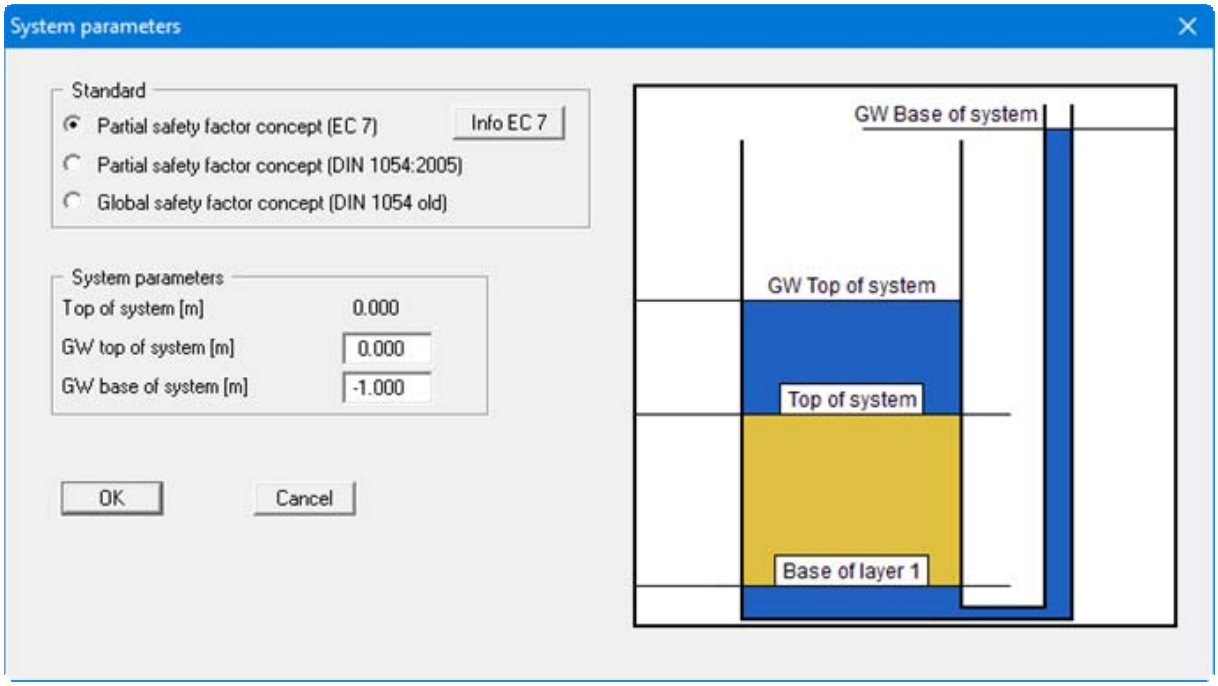


After leaving the box with "**OK**" select the "**Edit/Partial safety factors**" menu item and enter the partial safety factors given in the following dialog box:



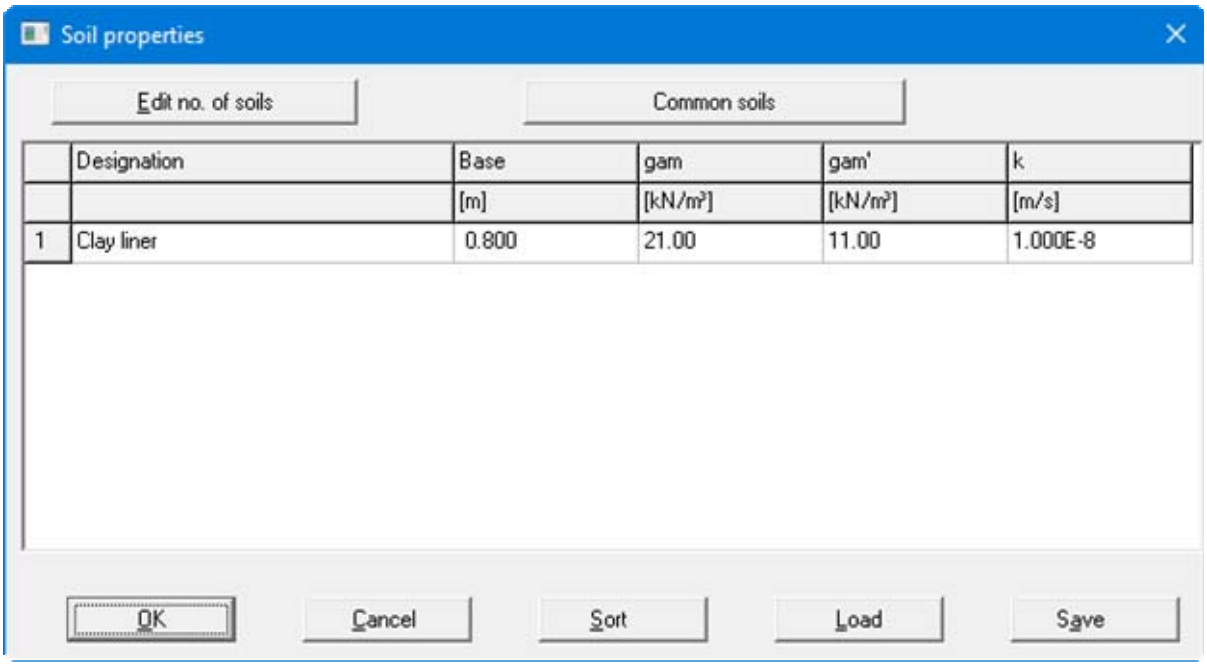
6.2.2 System data input (Ex. 2)

Select the menu item "**Edit/System parameters**" and enter the water levels:



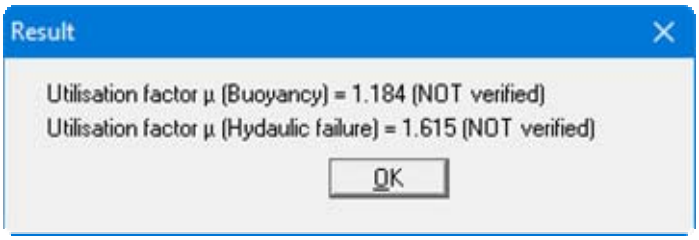
6.2.3 Edit soils (Ex. 2)

Select the menu item "**Edit/Soils**" and enter the soil properties:

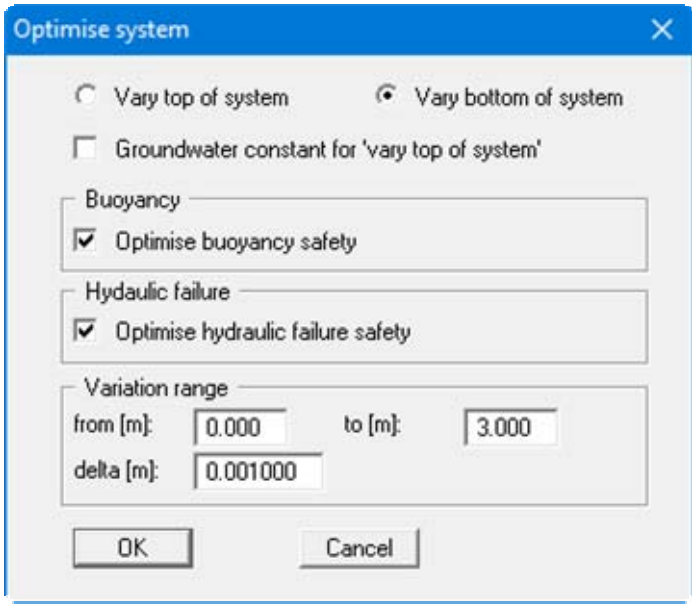


6.2.4 Analyse and optimize system (Ex. 2)

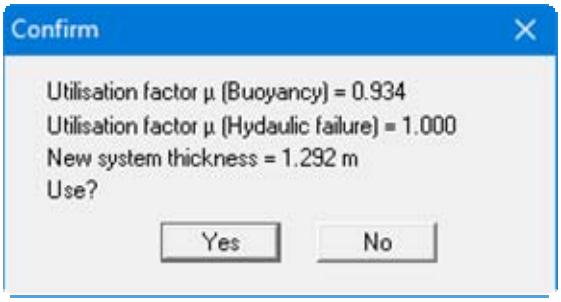
If you now point at the menu item "**System/Analyse**", you will get the following result:



The required verification was not possible with the selected system configuration. Now go to the menu item "**System/Optimise**" and enter the following variation range:



Confirm with "**OK**". You will get this result:



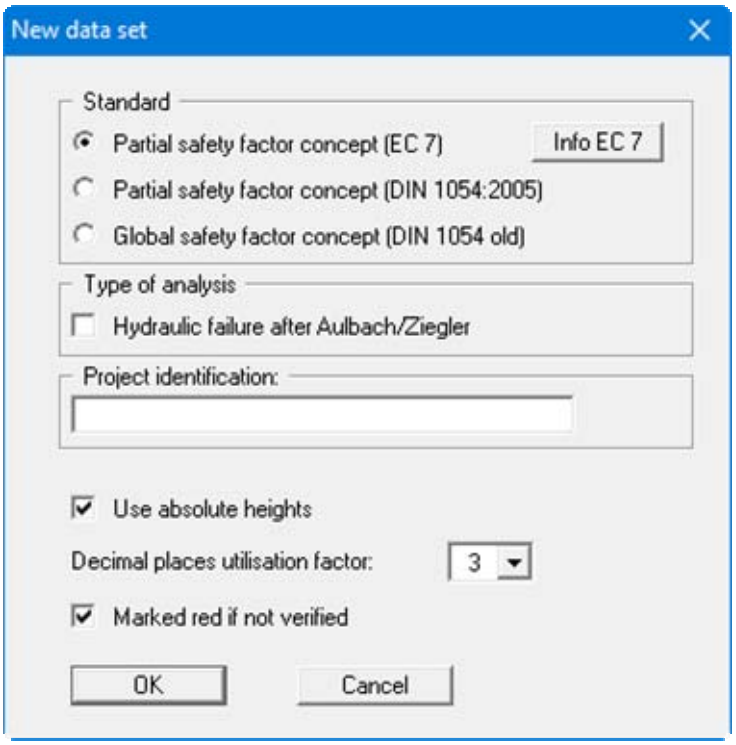
Thus, in order to achieve an optimum utilisation factor, a 1.29 m thick clay liner is required. If you answer "**Use ?**" with "**Yes**", the system thickness determined here will be used as the new base in "**Edit/Soils**". The results shown in the legends are automatically adjusted.

7 Description of menu items

7.1 File menu

7.1.1 "New" menu item

You can enter a new system using this menu item. You will see the following dialog box:



In the first group box the radio buttons are used to specify which safety concept to use for analysis. The hydraulic heave analysis after Aulbach/Ziegler can be activated below this.

If you wish, you can enter a project identification, which will then be used in the ***General legend*** (see Section 7.4.1).

Furthermore, you can specify whether analysis is to be performed using absolute heights (not possible for Aulbach/Ziegler). If you activate the "**Use absolute heights**" check box, the layer height input will be in absolute coordinates (e.g. in m AD). Otherwise, "**Top of system**" corresponds to 0.0 and all depth input is positive downwards. The absolute terrain elevations are entered in the "**Edit/Top of system**" dialog box (see Section 7.2.3).

If you have changed to one of the partial safety factor concepts, a dialog box will appear, after confirming your input, in which you can edit the partial safety factors. This dialog box can also be accessed via the menu item "**Edit/Partial safety factors**" (see Section 7.2.6). Verifications and safety factors can be modified at any time using the above mentioned menu item.

7.1.2 "Load" menu item

You can load a file with system data, which was created and saved at a previous session, and then edit the system.

7.1.3 "Save" menu item

You can save data entered or edited during program use to a file, in order to have them available at a later date, or to archive them. The data is saved without prompting with the name of the current file.

7.1.4 "Save as" menu item

You can save data entered during program use to an existing file or to a new file, i.e. using a new file name. For reasons of clarity, it makes sense to use "**.aft**" as file suffix, as this is the suffix used in the file requester box for the menu item "**File/Load**". If you choose not to enter an extension when saving, "**.aft**" will be used automatically.

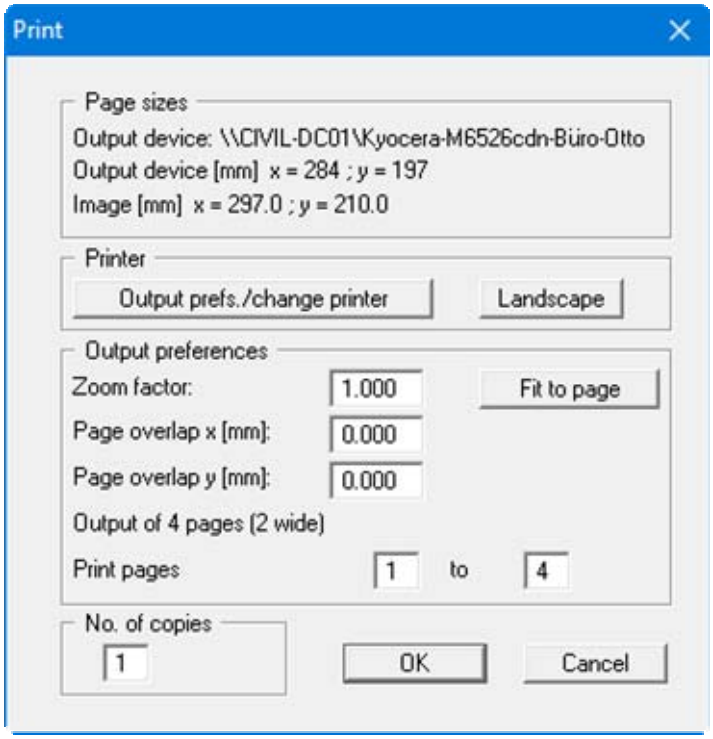
7.1.5 "Output preferences" menu item

You can edit output preferences (e.g. swap between portrait and landscape) or change the printer in accordance with WINDOWS conventions.

7.1.6 "Print and export" menu item

You can select your output format in a dialog box. You have the following possibilities:

- "**Printer**"
  allows graphic output of the current screen to the WINDOWS standard printer or to any other printer selected using the menu item "**File/Output preferences**". But you may also select a different printer in the following dialog box by pressing the "**Output prefs./change printer**" button.



  In the upper part of the dialog box, the maximum dimensions which the printer can accept are given. Below this, the dimensions of the image to be printed are given. If the image is larger than the output format of the printer, the image will be printed to several pages (in the above example, 4). In order to facilitate better re-connection of the images, the possibility of entering an overlap for each page, in x and y direction, is given. Alternatively, you also have the possibility of selecting a smaller zoom factor, ensuring output to one page ("**Fit to page**" button). Following this, you can enlarge to the original format on a copying machine, to ensure true scaling. Furthermore, you may enter the number of copies to be printed.

- "**DXF file**"
  allows output of the graphics to a XF file. DXF is a common file format for transferring graphics between a variety of applications.

- "**GGU-CAD file**"
  allows output of the graphics to a file, in order to enable further processing with the **GGU-CAD** program. Compared to output as a DXF file this has the advantage that no loss of colour quality occurs during export.

- "**Clipboard**"
  The graphics are copied to the WINDOWS clipboard. From there, they can be imported into other WINDOWS programs for further processing, e.g. into a word processor. In order to import into any other WINDOWS program you must generally use the "*Edit/Paste*" function of the respective application.

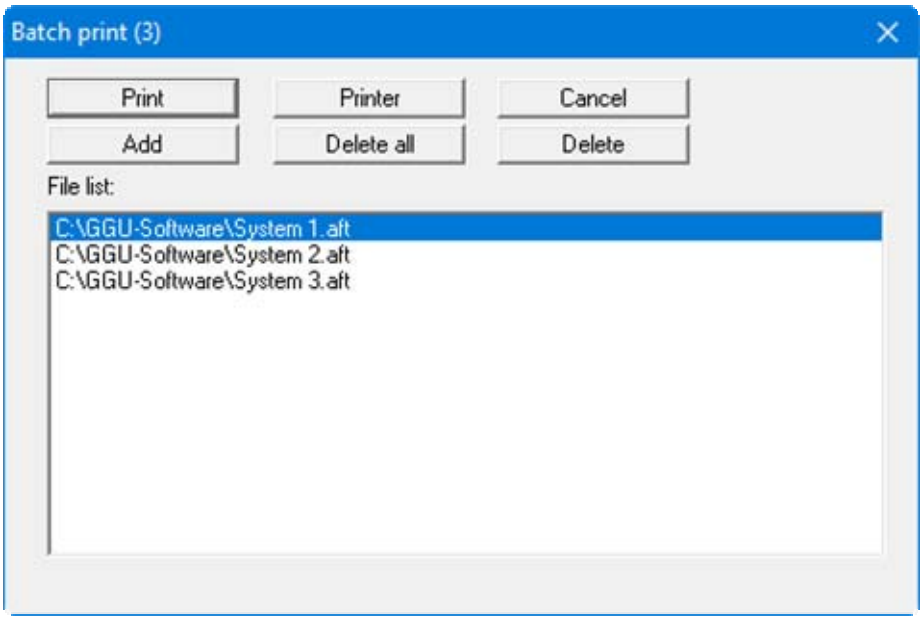
- "**Metafile**"
  allows output of the graphics to a file in order to be further processed with third party software. Output is in the standardised EMF format (Enhanced Metafile format). Use of the Metafile format guarantees the best possible quality when transferring graphics.

> If you select the "**Copy/print area**" tool from the toolbar, you can copy parts of the graphics to the clipboard or save them to an EMF file. Alternatively you can send the marked area directly to your printer (see "**Tips and tricks**", Section 8.3).
>
> Using the "**Mini-CAD**" program module you can also import EMF files generated using other GGU applications into your graphics (see Section 7.5.6).

- "**Mini-CAD**"
  allows export of the graphics to a file in order to enable importing to different GGU applications with the **Mini-CAD** module.
- "**GGUMiniCAD**"
  allows export of the graphics to a file in order to enable processing in the **GGUMiniCAD** program.
- "**Cancel**"
  Printing is cancelled.

7.1.7 "Batch print" menu item

If you would like to print several appendices at once, select this menu item. You will see the following dialog box:



Create a list of files for printing using "**Add**" and selecting the desired files. The number of files is displayed in the dialog box header. Using "**Delete**" you can mark and delete selected individual files from the list. After selecting the "**Delete all**" button, you can compile a new list. Selection of the desired printer and printer preferences is achieved by pressing the "**Printer**" button.

You then start printing by using the "**Print**" button. In the dialog box which then appears you can select further preferences for printer output such as, e.g., the number of copies. These preferences will be applied to all files in the list.

7.1.8 "Exit" menu item

After a confirmation prompt, you can quit the program.

7.1.9 "1, 2, 3, 4" menu items

The "**1, 2, 3, 4**" menu items show the last four files worked on. By selecting one of these menu items the listed file will be loaded. If you have saved files in any other folder than the program folder, you can save yourself the occasionally onerous ***rummaging*** through various sub-folders.

7.2.1 "Project identification" menu item

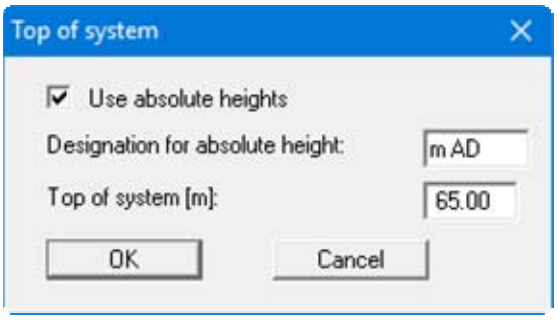
You can enter a description of the data set for this system. The project identification will then be used in the ***General legend*** (see section 7.4.1).

7.2.2 "Analysis options" menu item

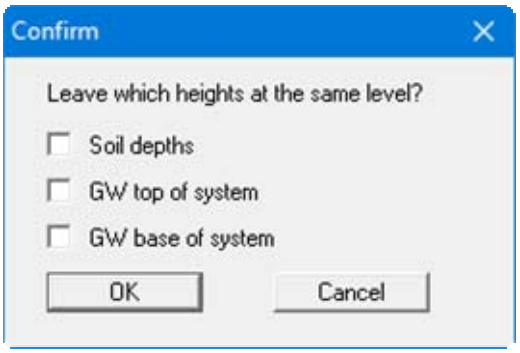
Using this menu item you can edit the default preferences of the current system, e.g. change the safety factor concept used during analysis. The dialog box corresponds to the box in the menu item "**File/New**" (see descriptions in Section 7.1.1).

7.2.3 "Top of system" menu item

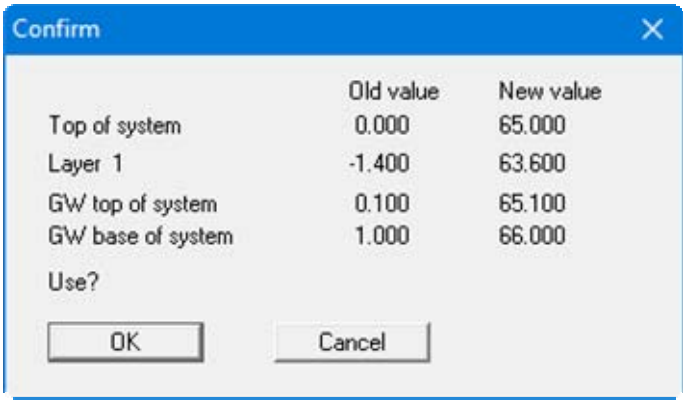
Using this menu item you can activate absolute elevations (e.g. m AD). Activate the check box and enter the new height for top of system (= excavation base). The designation for the absolute elevation, which you enter before, is shown in the soil properties legend as the depth dimension.



Once you have confirmed your input you will next be presented with a query on how to deal with the existing elevation data for soil strata and groundwater. If you leave the elevations at the same level (= check boxes activated), the originally entered data will not be modified.



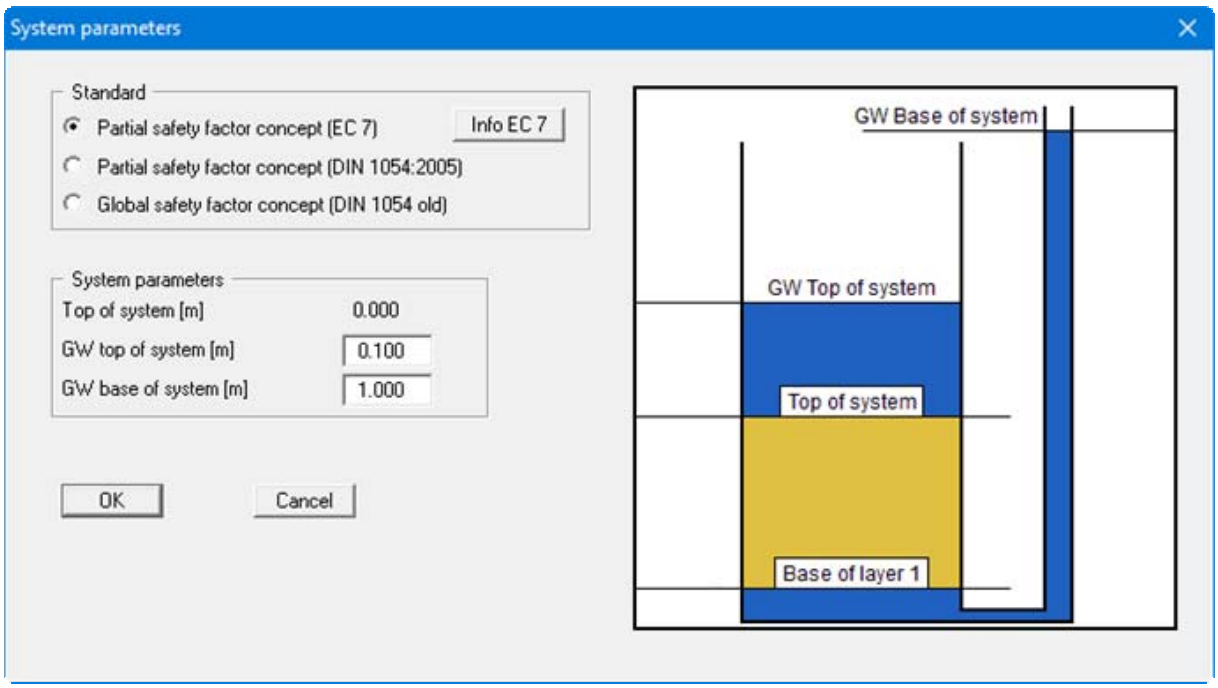
The check boxes are deactivated by default. Check the preferences and confirm your input. You will then see a message box, which compares the old and new data for you. If you used any of the previous check boxes mistakenly, you can repeat the process correctly by clicking "**Cancel**" in the message box. By exiting the dialog box using "**OK**" the new elevation data are entered into the system data.



7.2.4 "System parameters" menu item

7.2.4.1 Input for 'classical' analysis

Using this menu item you define the system geometry by entering the groundwater level at the top and bottom of the system



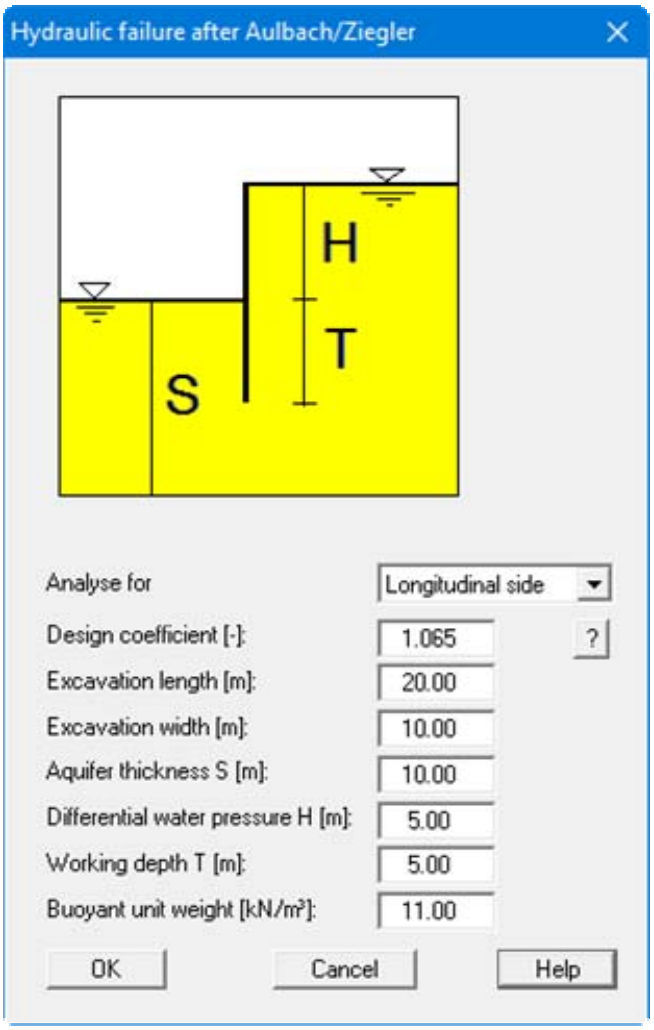
If using absolute elevations (program default setting, see Section 7.1.1), also enter the elevation of the top of the system using the "**Edit/Top of system**" menu item (see Section 7.2.3).

If the "**Use absolute heights**" check box has not been activated the top of the system always = 0.0 m and height input is positive downwards.

If you change to one of the partial safety factor concepts by activating the corresponding switch, you will see a dialog box for partial factor input; this can be opened any time using the menu item "**Edit/Partial safety factors**" (see Section 7.2.6).

7.2.4.2 Input for analysis of hydraulic heave after Aulbach/Ziegler

Aulbach/Ziegler's method can only be applied to homogeneous ground conditions. The following dialog box for entering the system data opens:



After Aulbach/Ziegler analysis of hydraulic heave can be performed for:

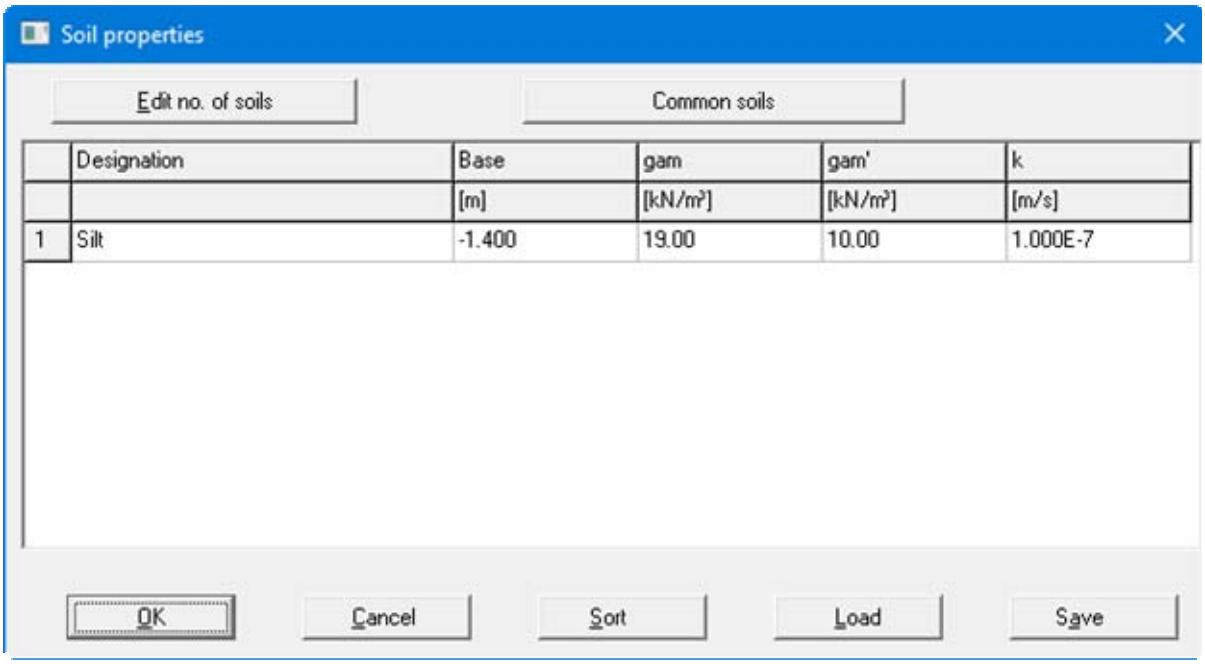
- Plane case
- Longitudinal side
- Short side or
- Corner.

Select the appropriate option from the combo box.

7.2.5 "Soils" menu item

This menu item is not visible when using the Aulbach/Ziegler method, because the method can only be applied in homogeneous ground conditions. For the 'classical' analysis, define your system's soil properties in the following dialog box:

- base of layer [m];
- unit weight of wet soil γ [kN/m³];
- buoyant unit weight of soil γ ' [kN/m³];
- permeability k [m/s].

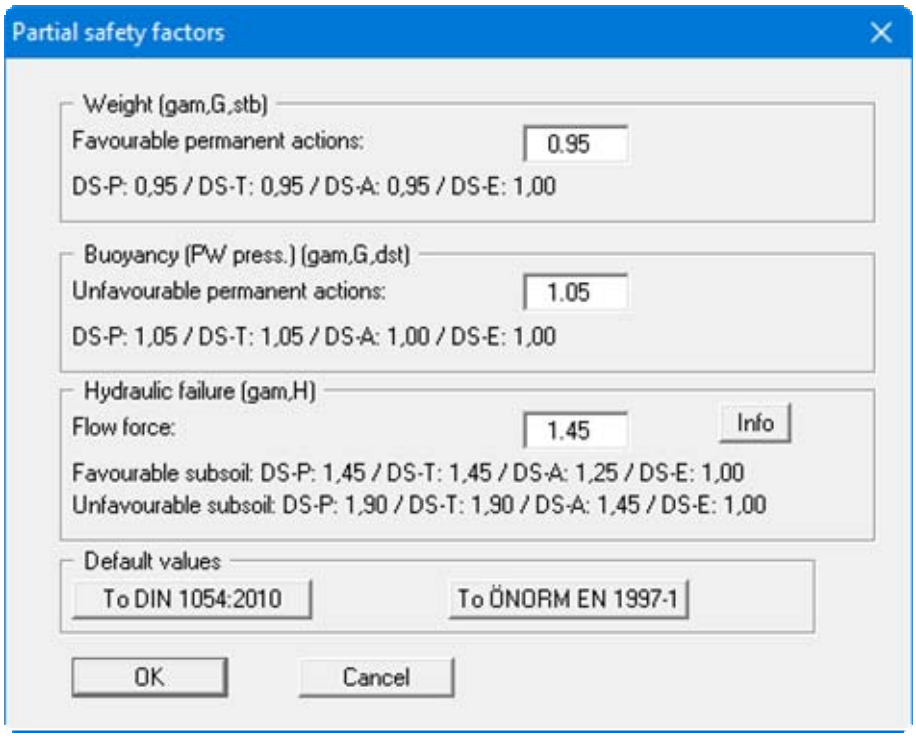


Using the "**Common soils**" button, you can easily select the soil properties of many common soils from a database or determine intermediate values. In the dialog box, which you open by pressing the "**Common soils**" button, open the "**Soils_*english*.gng_ggu**" file when first starting the program in English ("**Edit table**"/"**Load**" buttons). Then save the data set in the "**Soils.gng_ggu**" file on the program level in order to open your modified database file when the program starts. You can also enter your own data ("**Edit table**"/"**x soils to edit**" button) and save it in the "**Soils.gng_ggu**" file. You can also use your adapted file in other GGU programs by means of the "**Common soils**" function if you copy the file into the appropriate GGU program folder.

If you need to enter a ground structure with more or less layers than currently present, you can define the required number of layers using the "**Edit no. of soils**" button (see "**Example 1: Edit soils**", Section 6.1.4).

7.2.6 "Partial safety factors" menu item

If you have selected the ***partial safety factor concept***, you can edit the partial safety factors, using this dialog box:



If you press the "**Info**" button, you will see further information on the subsoil situation (favourable/unfavourable). In the "**Default values**" group box the partial factors for the various load cases and subsoil conditions given in the DIN 1054:2010 and in the EC 7 can be selected by means of the dialog box reached by clicking the "**To DIN 1054:2010**" button. The load case designations were altered for the EC 7 partial safety factor concept:

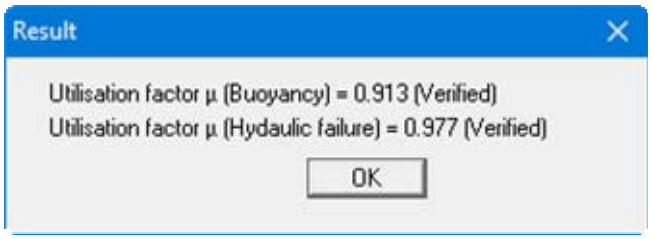
- Load Case 1 is now DS-P: Persistent Design Situation
- Load Case 2 is now DS-T: Transient Design Situation
- Load Case 3 is now DS-A: Accidental Design Situation

In addition, there is a seismic design situation (DS-E). In the DS-E design situation all partial factors = '**1,0**'.

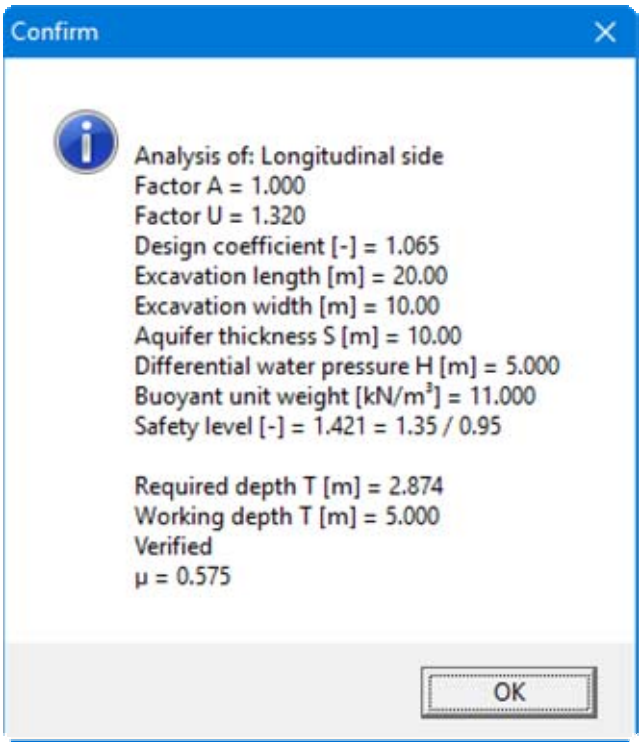
It is also possible to select the partial safety factors compliant with Austrian standards using the "**To ÖNORM EN 1997-1**" button.

7.3.1 "Analyse" menu item

With this menu item you can begin calculating the system. First, a plausibility check of the input data will be carried out. If necessary, you will see an error message, with an appropriate note on corrections. Then a dialog box with the analysis results appears, shown below for a 'classical' analysis:



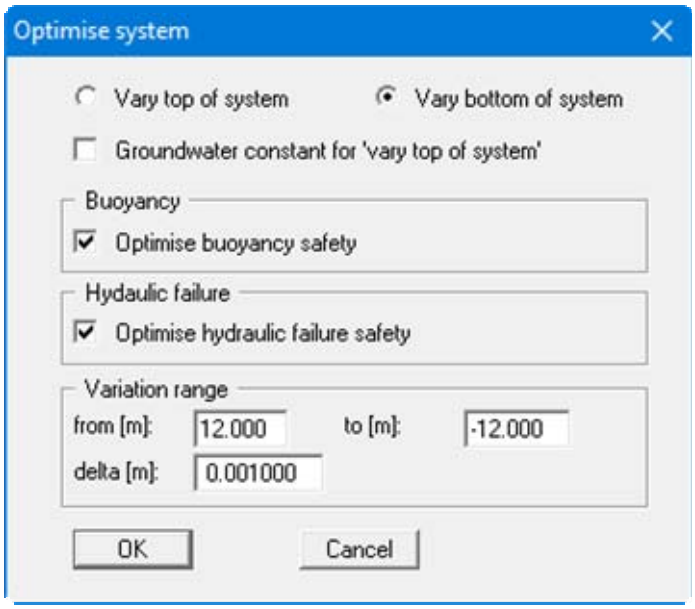
When using the Aulbach/Ziegler method you will see the following result box, for example:



The resulting utilisation factor μ is given by division of required T/working T.

7.3.2 "Optimise" menu item

Occasionally, it is desirable to determine the system dimensions which result in a certain, just sufficient, buoyancy safety or sufficient safety against hydraulic failure. This menu item can be helpful here.



In the upper part of the dialog box you specify whether the top of the system or the bottom is to be varied. If you activate the "**Vary top of system**" switch, you can additionally specify whether the groundwater level is to be kept constant during variation, or whether it is to be kept at a constant distance to the top of the system.

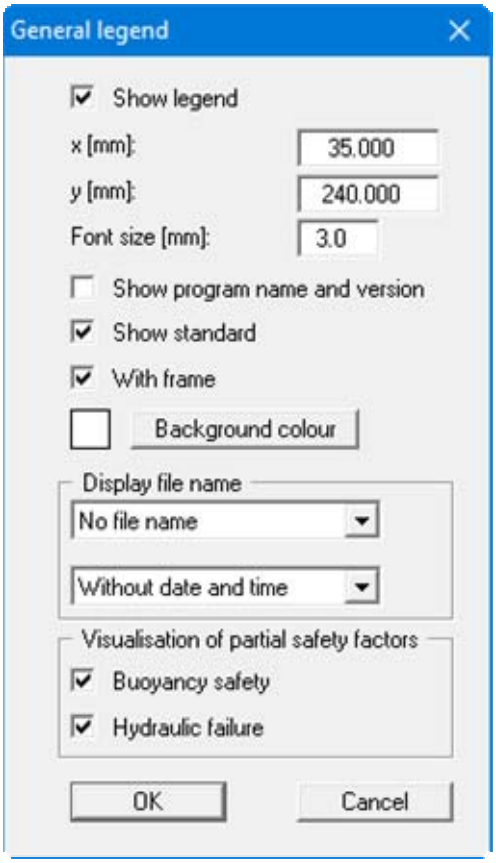
In the "**Buoyancy**" and "**Hydraulic failure**" group boxes you can define the safety to be optimised by activating the appropriate check boxes. If you have selected ***global safety factors*** as the analysis method, the safety factor input boxes are shown here. These boxes are not shown if you have selected ***partial safety factors*** as the analysis method, because in this case the editable partial safety factors ("**Edit**" menu) are used automatically.

In the "**Variation range**" group box you define the range and the increments for optimisation.

An example for system optimising can be found in Section 6.2, "**Example 2: Optimising the system**".

7.4.1 "General legend" menu item

A legend with general properties will be displayed on your output sheet. Using the dialog box of this menu item you can alter the type of visualisation, if you have activated the "**Show legend**" check box.



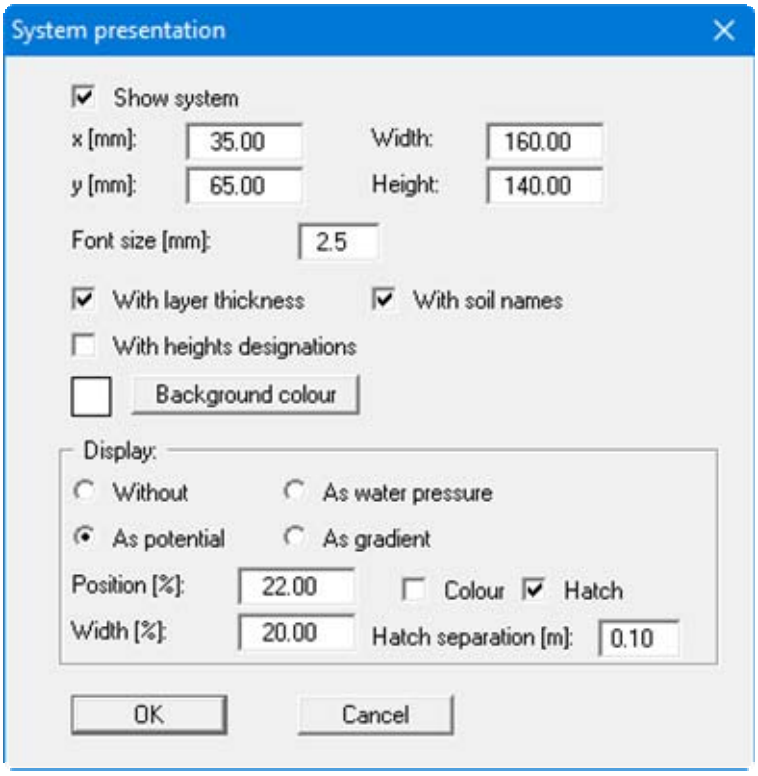
You can define and edit the position of the legend using the values "**x**" and "**y**". You control the size of the legend using "**Font size**", the frame can be switched off. The legend background can also be given a colour fill.

> The fastest way to modify the position of the legend is to press the [**F11**] function key and then to pull the legend to the new position with the left mouse button pressed.

In the ***General legend*** you can, if wished, display information on the program (name and version), on the adopted standard and on the current file (name, path, time info). Any project identification entered will also be shown in the ***General legend***. By activating the check boxes of the lower group box the used partial safety factors can be displayed additionally in the legend.

7.4.2 "System presentation" menu item

If the "**Show system**" check box is activated in the following dialog box you will see a graphics of your groundwater system and the analysis results represented within it. In the upper field you define your preferences for the system in general, and in the lower group box you can influence the appearance of your calculation results. If you have activated the Aulbach/Ziegler method, only the uppermost settings are available.

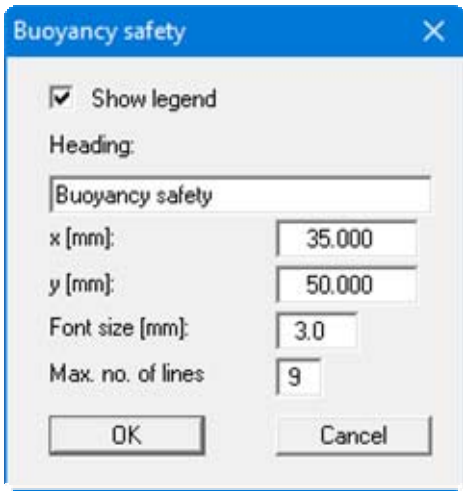


Representation uses the "**x**" and "**y**" coordinates defined, together with "**Width**" and "**Height**". You also define the "**Font size**" for labelling. The legend background can also be given a colour fill. The fastest way to modify the position of the system graphics is to press the [**F11**] function key and then to pull the legend to the new position with the left mouse button pressed.

- "**With layer thickness**"
  The layer thicknesses are represented using dimension lines.
- "**With soil names**"
  The defined soils are represented with their respective names.
- Display: "**Without**", "**As water pressure**", "**As potential**", "**As gradient**".
  The results of the groundwater analysis are presented according to the option buttons selected in the display group box.
- "**Position**", "**Width**"
  You enter the position and width of the result presentation in percentage values; this allows the results to always be presented in the same position within the system, and with the same percentage width, even if the total width of the system representation is altered.
- "**Colour**", "**Hatch**"
  The results can be presented either in colour or hatched; the colour used is that defined in menu item "**Graphics preferences/Pen colour and width**" for "**Water pressure**" (see Section 7.5.5). The hatch separation is defined in the text box below this.

7.4.3 "Buoyancy safety legend" menu item

When the system has been calculated, the buoyancy safety results can be displayed in a legend. You can alter the shape and appearance of the legend, if the "**Show legend**" check box is activated.



You can define and edit the position of the legend using the values "**x**" and "**y**". The size of the legend is controlled by the values for "**Font size**" and "**Max. no. of lines**"; where necessary, several columns are used. The legend background can also be given a colour fill.

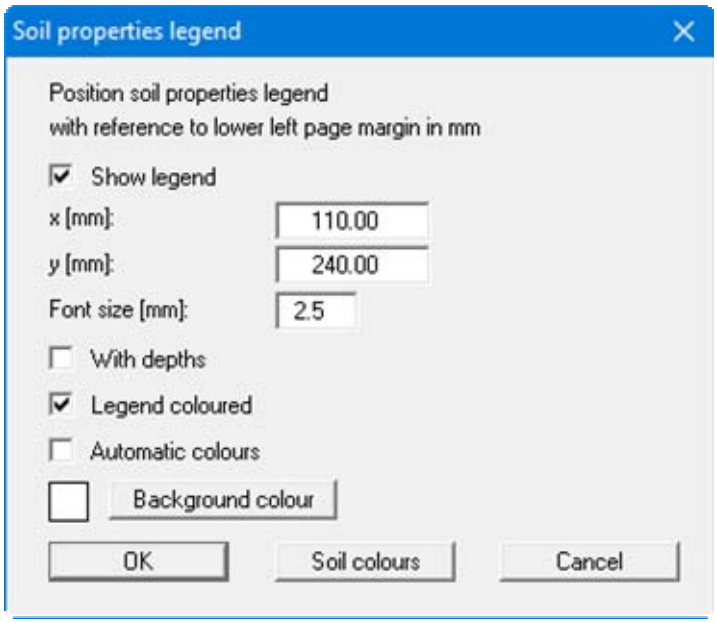
7.4.4 "Hydraulic failure safety legend" menu item

When the system has been calculated, the hydraulic failure safety results can be displayed in a legend. You can alter the shape and appearance of the legend, if the "**Show legend**" check box is activated.

You can define and edit the position of the legend using the values "**x**" and "**y**". The size of the legend is controlled by the values for "**Font size**" and "**Max. no. of lines**"; where necessary, several columns are used. The legend background can also be given a colour fill.

7.4.5 "Soil properties legend" menu item

A legend with the soil properties of the individual layers will be displayed on your output sheet. If you have activated the "**Show legend**" check box, you can alter the type of visualisation using the dialog box of this menu item.



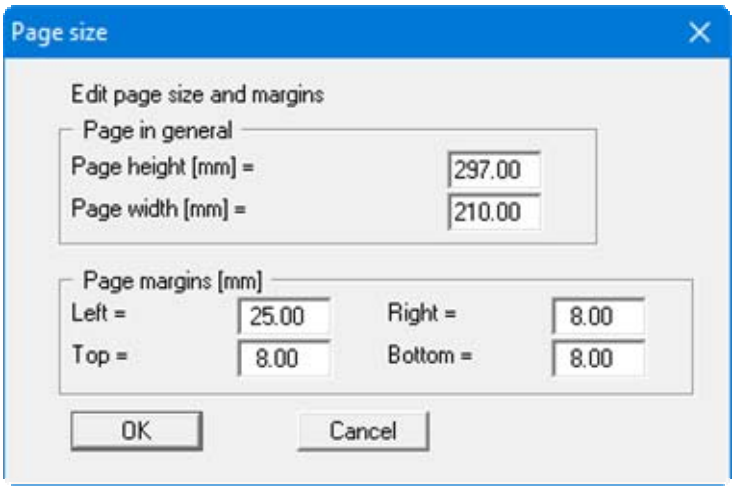
You can define and edit the position of the legend using the values "**x**" and "**y**". You control the size of the legend using "**Font size**". The legend background can also be given a colour fill.

> The fastest way to modify the position of the legend is to press the [**F11**] function key and then to pull the legend to the new position with the left mouse button pressed.

- "**With depths**"
  The depths of the individual soil layers will be shown in the soil properties legend.
- "**Legend coloured**"
  The soil colours are displayed in the legend. Otherwise, they will be numbered.
- "**Automatic colours**"
  The soils are assigned soils colours automatically by the program. If the check box is not selected, the soil colours individually defined using the "**Soil colours**" button will be adopted.
- "**Soil colours**"
  You will see a dialog box, in which you can define your preferences. After clicking the button with the desired number you can assign each soil layer a new number or reorganise using the "**Soil colours/Reorganise**" command button. You can save your colour preferences to a file with "**Soil colours/Save**" and use them for different systems by means of the "**Soil colours/Load**" command button. In the lower group box you can also transfer the colour preferences to the Windows colour management dialog box, or vice versa, as user-defined colour preferences for example. You can read a further description by pressing the "**Info**" button.

7.4.6 "Page size and margins" menu item

The default page set-up is A4 when the program is started. You can edit the page format in the following dialog box.



- "**Page in general**" defines the size of the output sheet. The A3 format is set as default. The program automatically draws thin cutting borders around the page, which are required when using a plotter on paper rolls. The borders can be switched off using the menu item "**Graphics preferences/Margins and borders**" (see Section 7.5.4).
- "**Page margins**" defines the position of a frame as a distance to the margins. This frame encloses the subsequent diagram. The margins can be switched off using the menu item "**Graphics preferences/Margins and borders**" (see Section 7.5.4).

In order to achieve 1:1 output on an A4 printer the borders must be switched off and the page height and page margins be adapted to the printable area of the printer.

7.4.7 "Move objects" menu item

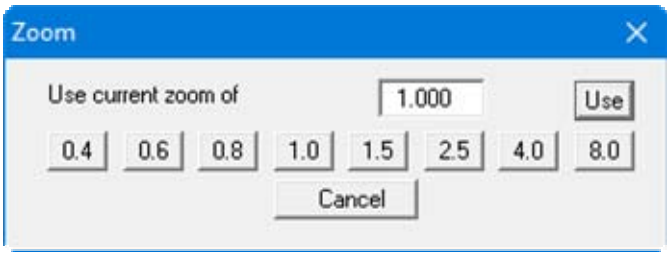
When you go to this item you can move the various objects and legends with the aid of the mouse. Move the mouse over the object to be moved. When you are located above a moveable object the mouse pointer appears in the shape of a cross. You can now press and hold the left mouse button and drag the object to the required position.

> After going to this menu item only one object at a time can be moved using the mouse. In order to move several objects, this function can be more quickly activated by pressing [**F11**] or the icon.

7.5.1 "Refresh and zoom" menu item

The program works on the principle of ***What you see is what you get***. This means that the screen presentation represents, overall, what you will see on your printer. In the last consequence, this would mean that the screen presentation would have to be refreshed after every alteration you make. For reasons of efficiency and as this can take several seconds for complex screen contents, the screen is not refreshed after every alteration.

If, e.g., after using the zoom function (see below), only part of the image is visible, you can achieve a complete view using this menu item.



A zoom factor between 0.4 and 8.0 can be entered in the input box. By then clicking on "**Use**" to exit the box the current factor is accepted. By clicking on the "**0.4**", "**0.6**", etc. buttons, the selected factor is used directly and the dialog box closed.

It is much simpler, however, to get a complete overview using [**Esc**]. Pressing [**Esc**] allows a complete screen presentation using the zoom factor specified in this menu item. The [**F2**] key allows screen refreshing without altering the coordinates and zoom factor.

7.5.2 "Zoom info" menu item

By clicking two diametrically opposed points you can enlarge a section of the screen in order to view details better. An information box provides information on activating the zoom function and on available options.

7.5.3 "Legend font selection" menu item

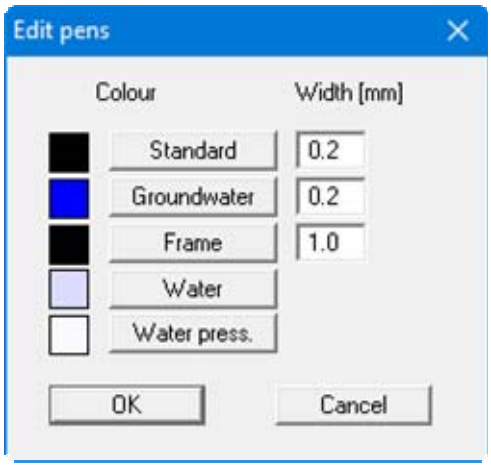
With this menu item you can switch to a different true-type font. All available true-type fonts are displayed in the dialog box.

7.5.4 "Margins and borders" menu item

The program automatically draws thin cutting edges around the page, which are required when using a plotter on paper rolls. Page margins (see menu item "**Output preferences/Page size and margins**", Section 7.4.6) defines the position of a frame as a distance to the cutting border. This frame encloses the subsequent diagram. You can switch off the lines by deactivating the "**With margins**" and "**With borders**" check boxes.

7.5.5 "Pen colour and width" menu item

In order to enhance the clarity of the graphics you can edit the pen settings for various graphic elements.



You can edit the pen widths for the elements shown in the dialog box; by clicking on the button with the element designation you can also edit the pen or fill colours.

On ***monochrome printers*** (e.g. laser printers), colours are shown in a corresponding grey scale. Graphic elements employing very light colours may be difficult to see. In such cases it makes sense to edit the colour preferences.

7.5.6 "Mini-CAD toolbar" menu item

Using this menu item you can add free text, lines, circles, polygons and images (e.g. files in formats BMP, JPG, PSP, TIF, etc.) to the main program graphics. PDF files can also be imported as images. A pop-up menu opens, the icons and functions used are described in more detail in the **Mini-CAD** manual saved in the '**C:\Program Files (x86)\GGU-Software\ Manuals**' folder during installation.

Objects created with the "**Mini-CAD**" tool are based on the page format (in mm). This makes you independent of the coordinate system and keeps you in the same position on the page. You should select the "**Mini-CAD toolbar**" if you wish to place general information on the drawing (company logo, report numbers, plan numbers, stamp etc.). Once you have saved the header information to disk (see **Mini-CAD** user manual), you can load it into completely different systems (with different system coordinates). The saved header information will appear in exactly the same position on the page, which greatly simplifies the creation of general page information

7.5.7 "Toolbar preferences" menu item

After starting the program a horizontal toolbar appears below the program menu bar. If you would rather work with a popup window with several columns, you can specify your preferences using this menu item. The smart icons can also be switched off.

At the bottom of the program window you find a status bar with further information. You can also activate or switch off the status bar here. The preferences will be saved in the "**GGU-UPLIFT.alg**" file (see menu item "**Graphics preferences/Save graphics preferences**") and will be active at the next time the program is started.

By clicking on the tools (smart icons) for the menu items you can directly reach most of the program functions. The meaning of the smart icons appears as a text box if you hover with the mouse pointer over the tools. Some of the tool functions cannot be activated from the normal menu items.

"Zoom out"
If you have previously ***zoomed in***, this tool returns to a full screen display.

"Zoom (-)" /"Zoom (+)"
With the zoom functions you can zoom in or out of parts of the image, by clicking the left mouse button.

"Copy/print area"
Use this tool to copy only parts of the graphics in order to paste them, e.g. to a report. You will see information on this function and can then mark an area, which is copied to the clipboard or can be saved in a file. Alternatively you can send the marked area directly to your printer (see "**Tips and tricks**", Section 8.3).

"Colour on/off"
If you need to remove the colour from the system presentation, to create a black and white printout, for example, use this on/off switch.

7.5.8 "Load graphics preferences" menu item

You can reload a graphics preferences file into the program, which was saved using the "**Graphics preferences/Save graphics preferences**" menu item. Only the corresponding data will be refreshed.

7.5.9 "Save graphics preferences" menu item

Some of the preferences you made with the menu items of the "**Graphics preferences**" menu can be saved to a file. If you select "**GGU-UPLIFT.alg**" as file name, and save the file on the same level as the program, the data will be automatically loaded the next time the program is started and need not be entered again.

> If you do not go to "**File/New**" upon starting the program, but open a previously saved file instead, the preferences used at the time of saving are shown. If subsequent changes in the general preferences are to be used for existing files, these preferences must be imported using the menu item "**Graphics preferences/Load graphics preferences**".

7.6.1 "Copyright" menu item

You will see a copyright message and information on the program version number.

The "**System**" button shows information on your computer configuration and the folders used by **GGU-UPLIFT**.

7.6.2 "Help" menu item

The **GGU-UPLIFT** manual is opened as a PDF document. The help function can also be accessed using the [**F1**] function key.

7.6.3 "GGU on the web" menu item

Using this menu item you can access the GGU Software website: www.ggu-software.com.

Get information on updates and modifications on a regular basis from your program module page. You can also subscribe to email notifications, which provide information on all modifications on a monthly basis.

7.6.4 "GGU support" menu item

This menu item takes to the GGU-Software Contact area at www.ggu-software.com.

7.6.5 "What's new?" menu item

You will see information on program improvements and bug fixes in comparison to older versions.

7.6.6 "Language preferences" menu item

This menu item allows you to switch the menus and the graphics from German to English and vice versa. To work in German, deactivate the two check boxes "**Dialoge + Menüs übersetzen (translate dialogues, menus)**" und "**Graphiktexte übersetzen (translate graphics)**".

Alternatively, you can work bilingually, e.g. with German dialog boxes but with graphic output in English. The program always starts with the language setting applicable when it was last ended.

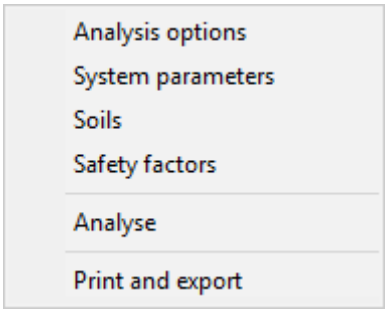
8 Tips and tricks

8.1 Keyboard and mouse

You can scroll the screen with the keyboard using the cursor keys and the [**Page up**] and [**Page down**] keys. By clicking and pulling with the mouse, with [**Ctrl**] pressed, you activate the zoom function, i.e. the selected section will fill the screen. Furthermore you can use the mouse wheel to zoom in/out or scrolling the screen presentation. The following mouse wheel functions are available:

- Mouse wheel up = move screen image up
- Mouse wheel down = move screen image down
- [**Ctrl**] + mouse wheel up = enlarge screen image (zoom in)
- [**Ctrl**] + mouse wheel down = shrink screen image (zoom out)
- [**Shift**] + mouse wheel up = move screen image right
- [**Shift**] + mouse wheel down = move screen image left

If you click the right mouse button anywhere on the screen a context menu containing the principal menu items opens.



By double-clicking the left mouse button on legends or **Mini-CAD** objects, you will immediately move to the editor for the selected object and can then edit it.

8.2 Function keys

Some of the function keys are assigned program functions. The allocations are noted after the corresponding menu items. The individual function key allocations are:

- [**Esc**] refreshes the screen contents and sets the screen back to the given format (A4). This is useful if, for example, you have used the zoom function to display parts of the screen and would like to quickly return to a complete overview.
- [**F1**] opens the manual file.
- [**F2**] refreshes the screen without altering the current magnification.
- [**F5**] opens the menu item "**System/Analyse**".
- [**F6**] opens the menu item "**System/Optimise**".
- [**F11**] activates the menu item "**Output preferences/Move objects**".

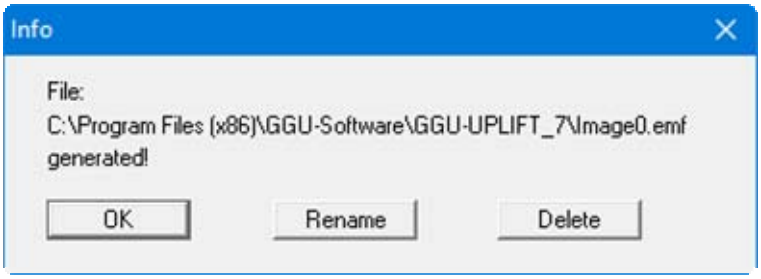
8.3 "Copy/print area" icon

A dialog box opens when the "**Copy/print area**" icon in the menu toolbar is clicked, describing the options available for this function. For example, using this icon it is possible to either copy areas of the screen graphics and paste them into the report, or send them directly to a printer.

In the dialog box, first select where the copied area should be transferred to: "**Clipboard**", "**File**" or "**Printer**". The cursor is displayed as a cross after leaving the dialog box and, keeping the left mouse button pressed, the required area may be enclosed. If the marked area does not suit your requirements, abort the subsequent boxes and restart the function by clicking the icon again.

If "**Clipboard**" was selected, move to the MS Word document (for example) after marking the area and paste the copied graphics using "*Edit/Paste*".

If "**File**" was selected, the following dialog box opens once the area has been defined:



The default location of the file is the folder from which the program is started and, if several files are created, the file is given the file name "**Image0.emf**" with sequential numbering. If the "**Rename**" button in the dialog box is clicked, a file selector box opens and the copied area can be saved under a different name in a user-defined folder. Saving can be aborted by pressing the "**Delete**" button.

If the "**Printer**" button was pressed in the first dialog box, a dialog box for defining the printer settings opens after marking the area. Following this, a dialog box for defining the image output settings opens. After confirming the settings the defined area is output to the selected printer.

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