

# GGU-GABION manual

Analysis and design of gabion walls

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## Theorie. Und Praxis.

**Geotechnische Softwarelösungen** können so einfach sein. Denn Theorie und Praxis lassen sich mit **GGU-Software** und den neuen Angeboten der **civilserve Academy** prima kombinieren: Knackige theoretische Aufgaben lösen und als Sahnehäubchen Ihr

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Praxisseminare  
vertiefen!**

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# 1 GGU-GABION: Preface

The **GGU-GABION** program allows the analysis of retaining structures manufactured using concrete elements, stacked blocks and gabions. It is also possible to easily generate and analyse a noise abatement wall using gabions.

The governing basis for these analyses is the March 2003 FGSV (*Forschungsgesellschaft für Straßen und Verkehrswesen*) Fact Sheet 555. For analysis both the global safety factors to DIN 1054 (old) and the new partial safety factors to EC 7 may be taken into consideration.

The program includes convenient data input. The system is permanently displayed on the screen. Every change to the data is displayed on the screen, so that optimum control of the input data is guaranteed.

There are "?" and "Info" buttons in the dialog boxes for many technical and program-specific questions. Click on the "?" buttons or "Info" buttons to obtain the necessary information.

The graphic output supports the true type fonts provided by WINDOWS, so that an excellent layout is guaranteed. Colour output and numerous graphic formats (BMP, TIF, JPG etc.) are supported. PDF and DXF files can also be imported via the integrated **Mini-CAD** system (see "**Mini-CAD**" manual).

The program has been extensively tested. No errors 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 GGU-GABION: Capabilities

The **GGU-GABION** program has the following special capabilities (and maximum values):

- Almost any kind of definition of gabion bodies may be defined.
- Base inclination of the gabion body
- Up to 50 soil layers
- Up to 40 berms on the active earth pressure side
- Up to 40 berms on the passive earth pressure side
- Analysis with active and increased active earth pressure and with at-rest earth pressure
- Coefficients of active earth pressure pursuant to DIN 4085
- Coefficients of passive earth pressure pursuant to DIN 4085, Streck, Caquot/Kerisel
- Additional active and passive ep calculation to Culmann is possible
- Analysis of settlements according to DIN 4019
- Verification of external stability
- Verification of inner stability to EC 2/DIN 1045-1 or DIN 4093
- Verification of sliding safety, overturning safety and maximum geogrid forces
- Convenient interface to the stability analysis application, **GGU-STABILITY**, for quick determination of safety factor against general failure
- Seismic effects via additional horizontal loads and/or altered earth pressure coefficients
- Analysis of static equilibrium in the EQU limit state
- Analysis of pull-out resistance of geogrids via  $\gamma(B)$
- Up to 50 additional earth pressure distributions
- Up to 20 area loads at any depth
- Structural analysis of the wall by means of a two-dimensional rod construction module based on finite-element methods
- Specification of up to 5 displacement boundary conditions (rotation, displacement in x or y directions) at any location
- Specification of up to 5 action boundary conditions (moment, shear force and normal force) at any location
- A variety of different earth pressure redistribution figures:
  - no redistribution
  - rectangle
  - 2 rectangles
  - triangle (maximum can be optionally placed at top, middle or bottom)

- trapezoidal
- quadrilateral with maximum at anchor locations or any other location
- user-defined polygon
- Passive earth pressure can be superimposed (global safety factor concept) or located in front of the wall.
- Following computation of the system, earth pressure, water pressure, moment, horizontal force, vertical force and the relationship  $V \cdot \mu / H$  are automatically displayed on the screen. The visualisation can be varied within wide limits.
- Display of the pressure line, the 1st and 2nd kernel width and the gravity axis
- Legends can be displayed on screen indicating soil characteristics, general computation data, data needed for settlement calculations and the main design data. Thus, virtually all the raw data necessary for the computation are shown on screen.
- **GGU-GABION's** user interface is based on **WYSIWYG** (What You See Is What You Get), which means that what you see on the screen is virtually identical with what is printed. It also means that you can print out what you see on the screen at any point during the analysis.
- The use of true-type fonts guarantees excellent layout.
- Colour presentation of virtually all system geometries. Colours can be freely determined by the user. In particular, soil strata can also be coloured according to the German DIN 4022 conventions.
- Zoom function
- By clicking the "**Copy/print area**" icon on the toolbar you can copy any part of the graphics to the clipboard or save it as an EMF file (Enhanced Metafile Format). Using the "**Mini-CAD toolbar**" or "**Header toolbar**" modules, you can paste emf files into your graphics. Thus, the results of a slope failure analysis or of a grading analysis, for example, can easily be imported into the current graphics.

### 3 GGU-GABION: Licence protection

To protect the GGU software from unauthorised access, each GGU program is equipped with the **CodeMeter software protection system** from WIBU-Systems. Each GGU program is bound to a so-called **CmContainer** via a licence with the corresponding product code.

To be able to use the GGU licences in a CmContainer, a runtime environment, the **CodeMeter Runtime Kit**, must be installed on your computer via driver software. You can obtain the current version from [Software for Users - Wibu-Systems](#) (CodeMeter User Runtime for Windows).

You can work with the following CmContainer types on your PC with the CodeMeter Runtime Kit installed (= **CodeMeter licence server**):

- **CmStick**  
The licence for your GGU program is stored in a USB dongle.
- **CmActLicense** (soft licence, not for virtual PC/servers)  
The licence for your GGU program is stored in a licence file that is linked to the hardware of a computer.
- **CmCloudContainer**  
The licence is located on a CmCloud server of WIBU-Systems and is mirrored to your CodeMeter licence server. The advantages of this type of licence binding are described on the following website: [Licence binding | GGU Software](#).

The GGU programs check at start-up and during runtime whether a corresponding license is available in a CmContainer.

## 4 GGU-GABION: Language selection

The GGU programs can be used in German and English. The program always starts with the language in which it was terminated.

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).

## 5 GGU-GABION: 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 simplifies system input by moving directly to the dialog box after clicking "**New**", which you can also open using the menu item "**File/New**". Once you have finished in this box you can generate the desired wall using the "**Common systems**".

The system will then be displayed on the screen and you will see nine menus at the top of the window:

- File
- Editor 1
- Editor 2
- Reinforced soil system
- System
- Evaluation
- Graphics preferences
- Page size + margins
- 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 screen is not refreshed after every alteration.

If you would like to refresh the screen contents, press either **[F2]** or **[Esc]**. The **[Esc]** key also resets the screen display to your current image zoom, which is usually preset to 1.0, which corresponds to an A3 or A4 sheet in most GGU programs (see menu item "**Graphics preferences/Refresh and zoom**").

## 6 Tips and tricks

### 6.1 GGU-GABION: "?"- and "Info" buttons

Reading of the manual can mostly be dispensed with, because

"?" buttons or "Info" buttons

dealing with almost all geotechnical and program-specific problems are available in the dialog boxes. You are presented with the necessary information by clicking the buttons.

### 6.2 GGU-GABION: 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:

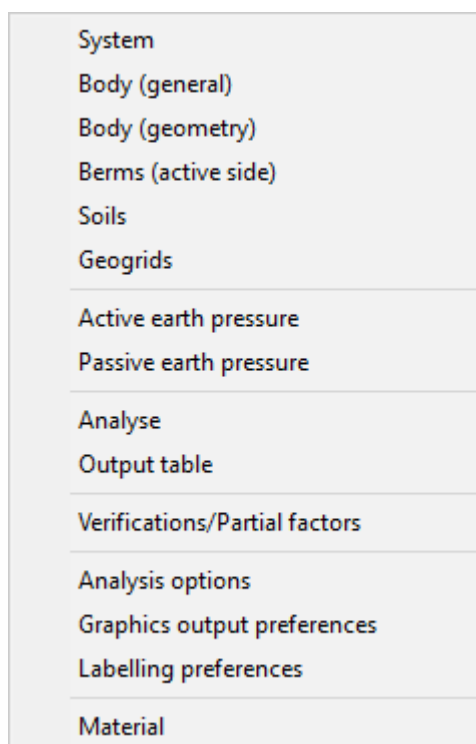
- **[Esc]** refreshes the screen content and resets the screen section to your current image zoom, which is preset to 1.0. This is useful, for example, if you have used the magnifying glass function to display sections of the drawing on the screen and want to quickly return to the overall view.
- **[F1]** opens the manual file.
- **[F2]** refreshes the screen without altering the current magnification.
- **[F11]** activates the menu item "**Move objects**", which appears in the GGU programs under various menu titles, e.g. "**Page size + margins**", "**Graphics preferences**" or "**Output preferences**".

In this GGU program, the following function keys are also assigned to program functions:

- **[F5]** opens the menu item "**System/Analyse**".
- **[F6]** opens the menu item "**Evaluation/Main output summary**".
- **[F7]** opens the menu item "**Evaluation/Bearing capacity**".
- **[F8]** opens the menu item "**Evaluation/Settlements**".
- **[F9]** opens the menu item "**Page size + margins/Auto-resize**".

### 6.3 GGU-GABION: Keyboard and mouse

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, the editor for the selected element immediately opens, allowing it to be edited.

In most dialog boxes, the buttons for leaving the box or buttons for decisive functions are marked thickly and can be reached by clicking the **[Enter]/[Return]** key.

In dialog boxes in which you have to make entries, e.g. change soil properties, the quickest way to jump to the next input box is to use the **[Tab]** key. The previous value is marked and can be overwritten directly with the new entry. You do not have to move to the box with the mouse and delete the old entry in advance.

In input boxes with numerical values, you can use the calculation operations listed in “**Tips and tricks: Mathematical functions in input boxes with numbers**” to change them.

You can scroll the screen with the keyboard using the cursor keys and the **[Page up]** and **[Page down]** keys. After activating the zoom functions, click on an area of the screen to enlarge or reduce the display by a factor of 2. Alternatively, by clicking and dragging the mouse while holding down the **[Ctrl]** key, you define a window section which is then displayed in full screen. By clicking and dragging the mouse while holding down the **[Shift]** and **[Ctrl]** keys, you zoom into your system graphic, i.e. you change the scale of your system representation.

You can also use the mouse wheel to zoom in or out or to move the screen display. When the program is started for the first time, the default setting for mouse wheel operation is activated according to Windows conventions:

- Mouse wheel up = move screen image up
- Mouse wheel down = move screen image down
- **[Shift]** + mouse wheel up = move screen image right

- **[Shift]** + mouse wheel down = move screen image left
- **[Strg]** + mouse wheel up = enlarge screen image (zoom in)

**[Strg]** + mouse wheel down = reduce screen image (zoom out)

If you want to change the system coordinates and the scale of your system using the mouse wheel, activate the "**Mouse wheel operation with global coordinates**" check box in the dialog box of the "**Graphics preferences/Zoom info**" menu item. If you close the program with this setting, the setting is still activated the next time you start it. You can now use the following mouse wheel functions to change the system:

- **[Shift]** + mouse wheel up = move system graphics up
- **[Shift]** + mouse wheel down = move system graphics down
- **[Shift]** + **[Strg]** + mouse wheel up = move system graphics right
- **[Shift]** + **[Strg]** + mouse wheel down = move system graphics left
- **[Strg]** + mouse wheel up = enlarge system graphics (change of scale)
- **[Strg]** + mouse wheel down = reduce system graphics (change of scale)

From a zoomed representation you return to the full screen with **[Esc]**. You can undo a change in scale or system coordinates with **[F9]** (= menu item "**Page size + margins/Auto-resize**").

You can view the changed system coordinates in the menu item "**Page size + margins/Manual resize (editor)**" and, if necessary, adjust them manually by entering more precise numbers.

## 6.4 GGU-GABION: Mathematical functions in input boxes with numbers

In input boxes for numerical values, you can use the following arithmetic operations (also in combinations) to determine the desired value or to adjust the existing value. After pressing the **[Return]** or **[Enter]** key, the calculated value is inserted.

| Function         | Input         |
|------------------|---------------|
| <b>Add:</b>      |               |
| 5 + 12,18        | 5 + 12,18     |
| <b>Subtract:</b> |               |
| 25,74 - 12,18    | 25,74 - 12,18 |

|                                   |                               |
|-----------------------------------|-------------------------------|
| <b>Multiply:</b>                  |                               |
| $5,23 \cdot 4,18$                 | $5,23*4,18$                   |
| $\pi \cdot 2,5^3$                 | $PI*2,5^3$                    |
| <b>Divide:</b>                    |                               |
| $5,23 / 4,18$                     | $5,23/4,18$ or $5,23:4,18$    |
| <b>Exponentiate:</b>              |                               |
| 25                                | $2^5$                         |
| <b>Radify:</b>                    |                               |
| Root of 27                        | $w(27)$ or $27^{(1/2)}$       |
| 5th root of 81,5                  | $81,5^{(1/5)}$                |
| <b>Sine, cosine, tangent etc.</b> |                               |
| $\sin(32^\circ)$                  | $\sin(32)$                    |
| $\cos(5,23^\circ)$                | $\cos(5,23)$                  |
| $\tan(45^\circ)$                  | $\tan(45)$                    |
| $\arctan(1,0)$                    | $\text{atan}(1,0) = 45^\circ$ |
| <b>Natural logarithm:</b>         |                               |
| $\ln(4,53)$                       | $\ln(4,53) = 1,5107$          |
| <b>Exponential function:</b>      |                               |
| $e^{1,5107}$                      | $\text{ep}(1,5107) = 4,53$    |

## 6.5 GGU-GABION: "Copy/print area" icon

A dialog box opens when the **"Copy/print area"** icon

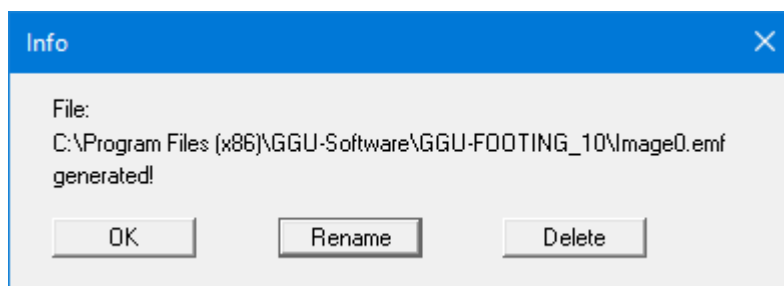


in the menu toolbar is clicked, describing the options available for this function. For example, using this icon it is possible to either copy areas of the screen graphics and paste them into the report, or send them directly to a printer.

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 appears after defining the area, shown here as an example for the **GGU-FOOTING** program:



The default location of the file is the folder from which the program is started (here: GGU-FOOTING\_10) 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.

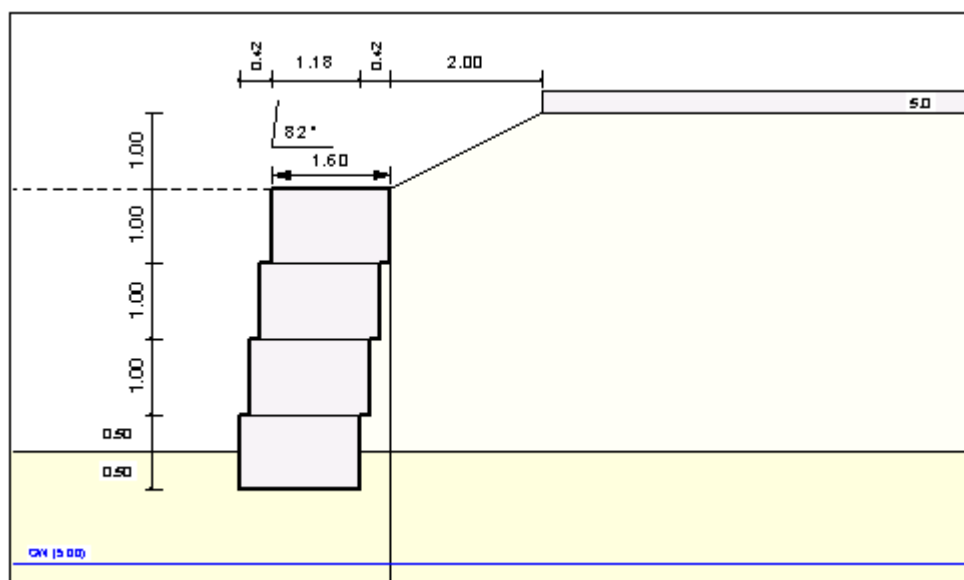
If the **"Printer"** button was pressed in the first dialog box, a dialog box for defining the printer settings opens after marking the area. Following this, a dialog box for defining the image output settings opens. After confirming the settings, the defined area is output to the selected printer.

## 7 First steps using worked examples

### 7.1 Worked example 1: Gabion wall

#### 7.1.1 GGU-GABION: System description (Ex. 1)

As, from personal experience, the reading of user-manuals is a chore, there will now follow a short description of the main program functions. After studying this section, you will be able to carry out analyses. You can take the details of the program from the following chapters.



A 3 m high terrace with a 1 m high head berm, inclined at 1 : 2 is to be supported. A vertical load of 5 kN/m<sup>2</sup> acts on the berm. The angle of repose of the gabion elements is 82°. The design groundwater level is at 1.5 m below ground level (b GL). The backfill is a gravel-sand. Below this is a medium-compact sand. 4 gabion elements with a uniform height of 1.0 m each and a uniform width of 1.6 m are used. The following material properties are present:

- **Gabions**

unit weight  $\gamma = 18 \text{ kN/m}^3$

friction coefficient in the joints  $\mu = 0.6$

design concrete compressive strength  $f_{m,d}$  (EC 2) of the elements = 0.20 MN/m<sup>2</sup>

- **Gravel-sand**

friction angle  $\varphi = 35^\circ$

cohesion  $c = 0 \text{ kN/m}^2$

wet unit weight  $\gamma = 18 \text{ kN/m}^3$

wall friction angle (active) =  $2/3 \varphi$

- **Sand**

friction angle  $\varphi = 32.5^\circ$

cohesion  $c = 0 \text{ kN/m}^2$

wet unit weight  $\gamma = 19 \text{ kN/m}^3$

buoyant unit weight  $\gamma' = 10 \text{ kN/m}^3$

wall friction angle (active)  $= 2/3 \varphi$

no passive earth pressure used

constrained modulus  $ES = 60 \text{ MN/m}^2$

## 7.1.2 GGU-GABION: Step 1 - Select analysis options (Ex. 1)

After starting the program, the logo is displayed. Select the menu item **"File/New"**. The following dialog box will appear:

**Analysis options**

Project identification:

Standard:

- ☒ Partial safety factors (EC 7) Info EC 7
- ☐ Partial safety factors (DIN 1054:2005)
- ☐ Global safety factors (DIN 1054 old)

Analysis of internal safety

- ☐ Based on DIN 4093:2012-08 ?
- ☒ Based on EC 2 ?
- ☒ EC 2 with serviceability ?

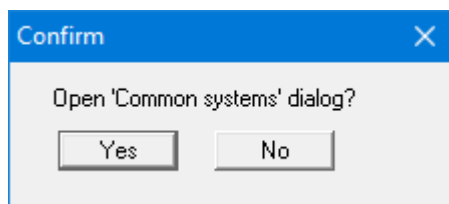
General

- ☐ Show gabion wall on right
- ☐ Do not investigate overturning
- ☐ Use absolute heights Desig.
- ☐ Differentiate active + passive soil properties  
(with reference to: phi, gamma + gamma')

Geogrids

- ☒ Geogrids via company products
- ☒ Store company products in record

For this example, use the settings shown in the dialog box above and click **"OK"**. First, another dialog box opens:

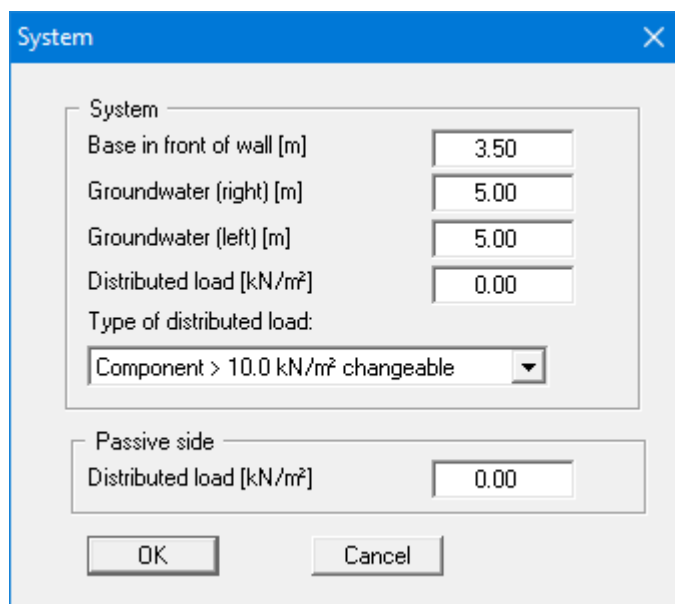


If you click "**Yes**", you can immediately generate the body's geometry (see "**Example 1: Step 4 - Define body geometry**"). However, for this example, click on "**No**" first.

A new system is then displayed on the screen and the complete menu bar is shown.

### 7.1.3 GGU-GABION: Step 2 - Define the system (Ex. 1)

Select the menu item "**System**" from the "**Editor 1**" menu. The following dialog box will appear. Enter the figures shown below:

A dialog box titled "System" with a close button (X) in the top right corner. It contains two main sections: "System" and "Passive side". The "System" section has four input fields: "Base in front of wall [m]" with value 3.50, "Groundwater (right) [m]" with value 5.00, "Groundwater (left) [m]" with value 5.00, and "Distributed load [kN/m²]" with value 0.00. Below these is a dropdown menu for "Type of distributed load:" with the selected option "Component > 10.0 kN/m² changeable". The "Passive side" section has one input field: "Distributed load [kN/m²]" with value 0.00. At the bottom are "OK" and "Cancel" buttons.

Because no absolute heights are used the top of the wall has a height of 0.0 m and all depths entered are positive downwards.

The 5 kN/m² live load for the example system is entered later using the menu item "**Editor 1/Berms (active side)**".

### 7.1.4 GGU-GABION: Step 3 - Define body loads (Ex. 1)

Select the menu item "**Body (general)**" from the "**Editor 1**" menu.

In general, gabions have no **"Vertical load"** or **"Horizontal load"** at the top of the wall. Regardless of this, values may be entered here if such loads do exist. Define the location of the vertical load from the top right edge of the gabion wall using **"x(load)"**.

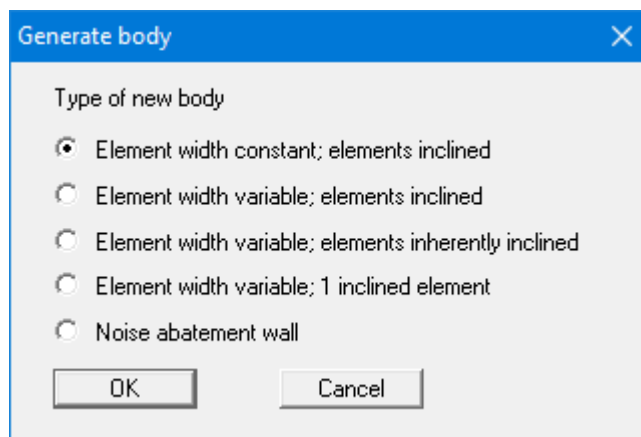
The **"Load transmission width"** is required for verification of the internal stability of the gabion wall to EC 2. If the load is not transmitted across the whole width, define the appropriate value. Otherwise, you may leave the default value of 99.0 unaltered.

The **"Footing length"** only influences the verification regarding bearing capacity and settlements. You can also define any existing **"Base inclination"** in the above dialog box. The **"Friction coefficient"** between the stacking elements (gabions) is required for verification of the internal sliding safety of the gabion wall.

## 7.1.5 GGU-GABION: Step 4 - Define body geometry (Ex. 1)

Select the menu item **"Editor 1/Body (geometry)"**. Data input for body geometry is in horizontal sections. For this, you define the depth of the horizontal section and the two corresponding x values of the gabion wall in the dialog box (see more detailed description in the menu item **"Editor 1/Body (geometry)"**).

For most practical cases input can be automatically generated using the **"Generate"** button. When the **"Generate"** button is clicked, the following dialog box opens, allowing the type of elements to be specified.



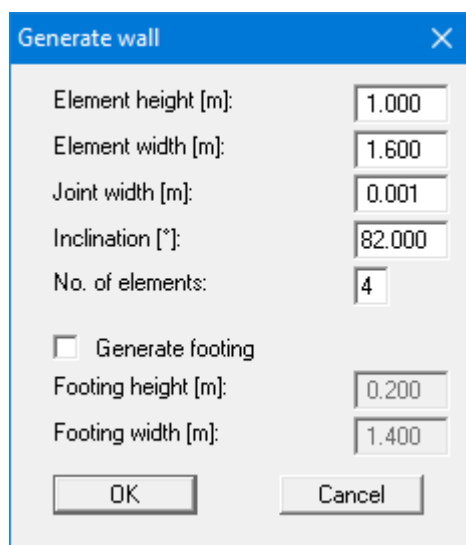
**Generate body**

Type of new body

- ☒ Element width constant; elements inclined
- ☐ Element width variable; elements inclined
- ☐ Element width variable; elements inherently inclined
- ☐ Element width variable; 1 inclined element
- ☐ Noise abatement wall

OK Cancel

For this example, confirm the default with "OK". A further dialog box opens.



**Generate wall**

Element height [m]: 1.000

Element width [m]: 1.600

Joint width [m]: 0.001

Inclination [°]: 82.000

No. of elements: 4

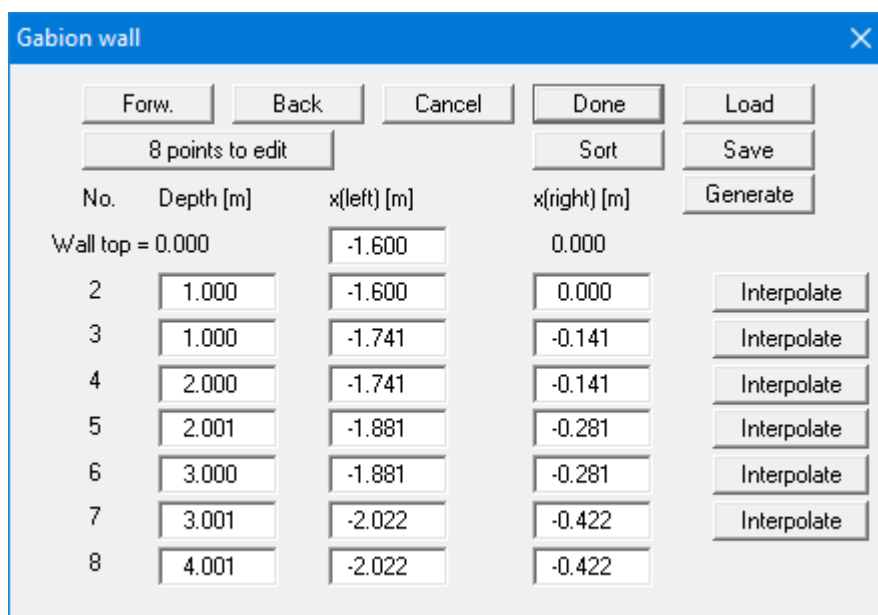
☐ Generate footing

Footing height [m]: 0.200

Footing width [m]: 1.400

OK Cancel

Once you have entered the data from the above dialog box and closed the box using "OK", the newly generated points are accepted.



**Gabion wall**

Forw. Back Cancel Done Load

8 points to edit Sort Save

Generate

| No.              | Depth [m] | x(left) [m] | x(right) [m] |             |
|------------------|-----------|-------------|--------------|-------------|
| Wall top = 0.000 |           |             |              |             |
|                  |           | -1.600      | 0.000        |             |
| 2                | 1.000     | -1.600      | 0.000        | Interpolate |
| 3                | 1.000     | -1.741      | -0.141       | Interpolate |
| 4                | 2.000     | -1.741      | -0.141       | Interpolate |
| 5                | 2.001     | -1.881      | -0.281       | Interpolate |
| 6                | 3.000     | -1.881      | -0.281       | Interpolate |
| 7                | 3.001     | -2.022      | -0.422       | Interpolate |
| 8                | 4.001     | -2.022      | -0.422       |             |

The geometry of the gabion body has now been successfully entered. After closing the box using the "Done" button you will see the generated gabion elements represented on the screen.

If the system is not displayed completely, click the [F9] function key once or the menu item "Page size + margins/Auto-resize".

## 7.1.6 GGU-GABION: Step 5 - Define material of gabion (Ex. 1)

Select the menu item "Editor 1/Material" and enter the values shown in the dialog box.

**Material**

**gamma (Gabion)**

gamma [kN/m³]: 18.00

gamma (Auftrieb) [kN/m³]: 8.00

**'2nd gamma' (Gabion)**

☐ Use '2nd gamma'

'2nd gamma' [kN/m³]: 23.00

"2. gamma (Auftrieb)" [kN/m³]: 13.00

below [m]: 9.00

**Water in gabion**

☒ 'Buoyant gamma' if groundwater in wall ?

☒ No water pressure on gabions

**Gabion**

☒ Verify internal stability

from [m]: 0.000

to [m]: 999.000

f<sub>m,d</sub> [MN/m²]: 0.200 ?

sig.Ek,SLS [MN/m²]: 1.600 ?

Young's mod. [kN/m²]: 2.5000E+4

n-value for load distribution (see DIN 1045 Table 17): 2.000

☐ Wall top kept horizontal ?

☐ No buckling analysis for displacement to earth side

OK Cancel

The program allows you adopt user-defined unit weights to be used in the analysis, if the gabion wall rests on a footing, for example. It is also possible to consider a "**Buoyant gamma**" if the gabion wall is constructed within groundwater. "**Young's mod.**" designates the Young's modulus of the gabion material. This value is required for the structural analysis of the wall.

Using existing design practice, the internal stability of a gabion wall is often incorrectly analysed. Failure cases show, however, that improvements are required in this area. The paper therefore contains the demand:

*"The internal stability of the gabion elements of the wall is to be verified numerically, or via loading tests.*

*The inner stability of an element is influenced mainly by*

- the fill material and
- the wire mesh.

*A reliable numerical determination of inner stability is barely possible, due to the complexity of interactions between the fill material and the wire mesh. If necessary, the verification concept of the DIN 1045 can be used, if an equivalent value for the design value of the concrete compressive strength of the gabion elements ( $f_{m,d}$ ) can be determined by modelling tests."*

The program allows analysis of the internal stability to EC 2/DIN 1045-1 and DIN 4093 using this concrete compressive strength. Values for "**fm,d**" (design strength of the concrete) and "**n-value for load distribution**" are required here (see detailed explanation in "**Theoretical principles: Analysis of internal stability**").

## 7.1.7 GGU-GABION: Step 6 - Define berm (Ex. 1)

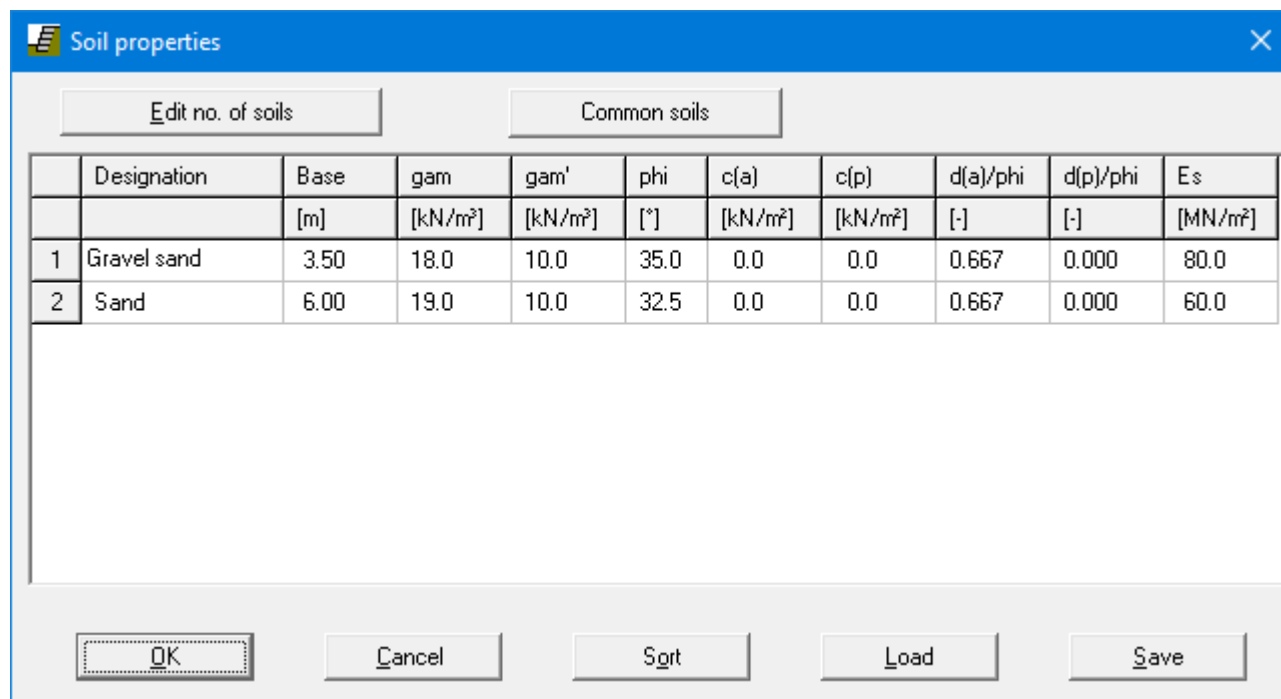
From the "**Editor 1**" menu select "**Berms (active side)**". Click "**0 berm(s) to edit**" and enter **1** as the new number of berms.

| No. | Left [m] | Right [m] | Delta h [m] | Surcharge [kN/m²] | Live load                           |
|-----|----------|-----------|-------------|-------------------|-------------------------------------|
| 1   | 0.000    | 2.000     | 1.000       | 5.00              | <input checked="" type="checkbox"/> |

Enter the values from the above dialog box and confirm by clicking "**Done**".

## 7.1.8 GGU-GABION: Step 7 - Define soils (Ex. 1)

Select the menu item **"Soils"** from the **"Editor 1"** menu. Edit the number of soils by selecting the **"Edit no. of soils"** button and then entering the number **2**.



|   | Designation | Base | gam                  | gam'                 | phi  | c(a)                 | c(p)                 | d(a)/phi | d(p)/phi | Es                   |
|---|-------------|------|----------------------|----------------------|------|----------------------|----------------------|----------|----------|----------------------|
|   |             | [m]  | [kN/m <sup>3</sup> ] | [kN/m <sup>2</sup> ] | [°]  | [kN/m <sup>2</sup> ] | [kN/m <sup>2</sup> ] | [-]      | [-]      | [MN/m <sup>2</sup> ] |
| 1 | Gravel sand | 3.50 | 18.0                 | 10.0                 | 35.0 | 0.0                  | 0.0                  | 0.667    | 0.000    | 80.0                 |
| 2 | Sand        | 6.00 | 19.0                 | 10.0                 | 32.5 | 0.0                  | 0.0                  | 0.667    | 0.000    | 60.0                 |

Enter the values given in the above dialog box. You can enter differing cohesion and angles of friction for the active (a) and the passive sides (p).

## 7.1.9 GGU-GABION: Step 8 - Define type of earth pressure (Ex. 1)

Select the menu item **"Type of earth pressure"** from the **"Editor 1"** menu.

**Type of earth pressure**

**General**

☒ Use active earth pressure  
☐ Use at-rest earth pressure  
☐ Use increased active earth pressure  
Relationship:  $(1.0 - \text{factor}) \cdot k_{ah} + \text{factor} \cdot k_0$   
Factor [-]:

**Area loads**

☒ Use active earth pressure for area loads  
☐ Use at-rest earth pressure for area loads  
☐ Use increased active earth pressure for area loads  
Relationship:  $(1.0 - \text{factor}) \cdot e(\text{active}) + \text{factor} \cdot e(\text{at-rest})$   
Factor [-]:

OK Cancel

The necessary command buttons are already selected, so you need not change anything. The same applies to the remaining menu items in "**Editor 1**". However, you should click these items and look at them, in order to familiarise yourself with them.

This completes data input.

## 7.1.10 GGU-GABION: Step 9 - Analyse system (Ex. 1)

Now select the "**Analyse**" menu item from the "**System**" menu.

**Calculate wall**

Type of toe pivot:

Special preferences: ☐ 2nd order theory

Type of ep redistribution:

- ☒ Do not redistribute
- ☐ Redistribute after EAB
- ☐ Rectangular
- ☐ Birectangular
- ☐ Triangular
- ☐ Trapezoidal
- ☐ Quadrilateral
- ☐ User-defined

☒ Show warnings during analysis

OK Cancel

After clicking the "OK" button the analysis begins. The program first performs an intensive plausibility check of the data input. Once the analysis is complete the system is displayed on the screen, together with the results. Besides the action effects the following are shown:

- Pressure line:  
Location of the resultant in each section
- 1st kernel width:  
If the pressure line is within the 1st kernel width the plan area is completely under pressure => compressive loading only.
- 2nd kernel width:  
If the pressure line is outside of the 1st kernel width but inside of the 2nd kernel width, a foundation gap occurs to a maximum of the position of the centroid.
- 'n-region':  
This designates the governing design area to EC 2/DIN 1045-1, which results from the n-value and the load transmission width.

## 7.1.11 GGU-GABION: Step 10 - Evaluate and visualise the results (Ex. 1)

Amongst other things, four legends are displayed on the screen, containing the soil properties, the most important analysis data, analysis results and the results of the settlement analysis.

If you don't like the legend positions, they can be easily altered. Go to the "**Move objects**" menu item in the "**Graphics preferences**" menu and follow the instructions there. The size of the legends can be altered by changing the font sizes in the individual dialog boxes (see "**Graphics preferences**" menu).

Besides the system, the earth pressures, action effects, etc. are displayed for the whole height of the wall. These entries can also be edited. Go to the "**Graphics output preferences**" menu item in the "**System**" menu. Further evaluations can be displayed by going to the "**Evaluation**" menu.

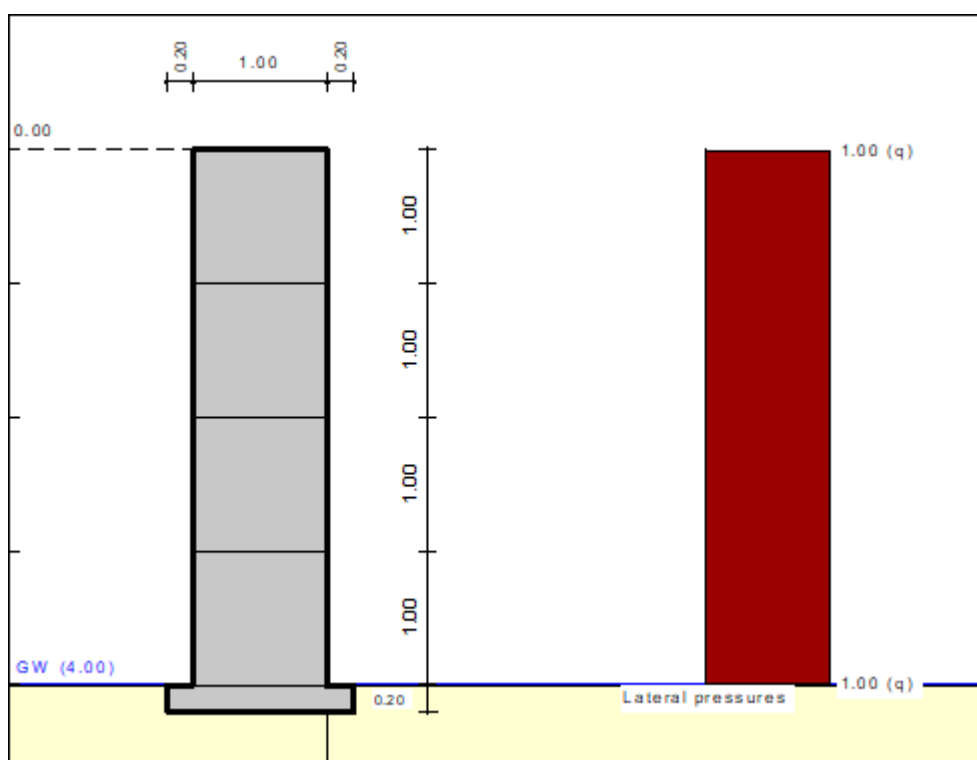
The diagram can be printed on the selected printer ("**File/Print and export**" menu item). You can also print off a detailed protocol ("**File/Print output table**" menu item). The zoom function (see "**Graphics preferences/Zoom info**" menu item) allows you to magnify selected areas of the graphic. Double-clicking in the graphics at a particular point will cause a box to appear containing the corresponding state variables.

To further clarify the analysis results the graphics can be supplemented with text and graphic elements using the "**Mini-CAD**" module. You can save your work to a file. Go to the "**Save as**" menu item in the "**File**" menu.

## 7.2 Worked example 2: Noise abatement wall

### 7.2.1 GGU-GABION: System description (Ex. 2)

A noise abatement wall with an overall height of 4 metres on level ground will be analysed. Four gabion elements with a uniform height and width of 1.0 m x 1.0 m are used. The noise abatement wall is built on a 1.4 m wide footing, embedded 0.2 m in medium dense sand. The design groundwater table is at ground level. A wind load of 1.0 kN/m<sup>2</sup> is adopted.



The following material properties are present:

- **Gabions**

unit weight  $\gamma = 16 \text{ kN/m}^3$

friction coefficient in the joints  $\mu = 0.75$

design concrete compressive strength  $f_{m,d}$  (EC 2) of the elements = 0.20 MN/m<sup>2</sup>

- **Sand**

friction angle  $\varphi = 32.5^\circ$

cohesion  $c = 0 \text{ kN/m}^2$

wet unit weight  $\gamma = 19 \text{ kN/m}^3$

buoyant unit weight  $\gamma' = 10 \text{ kN/m}^3$

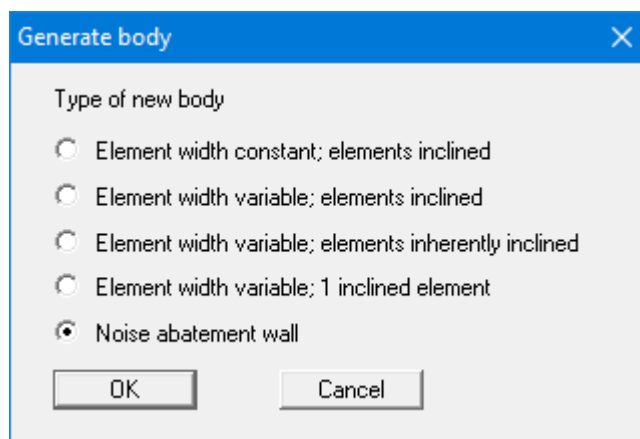
no passive earth pressure used

Due to the wind loads the active wall friction angle must be set to zero to analyse noise abatement walls. Otherwise, the wind load would generate a favourably acting active earth pressure at the rear face of the wall.

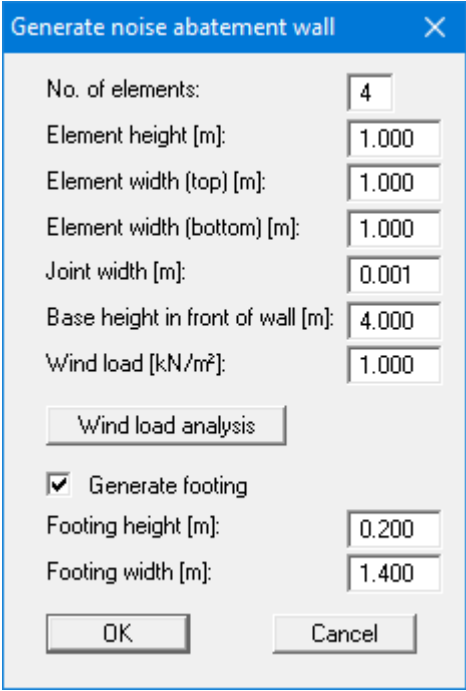
## 7.2.2 GGU-GABION: Step 1 - Select analysis options and generate noise abatement wall (Ex. 2)

After starting the program, you will see the **GGU-GABION** start-up screen. Select the "**File/New**" menu item and accept all presettings. If you prefer, you can enter a project identification, e.g. "**Example 2**".

After leaving the dialog box, you will again be queried on "**Common systems**". For this example, click the "**Yes**" button. Alternatively, you can go to the "**Editor 1/Body (geometry)**" menu item and click on the "**Generate**" button there. In both cases the following dialog box opens, in which you select "**Noise abatement wall**" as the type of new body.



After confirming by pressing "**OK**" you will see another dialog box, in which you use the following settings to automatically generate the noise abatement wall.



| Generate noise abatement wall                        |       |
|------------------------------------------------------|-------|
| No. of elements:                                     | 4     |
| Element height [m]:                                  | 1.000 |
| Element width (top) [m]:                             | 1.000 |
| Element width (bottom) [m]:                          | 1.000 |
| Joint width [m]:                                     | 0.001 |
| Base height in front of wall [m]:                    | 4.000 |
| Wind load [kN/m²]:                                   | 1.000 |
| <button>Wind load analysis</button>                  |       |
| <input checked="" type="checkbox"/> Generate footing |       |
| Footing height [m]:                                  | 0.200 |
| Footing width [m]:                                   | 1.400 |
| <button>OK</button> <button>Cancel</button>          |       |

The "**Base height in front of wall**" is calculated from the top of the wall (= 0.0 m) and is positive downwards. An active berm of 4.0 m is generated in the noise abatement wall's active earth pressure zone in order to simulate the free-standing wall.

The wind load entered in the dialog box is taken into consideration by the system as a surcharge load. (see "**Editor 2 / Lateral pressures**" menu item) To prevent a favourably acting active earth pressure being generated at the rear face of the wall, the program automatically sets the active wall friction angle to zero.

After confirming your input by pressing "**OK**" you then move to the body geometry editor box and exit this box by pressing "**Done**". The entered system is now displayed on your screen. System visualisation can be optimised by pressing the [**F9**] function key.

## 7.2.3 GGU-GABION: Step 2 - Define material of gabion (Ex. 2)

Select the "**Editor 1/Material**" menu item and adapt the unit weight of the gabion elements.

**Material** [X]

**gamma (Gabion)**

gamma [kN/m<sup>2</sup>]: 16.00

gamma (Auftrieb) [kN/m<sup>2</sup>]: 8.00

**'2nd gamma' (Gabion)**

☐ Use '2nd gamma'

'2nd gamma' [kN/m<sup>2</sup>]: 23.00

"2. gamma (Auftrieb)" [kN/m<sup>2</sup>]: 13.00

below [m]: 9.00

**Water in gabion**

☒ 'Buoyant gamma' if groundwater in wall ?

☒ No water pressure on gabions

**Gabion**

☒ Verify internal stability

from [m]: 0.000

to [m]: 999.000

fm,d [MN/m<sup>2</sup>]: 0.200 ?

sig.Ek,SLS [MN/m<sup>2</sup>]: 0.150 ?

Young's mod. [kN/m<sup>2</sup>]: 1.0000E+5

n-value for load distribution  
(see DIN 1045 Table 17): 2.000

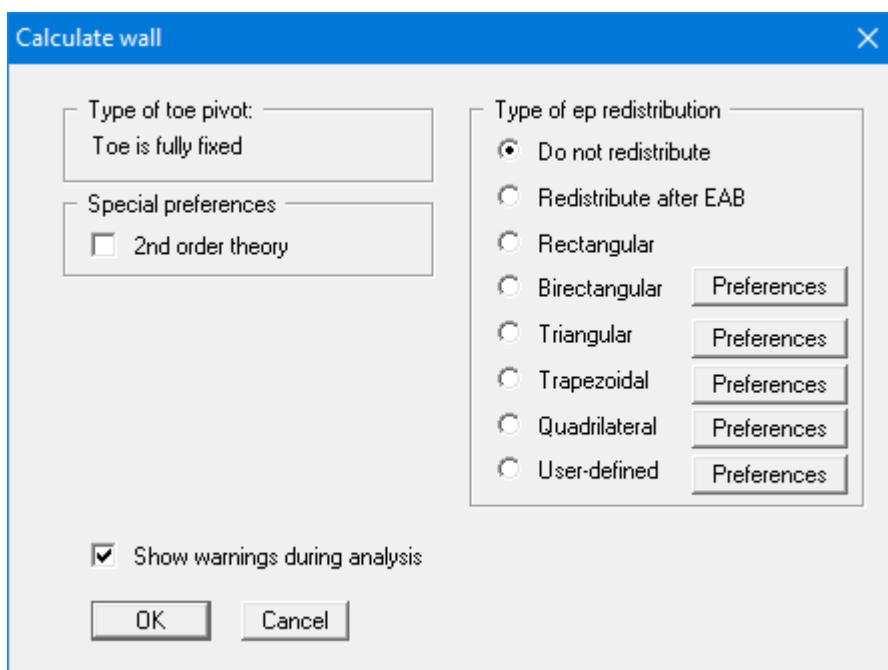
☐ Wall top kept horizontal ?

☐ No buckling analysis for displacement to earth side

OK Cancel

## 7.2.4 GGU-GABION: Step 3 - Analyse system (Ex. 2)

Now select the "**Analyse**" menu item from the "**System**" menu.



**Calculate wall**

Type of toe pivot:   
 Toe is fully fixed

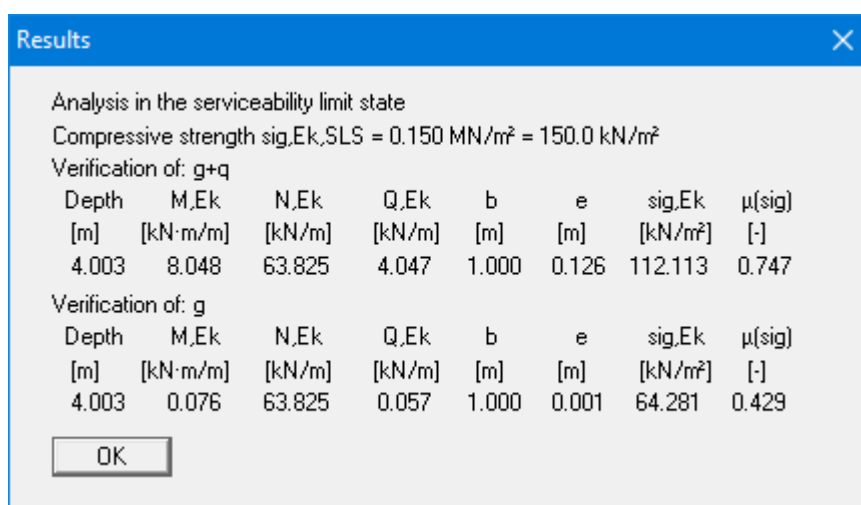
Special preferences   
 ☐ 2nd order theory

Type of ep redistribution   
☒ Do not redistribute   
☐ Redistribute after EAB   
☐ Rectangular   
☐ Birectangular   
☐ Triangular   
☐ Trapezoidal   
☐ Quadrilateral   
☐ User-defined

☒ Show warnings during analysis

OK Cancel

After clicking the "OK" button the analysis begins. The program first performs an intensive plausibility check of the data input and returns the appropriate information. Once analysis is complete the results are shown in a message box.



**Results**

Analysis in the serviceability limit state  
Compressive strength  $\text{sig.Ek.SLS} = 0.150 \text{ MN/m}^2 = 150.0 \text{ kN/m}^2$

Verification of: g+q

| Depth | M,Ek     | N,Ek   | Q,Ek   | b     | e     | sig.Ek               | $\mu(\text{sig})$ |
|-------|----------|--------|--------|-------|-------|----------------------|-------------------|
| [m]   | [kN·m/m] | [kN/m] | [kN/m] | [m]   | [m]   | [kN/m <sup>2</sup> ] | [-]               |
| 4.003 | 8.048    | 63.825 | 4.047  | 1.000 | 0.126 | 112.113              | 0.747             |

Verification of: g

| Depth | M,Ek     | N,Ek   | Q,Ek   | b     | e     | sig.Ek               | $\mu(\text{sig})$ |
|-------|----------|--------|--------|-------|-------|----------------------|-------------------|
| [m]   | [kN·m/m] | [kN/m] | [kN/m] | [m]   | [m]   | [kN/m <sup>2</sup> ] | [-]               |
| 4.003 | 0.076    | 63.825 | 0.057  | 1.000 | 0.001 | 64.281               | 0.429             |

OK

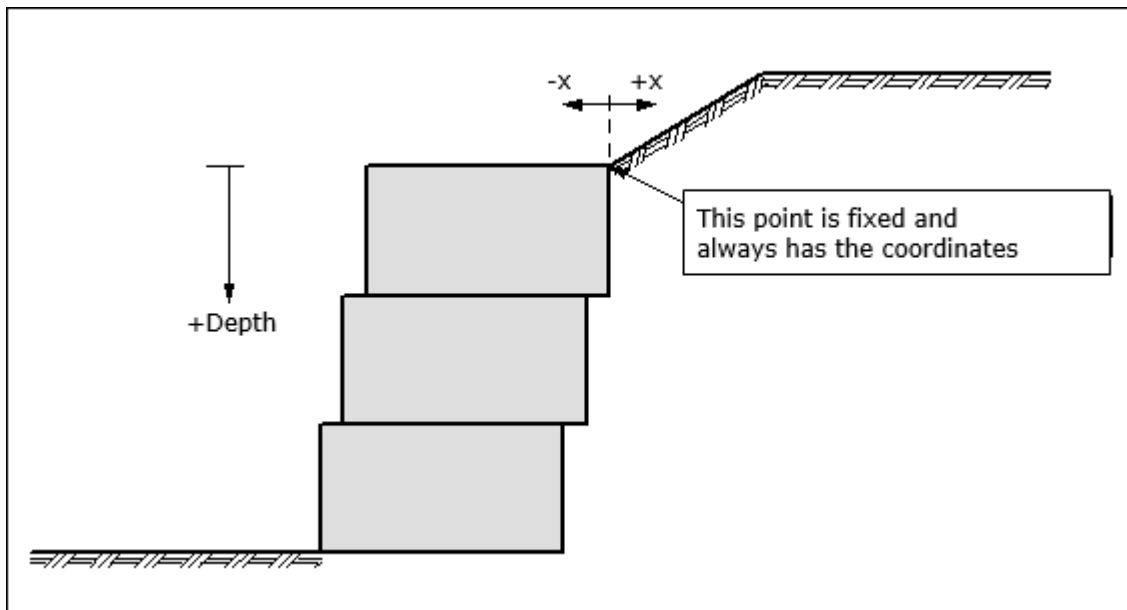
After closing the message box, the system is displayed on the screen, together with the results.

## 8 Theoretical principles

### 8.1 GGU-GABION: Body

The body is defined in horizontal sections of three values each:

- depth of cross-section below top of the wall;
- corresponding left and right wall boundary.



In order to define this body, you must enter the depths and the two corresponding x-values in six horizontal steps (also see menu item “**Editor 1/Body (geometry)**”). All earth pressures (including from area loads) are calculated on the vertical line at  $x = 0$ .

### 8.2 GGU-GABION: Soil properties

Up to 50 soil layers can be taken into consideration. For each layer the following parameters must be given:

- depth in metres below top of the wall, or absolute depth,
- unit weight  $[\text{kN/m}^3]$  of moist soil  $\gamma$ ,
- unit weight  $[\text{kN/m}^3]$  of buoyant soil  $\gamma'$ ,
- friction angle  $[\circ]$ ,
- cohesion (active and passive)  $[\text{kN/m}^2]$ ,
- active angle of wall friction as the ratio  $\delta a/\varphi$ ,

- passive angle of wall friction  $\delta_p/\varphi$ ,
- constrained modulus  $E_s$  [kN/m<sup>2</sup>] (for settlement analysis).

If you activate the "**Differentiate active + passive soil properties**" check box in the dialog box in "**File/New**" or "**Editor 1/Analysis options**", you can enter differing friction angles and unit weights for the active and the passive sides.

The program provides an expandable database with soil properties for common soils. The database can be opened via the "**Common soils**" button in the "**Editor 1/Soils**" editor box .

If you are already working with **GGU-CONNECT**, you can also import soil properties from your subsoil layer model that you have created in **GGU-CONNECT**.

Further explanations can be found under the menu item "**Editor 1 / Soils**".

## 8.3 GGU-GABION: Active earth pressure

Active earth pressure is analysed to DIN 4085. DIN 4085 provides two relationships for the coefficients of earth pressure  $k_{ah}$  (friction) and  $k_{ch}$  (cohesion). Alternatively, there is the option of determining the cohesion coefficient from  $k_{ch} = k_{ah}^2$ , a method often found in older literature.

## 8.4 GGU-GABION: At-rest earth pressure

The at-rest earth pressure coefficient is calculated compliant with DIN 4085:2011.

## 8.5 GGU-GABION: Increased active earth pressure

The coefficient of increased active earth pressure,  $k_{eh}$ , is obtained from the coefficient of active earth pressure and at-rest earth pressure:

$$k_{eh} = (1.0 - f) \cdot k_{ah} + f \cdot k_0$$

$$0.0 \leq f \leq 1.0$$

## 8.6 GGU-GABION: Passive earth pressure

The coefficient of passive earth pressure can be calculated using a number of methods:

- DIN 4085:2017,
- DIN 4085:1987,
- Streck,
- Caquot/Kerisel,

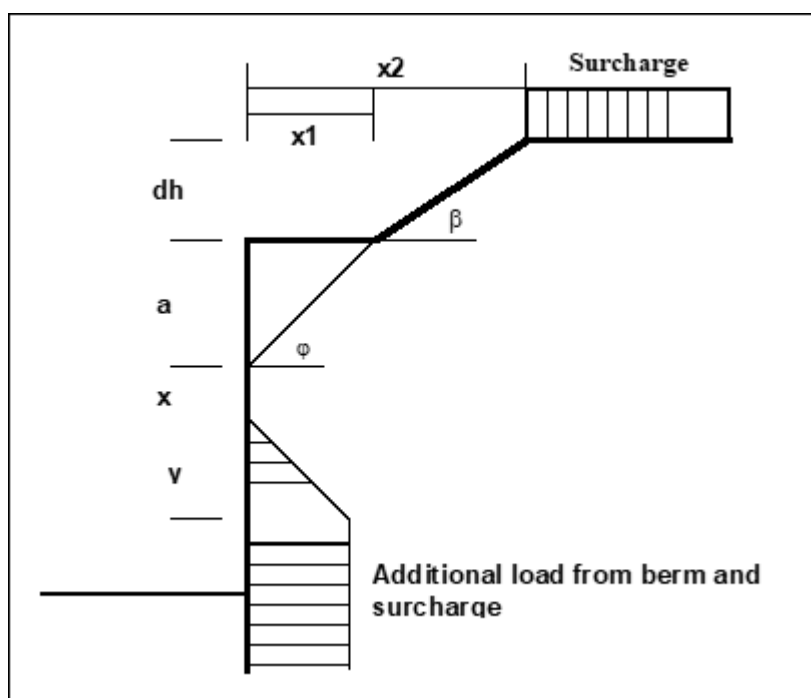
- DIN 4085:1987/Caquot/Kerisel,
- Culmann.

The earth pressure after Culmann is acquired by varying the slip surface angle (see Piling Handbook 1977). The forces at the earth pressure wedge are calculated using a slice method.

According to DIN 4085:2017, planar sliding surfaces may be used up to a friction angle of  $\leq 35^\circ$  and a wall friction angle  $\leq -2/3 \phi$ . This results in more favourable earth pressure coefficients.

## 8.7 GGU-GABION: Berms

The program can handle 40 berms on both the active and the passive sides of the wall. The berms may include surcharges. The effect on earth pressure is taken into consideration according to the Piling Handbook (Krupp Hoesch Stahl).



The following relationships apply for the parameters  $x$  and  $y$ :

$$x = \frac{kah_0}{(kah\beta - kah_0)} \cdot a$$

$$y = \frac{kah_0}{(kah\beta - kah_0)} \cdot dh$$

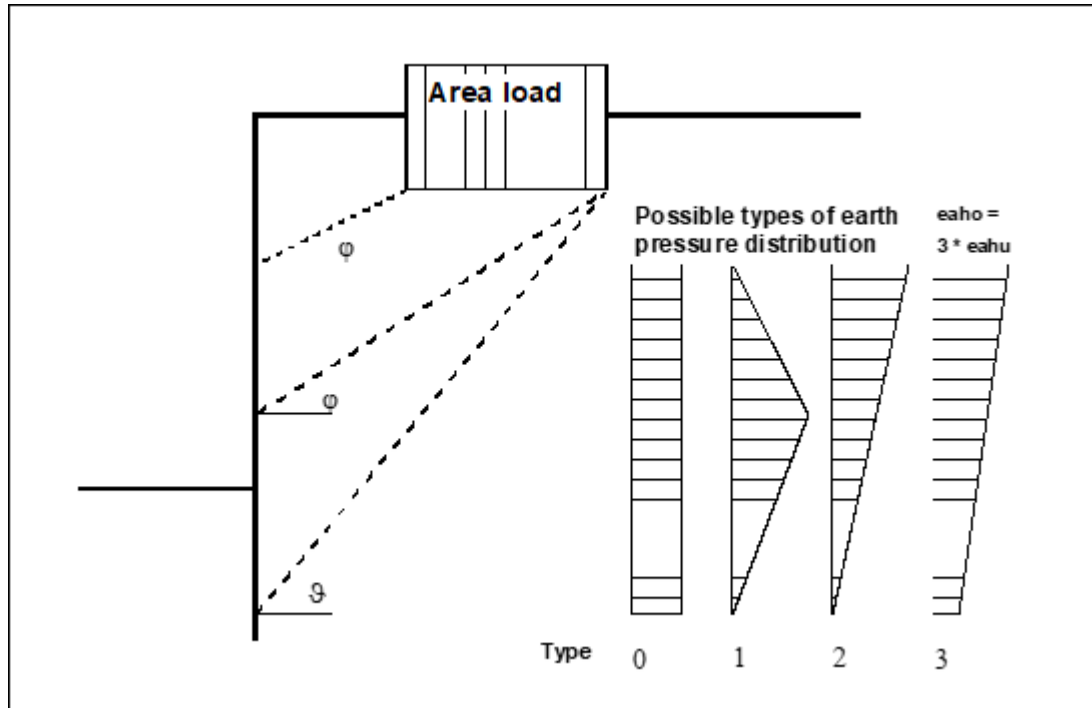
$$\Delta e_{ahu} = \gamma \cdot dh + \text{surcharge}$$

$\gamma$  = unit weight of soil in the berm area

If the angle  $\beta$  is greater than  $\phi$ , it is assumed that  $\beta = \phi$  for analysis. Berms on the passive side are dealt with in the same manner.

## 8.8 GGU-GABION: Area loads

Up to 20 area loads can be positioned on the active side at any height.



The slip surface angle for the active earth pressure resulting from the self-weight of the soil is adopted for analysis compliant to DIN 4085.

$$\vartheta_{ag} = \varphi + \arctan \left( \frac{\cos(\varphi - \alpha)}{\sin(\varphi - \alpha) + \sqrt{\frac{\sin(\varphi + \delta_a) \cdot \cos(\alpha - \beta)}{\sin(\varphi - \beta) \cdot \cos(\alpha + \delta_a)}}} \right)$$

When there are several soil layers, the program moves from layer to layer applying the appropriate angles of friction. The type of the resulting earth pressure distribution can be specified in 4 different ways.

For at-rest earth pressure, the area loads are calculated by increasing by the factor  $k_0/k_{ah}$  in compliance with DIN 4085 Section 6.4.3.

Alternatively, it is possible to determine the demands placed on a wall from area loads using the theory of elastic half-space. The two load concentration factors "3" and "4" can be taken into consideration (see also the following Figure).

- For over consolidated, cohesive soils the concentration factor "3" applies, where:  

$$eop = q/\pi \cdot (\beta_2 - \beta_1 + \cos\beta_1 \cdot \sin\beta_2 - \cos\beta_2 \cdot \sin\beta_1)$$
- For non-cohesive soils, or for cohesive but not over consolidated soils, the concentration factor "4" applies, where:  

$$eop = q/4 \cdot (\sin^3\beta_2 - \sin^3\beta_1)$$

Regarding the kind of earth pressure, area loads can be defined independent of the global preferences (see menu item "**Editor 1/Type of earth pressure**").

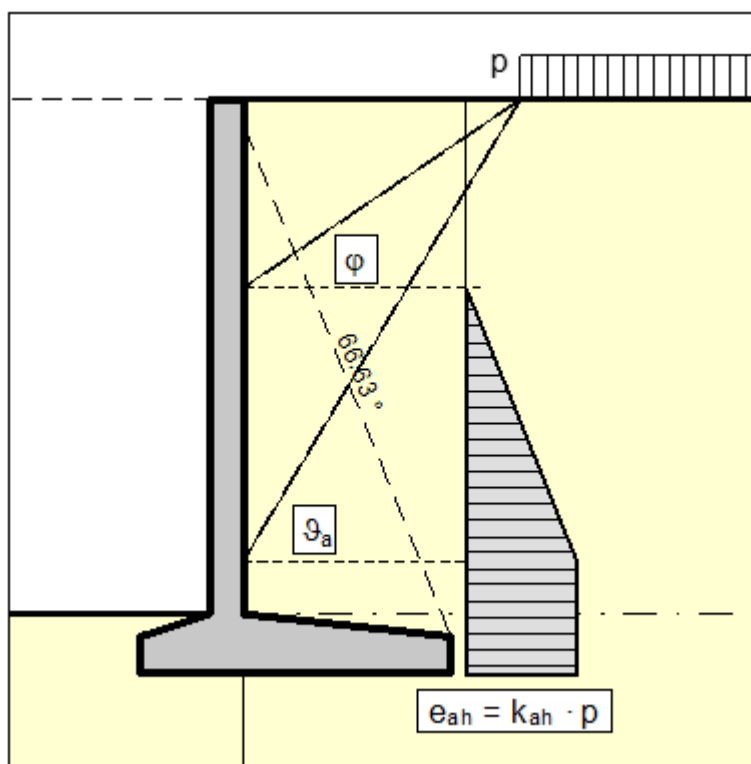
With regard to the kind of earth pressure, area loads can be defined independent of the global preferences (see menu item "**Editor 1/Type of earth pressure**").

## 8.9 GGU-GABION: Loads with limited plan dimensions

Loads with limited plan dimensions can be reduced compliant with "Piling Handbook" Figure 4.20 (page 64) or DIN 4085:2017-08 (page 17), see menu item "**Editor 2/Area loads**".

## 8.10 GGU-GABION: Bounded surcharges (active side)

Up to 40 bounded surcharges can be positioned at any height on the active side.



The earth pressure coefficient  $k$  is acquired from  $k_{ah}$  for active earth pressure and from  $k_0$  for at-rest earth pressure. If this option is activated, the resulting earth pressure is then redistributed.

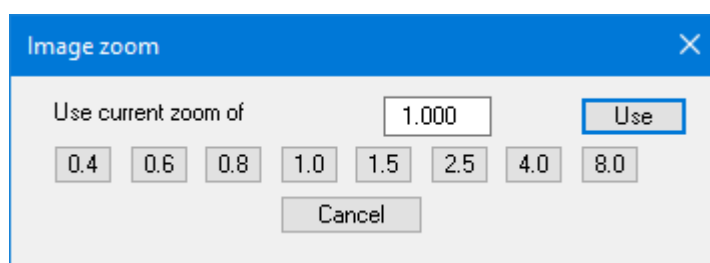
If negative values are entered, e.g. to generate a double-bounded surcharge, the linear component between  $\varphi$  and  $\theta$  may not be adopted.

## 9 Graphics preferences menu

### 9.1 GGU-GABION: "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.

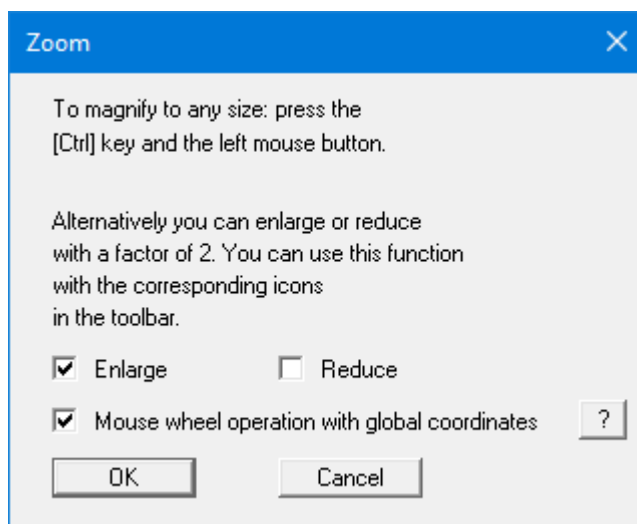


A zoom factor between 0.4 and 8.0 can be entered in the input box. By then clicking on "**Use**" to exit the box the current factor is accepted. By clicking on the "0.4", "0.6", etc. buttons, the selected factor is used directly, and the dialog box closed.

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.

## 9.2 GGU-GABION: "Zoom info" menu item

An info box informs you about the activation and possibilities of the zoom functions.



A quick way to enlarge a specific section of the screen is to open a magnifying glass window by holding down the **[Ctrl]** key and the mouse button.

A quicker way to zoom in and out of the system graphics is to use the mouse wheel. When the program is started for the first time, the default setting for mouse wheel operation is activated according to Windows conventions.

If you want to change the system coordinates and the scale of your system using the mouse wheel, activate the **"Mouse wheel operation with global coordinates"** check box. If you close the program with this setting, the setting is still activated the next time you start it.

The functions via the mouse wheel can be found in the chapter **"Tips and Tricks: Keyboard and Mouse"**.

## 9.3 GGU-GABION: "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.

## 9.4 GGU-GABION: "Pen colour and width" menu item

In order to enhance the clarity of the graphics you can preset the pen settings for various graphic elements in the GGU programs.

You can change the pen widths for the elements listed in the dialog box and adjust the pen and/or fill colours by clicking on the button with the element name. In some GGU programs you can also define a line colour for selected elements.

For the graphic output of colours on **monochrome printers** (e.g. laser printers), colours are replaced by an equivalent shade of grey. In the case of very light colours, the corresponding graphic elements are then barely visible on the printer. In such cases, it makes sense to change the colour setting to darker colours.

## 9.5 GGU-GABION: "Mini-CAD toolbar" and "Header toolbar" menu items

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](#).

The differences between the Mini-CAD and Header CAD are as follows:

- Drawing objects created with **Mini-CAD** refer to the coordinate system (generally in [m]) in which the drawing is created and are displayed accordingly. You should therefore select this menu item if you wish to enter additional information on the system. These objects can be saved in a **".mcd"** file using the



icon in the pop-up menu and loaded as such in other GGU programs using the



icon in the pop-up menu.

- Drawing objects created with the **Header CAD** refer to the sheet format (in [mm]). They therefore always remain at the same sheet position, regardless of the coordinate system of the measuring points. You should select this menu item if you want to enter general information on the drawing (e.g. company logo, report number, system number, stamp). If you save this so-called header data in a **".kpf"** file using the icon



in the pop-up menu, you can reload this header data for a completely different system (with different system coordinates) and also in other GGU programs using the icon



in the pop-up menu. The saved header data can then be found in the same position. This considerably simplifies the creation of general sheet information.

## 9.6 GGU-GABION: "Toolbar preferences" menu item

After starting the program, a horizontal toolbar for menu items 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-GABION.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 called up via normal menu titles and menu entries.

Not all of the icons described below are available in all GGU programs.



### "Next page"/"Previous page"

You can use these icons to scroll forwards and backwards between individual pages. In many GGU programs, you can use this in the ***output table representation***.



### "Select page" or "Diagram/Output table"

If you are in the ***output table representation***, you can use this symbol to jump to a specific page or switch back to the normal display, i.e. your graphic display.



### "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**").

**"Colour on/off" or "Colour/hatching"**

If you want to remove the colour from the system display, e.g. to create a black and white printout, you can do this using this on/off switch.

In several GGU programs, 4 colour and hatching settings are possible via this icon, which you can click through in sequence. A colour filled representation is the default setting, the next click shows the hatching, then coloured and hatched. The fourth click shows a representation with neither colour nor hatching. The next click starts again.

**"Move object"**

Use this icon to position legends and diagrams at the desired position on the output sheet.

**"Undo move object"**

By clicking this icon the last performed movement of graphical elements made using the [F11] function key or the menu item **"Output preferences/Move objects"** can be undone.

**"Restore move object"**

By clicking this symbol, the last object movement undo carried out using "Undo move object" can be restored.

**"Construction phase back"/"Construction phase forward"**

If you are in the display of construction phases, you can use these icons to scroll back and forth between the individual construction phases.

## 10 Page size + margins menu

### 10.1 GGU-GABION: "Auto-resize" menu item

This menu item provides a to-scale visualisation, in both x and y coordinates, of the system and result graphics. If you have previously altered the image coordinates graphically or via editor, you can quickly achieve a complete view using this menu item.

This function can also be accessed using the [F9] function key.

### 10.2 GGU-GABION: "Manual resize (mouse)" menu item

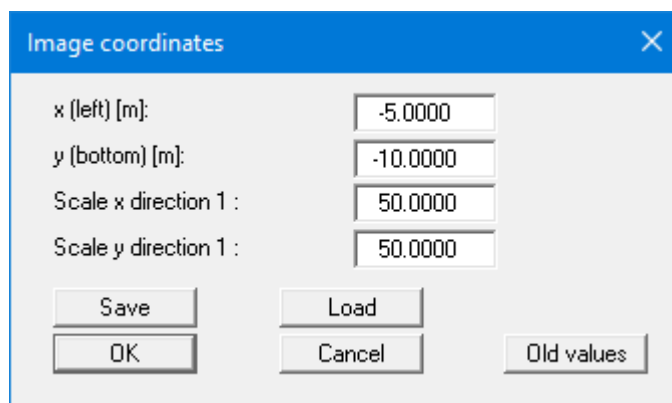
You can transfer the coordinates of a section of your previous graphic display as new image coordinates by holding down the [Ctrl] and [Shift] keys and marking the desired area with the left mouse button. The scales of the x-direction and y-direction are adjusted accordingly.

In the default setting, the "**Proportional section**" check box is activated. This retains the previous proportions (scale x-direction/scale y-direction).

If you activate the "**Redefine origin**" check box, you can adjust the image coordinates without changing the scale. In this way, you can quickly achieve the desired visualisation without having to try out the x/y coordinates if the scale is set appropriately.

### 10.3 GGU-GABION: "Manual resize (editor)" menu item

You can alter the current image coordinates by direct numerical input in a dialog box. This allows precise scale input. The coordinates refer to the drawing area. This can be defined in the "**Page size + margins/Page size and margins**" menu item by means of the plot margins.



| Image coordinates              |          |
|--------------------------------|----------|
| x (left) [m]:                  | -5.0000  |
| y (bottom) [m]:                | -10.0000 |
| Scale x direction 1 :          | 50.0000  |
| Scale y direction 1 :          | 50.0000  |
| Save Load OK Cancel Old values |          |

The image coordinates entered here can be saved in a file with the extension ".bxy" and be reloaded later for the same file or for different files.

If you want to recover the previous values during input or use the menu item again after editing the coordinates, you can do this by pressing the "**Old values**" button.

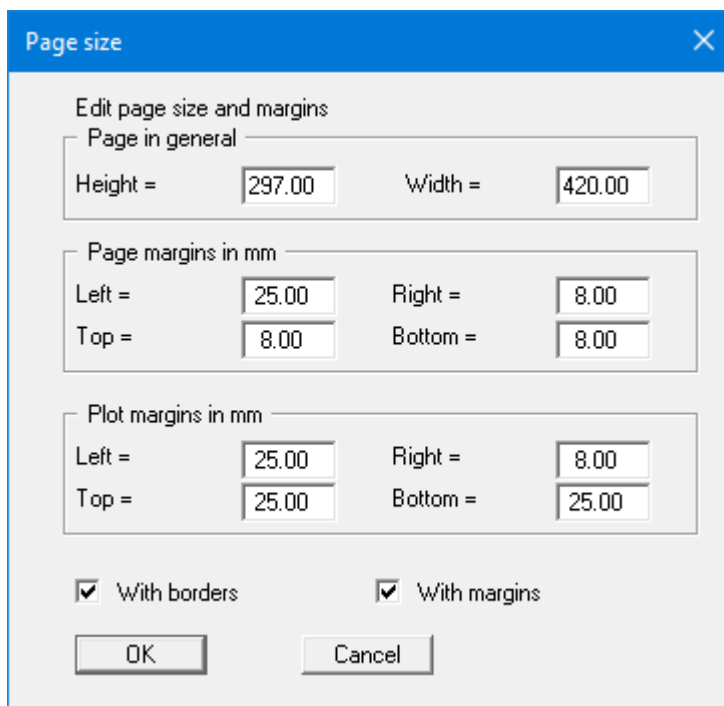
## 10.4 GGU-GABION: "Font size selection" menu item

You can edit font sizes for labelling the various drawing elements.

The font sizes of text within legends are edited in the respective legend editor. Just double-click in a legend to do this.

## 10.5 GGU-GABION: "Page size and margins" menu item

The default page set-up is A3 when the program is started. You can edit the page format in the following dialog box.



The screenshot shows the "Page size" dialog box. It has a blue header bar with the text "Page size" and a close button (X). The main area is light gray and contains three sections, each with a title and a group of input fields:

- Edit page size and margins**
  - Page in general**: Height = 297.00, Width = 420.00
  - Page margins in mm**: Left = 25.00, Right = 8.00, Top = 8.00, Bottom = 8.00
  - Plot margins in mm**: Left = 25.00, Right = 8.00, Top = 25.00, Bottom = 25.00
- At the bottom, there are two checked checkboxes: ☒ With borders and ☒ With margins.
- At the very bottom are two buttons: OK and Cancel.

- "**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 deactivating the "**With borders**" check box.
- "**Page margins**" define the position of a frame as a distance to the margins. This frame encloses the subsequent diagram. You can switch off the frame deactivating the "**With margins**" check box.
- The "**Plot margins**" define a set distance between the page margin and the actual **drawing area** in which the graphical evaluation of your input is presented.

## 10.6 GGU-GABION: "Undo" menu item

If you have carried out any changes to dialog boxes or moved objects to a different position on the screen after selecting the "**Graphics preferences/Move objects**" menu item or using the **[F11]** function key, this menu item will allow you to undo the movements.

This function can also be reached by using the key combination **[Alt] + [Back]** or the icon



in the toolbar.

## 10.7 GGU-GABION: "Restore" menu item

When this menu item is selected the last change made in a dialog box or the last change in the position of objects, which you undid using the menu item "**Page size + margins/Undo**" will be restored.

This function can also be reached by using the key combination **[Ctrl] + [Back]** or the icon



in the toolbar.

## 10.8 GGU-GABION: "Preferences" menu item

You can activate or deactivate the undo functions.

## 11 Info menu

### 11.1 GGU-GABION: "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 the GGU program.

### 11.2 GGU-GABION: "Maxima" menu item

Here you can check the defaults for maximum values of the program.

### 11.3 GGU-GABION: "Compare ep coefficients" menu item

Here you can calculate the earth pressure coefficients for the given values of  $\phi$ ,  $\delta$  and  $\beta$ .

### 11.4 GGU-GABION: "Help" menu item

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

### 11.5 GGU-GABION: "GGU on the web" menu item

Using this menu item, you can access the [GGU Software website](#).

Check the page of your program module at regular intervals for information about updates and changes. On the "**Changelogs**" subpage, you can also subscribe to an e-mail notification that informs you of all changes on a monthly basis.

### 11.6 GGU-GABION: "GGU support" menu item

This menu takes you directly to the [GGU Software Support Portal](#).

Here you can enter your support request directly and upload your edited GGU program file.

## 11.7 GGU-GABION: "What's new?" menu item

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

## 11.8 GGU-GABION: "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.