Bearing Resistance Failure GBR+

Inhaltsverzeichnis

Basic Documentation – Overview

In addition to the individual program manuals, you will find basic explanations on the operation of the programs on our homepage www.frilo.com in the Campus-download-section.

Application options

The GBR+ application is suitable for the verification of squared and rectangular foundations. External loads can optionally apply centrically or with a uniaxial or biaxial eccentricity.

The software application calculates the soil pressure underneath the four corner points and the position of the zero-line in combination with a gaping joint.

The gaping joint, the permissible bearing pressure, the sliding resistance and the position stability as well as of the resistance to ground failure are verified for the foundation.

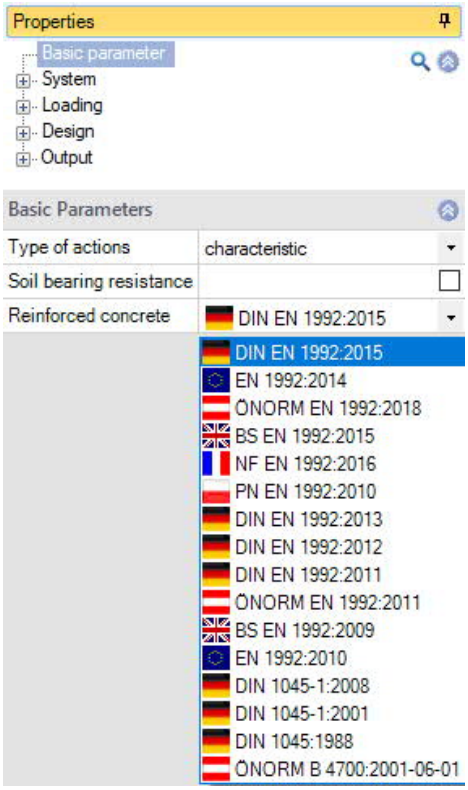
The structural system consists of the foundation slab and optionally includes a cast-on column (or plinth) with or without eccentricity.

The user can include the following load types in the calculation:

- Single vertical load V at the column location
- Horizontal loads Hx and Hy optionally at the top edge of the column or in the foundation base
- Outer moments Mx and My
- Earth top load and an additional uniformly distributed load applying to the foundation surface without a column and additional vertical single loads applying at freely selectable points.

Standards

- DIN EN 1992
- ÖNORM EN 1992
- BS EN 1992
- NF EN 1992
- PN EN 1992
- EN 1992
- still available:
- DIN 1045-1
- ÖNORM B 4700



According to the selected reinforced concrete standard, the program automatically sets the associated foundation and ground failure standard.

- DIN EN 1997-1
- ÖNORM EN 1997-1
- BS EN 1997-1
- NF EN 1997-1
- PN EN 1997-1
- DIN 1054:1976/2005/2021

Support of all 3 verification methods according to Eurocode 7, adjustable for all national annexes.

The partial safety factors and combination equations for the geotechnical verifications can be edited.
See Design - Parameters.

Additional option FD-PRO

With the additional option FD-PRO, the foundation programmes FD+/FDB+/FDS+ and GBR+ can be extended to include

- an earth pressure approach
- an inclined foundation base
- a seismic ground failure verification
- a ground failure - punching shear verification
- a bearing capacity calculation of the foundation soil with a table of design values of the base pressure resistance.
- a graphical output of the internal forces along the main axes

In FD+/FDB+/GBR+, the circular foundation type is also available with the additional option.

See calculation basis for foundation engineering in the FD+ manual.

See also ▸ Video

Basis of calculation

Position stability

For the verification of the position stability, the stabilising and destabilising moments in relation to the outer edges of the foundation are calculated in combination with the Eurocodes. If you use the result load cases instead of the characteristic ones, they are used in the calculation of the stabilising and destabilising moments without consideration of reduction factors. In this case, only self-weight is multiplied with the partial safety factors that have a favourable or unfavourable effect.

Gaping joint

Under permanent loading, no gaping joint must occur and under the total loading, gaping of the foundation joint is allowed up to the centre of gravity. In combination with Eurocodes, the calculation of the gaping joint is based on representative loads instead of characteristic ones.

If you use result load cases instead of superpositions (Basic parameters ▸ Type of loading), the loads are reduced to the characteristic level with the help reduction factors before examining the gaping joint. In this connection, it is important to define whether the individual load cases are the result of permanent loads exclusively or of both, permanent and variable loads: a gaping joint up to the centre of gravity is only permitted for the combination of permanent and variable loads. It is not permitted if only permanent loads apply.

Permissible bearing pressure

For a simplified verification in standard cases, the existing bearing pressure is compared to the permissible bearing pressure or a design value of the bearing pressure resistance. The permissible bearing pressure can be determined automatically with the help of standardised tables for the simplified verification. You can increase or reduce the permissible bearing pressure taken from the standard tables if the corresponding border conditions, such as the required anchoring depth, ground water or the relation of the horizontal and vertical loads, require this. In combination with Eurocodes, the calculation of the equivalent area for the design value of the bearing pressure is based on representative loads instead of characteristic ones.

If you use result load cases instead of superpositions, the loads are reduced to the characteristic level with the help reduction factors before examining the equivalent area. The design value of the bearing pressure is obtained by dividing the design value of the vertical loads by the representative or characteristic equivalent area. As additional information, the software determines the inclination of the characteristic or representative bearing pressure resultant in order to check whether the inclination is suitable for a simplified verification.

Stability against sliding

If horizontal forces apply, the stability against sliding is verified. It is considered satisfactory if $T_d \leq R_{td}$.

T_d design value of the loads applying in parallel to the bottom of the foundation.

T_d is calculated by the software by multiplying T_k with the partial safety factors for the decisive limit state. The software uses the partial safety factors for the permanent and quasi-permanent design situations. If you define loads by accidental actions or earthquakes, the accidental and earthquake design situations are taken into account as well.

R_{td} design value of the sliding resistance.
R_{td} is calculated by dividing R_{tk} by the partial safety factor for the sliding resistance for the decisive limit state in accordance with the currently selected foundation standard.

Safety against ground failure

In combination with Eurocodes, the ground failure safety is calculated with characteristic or representative values. The design values of the ground failure resistance are determined by dividing the characteristic values by the partial safety coefficients. They are compared to the design values of the actions, which are multiplied by partial safety factors. Depending on the selected design standard, the characteristic or representative ground failure safety is calculated on the basis of ÖNORM B 4435-2 or DIN 4017.
The FD+, FDB+, FDS+ and FDR+ applications always calculate the ground failure safety as an isolated foundation. FDS+ and FDR+ calculate the ground failure safety as a strip foundation if the wall length corresponds to the foundation length.
In the GBR+ application, the "strip foundation" verification type is optionally available. When you select this type of verification, all shape coefficients and the load inclination coefficients 'ma' and 'mb' are set to 1.0. Instead of the arithmetical equivalent width in the longitudinal wall direction (y-direction) the foundation length (y-direction) is taken into account.

Definition of the structural system

The definition of properties and control parameters is done in the menu on the left side of the screen.You can check the effect of the entered values in the graphical representation on the right screen section.
Before the first entry, you can change the units of measurement (cm, m ...) via File ▸ Settings if required.

Assistant/Wizard

The Assistant (formerly called wizard) appears by default/automatically when the program starts, but can be switched off.

Input options in the 3D graphics

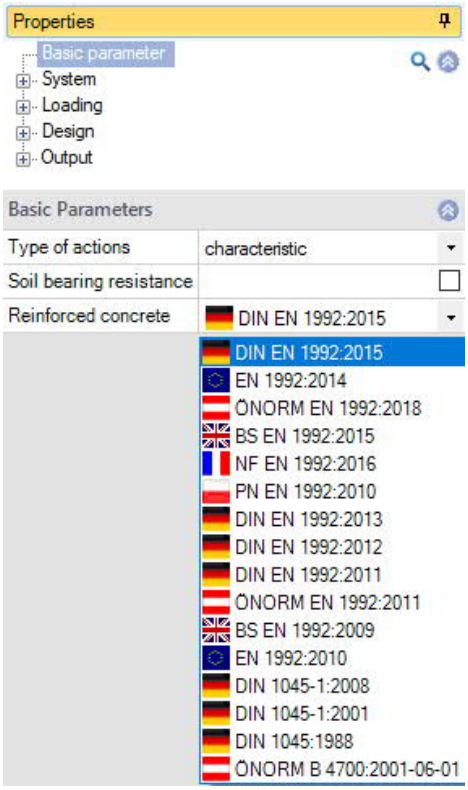
The description of the input options in the graphic window is given in the Document "Basic operating instructions PLUS".

Basic parameters

Type of actions

Design values	the loads shall be defined with their partial safety factors. Under particular conditions, these values are reduced by reduction factors for the foundation analyses.
Characteristic	the loads are specified with the characteristic (1.0-fold) value.

Soil bearing resistance	If the option is selected, only the bearing capacity of the soil is output in the form of a table with the design values for the bearing pressure resistance.



Standard reinforced concrete

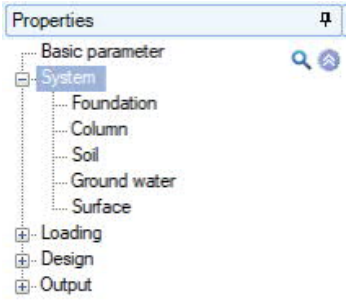
Selection of the desired reinforced concrete standard.

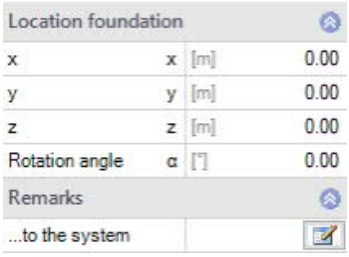
The corresponding foundation standard is displayed in the graphics window at the top left

System

Location foundation

The global position related to the foundation axis is only required for communication with other programs such as GEO and SBR+.





Remarks

Click the button  to enter your own comments about the system.

Foundation

Foundation Type

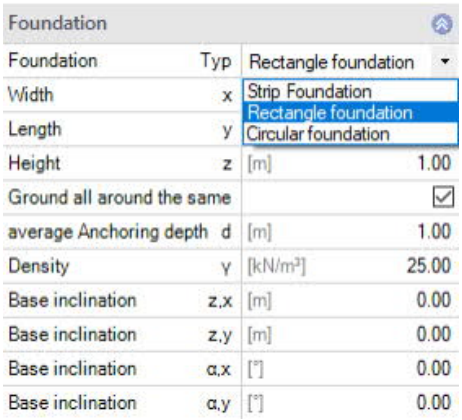
Here you select the desired foundation shape

- Rectangular foundation
- Strip foundation
- Circular foundation (with additional option FD-PRO)

which influences the shape coefficients in the bearing failure verification.

See also Basis of calculation.

In the foundation ground plan, the x-axis (positive) runs from the left to the right and the y-axis (positive) from the bottom to the top.



Width x	foundation dimension in x-direction
Length y	foundation dimension in y-direction
Height z	foundation height
Ground...the same	Define here whether the terrain around the foundation should be the same everywhere. This setting affects the earth pressure calculation and can affect the bearing capacity calculation.
Average anchoring depth d	Lowest foundation depth below the ground level or the top edge of the basement floor.
Density γ	gamma concrete

Base inclination and a 4-sided different surface definition are possible with the additional option FL-PRO.

Column

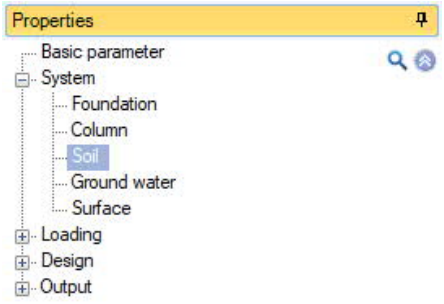
Width x	width of the column
Thickness y	thickness of the column
Height z	height of the column

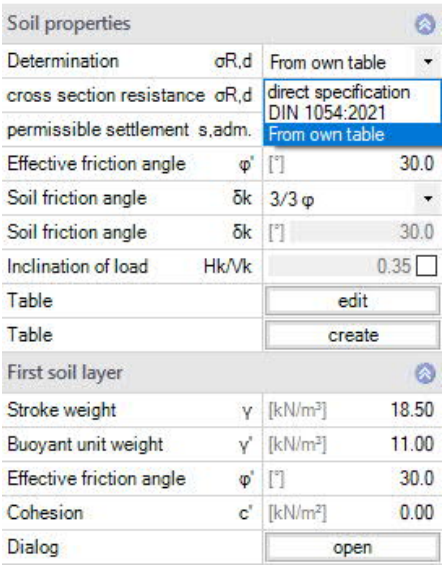
Eccentricity

Eccentricity x	Column eccentricity in x-direction.
Eccentricity y	Column eccentricity in y-direction.

Soil

Soil properties





Note: Depending on the selected standard, further/other parameters are available - the description can be found in the info area below.

Determination σR,d — Select whether the design value of the bearing resistance should be entered directly, or to come from a standard table (DIN 1054) or from a user defined (own) table - see section below.

Cross s. resistance $\sigma_{R,d}$ — Specification of the permissible bearing pressure σR,d (design value of the bearing resistance)

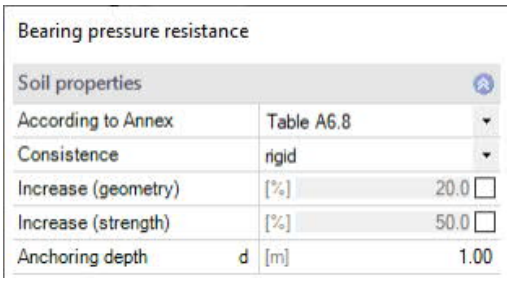
Permissible settlement — Permissible settlement for comparison with the calculated settlement and presentation of the utilisation of the settlement verification.

Eff. friction Angle φ´ — Angle of the inner friction underneath the foundation base.

Soil friction angle — The soil friction angle is relevant for the sliding safety check. If the angle of friction δ is not determined separately, the characteristic angle of friction ϕ'k may be used instead of the critical angle of friction for in-situ concrete foundations. A value of 35° must not be exceeded. The same applies to prefabricated foundations if the precast elements are laid in the mortar bed. If the prefabricated foundations are smooth and without a mortar bed, the characteristic soil friction angle $\delta k = 2/3\ \phi' k$ shall be used.

Inclination of load Hk/Vk — Enter the maximum tilt of the characteristic or representative bearing pressure-resultant H/V, which should be checked in the case of simplified verification.

Dialog/Table — If the determination σR,d is not specified directly, the design value of the bearing pressure resistance is taken from a table (standard or user defined)
Click the “open”/”edit” Button to open the tabledialog.



Parameters by standard table (DIN 1054):

According to Annex — The soil pressure is taken from the corresponding table in the soil engineering standard or its National Annex.

Consistence — consistency of soil: rigid, half-solid, solid – only with tables A6.6. to A6.8.

Increase (geometry) — The permissible bearing pressure can be increased by 20% if the relevant border conditions (b/d) specified by the applicable standard are satisfied. By ticking this option the value can be edited.

Increase (strength) — The permissible bearing pressure is increased by 50%, if the soil is sufficiently solid. By ticking this option the value can be edited.
Note: The values are added up under particular conditions (70%). The subsoil has sufficient strength down to a depth below the foundation base that corresponds to twice the width of the foundation, but at least down to a depth of 2.0 m. The program

checks whether an increase in the design value of the bearing pressure resistance is permissible and then applies this.

Anchoring depth d	Lowest foundation depth below the ground level or the top edge of the basement floor.

From own table

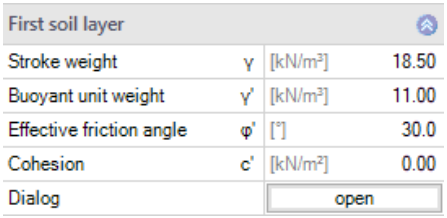
Create:	Generates a table with design values of the bearing pressure resistance from several parameters.
Edit:	Open the dialog to enter the design value of the bearing pressure resistance σRd.

The value $\sigma_{R,d}$ should come from a geotechnical report and should have sufficient guarantees against ground failure and a sufficient limitation of settlements. Furthermore, the corresponding foundation width and anchoring depth must be specified.
The meaning of the other buttons can be seen from the Tooltips.

First soil layer

In this section you can enter the values of the first soil layer.

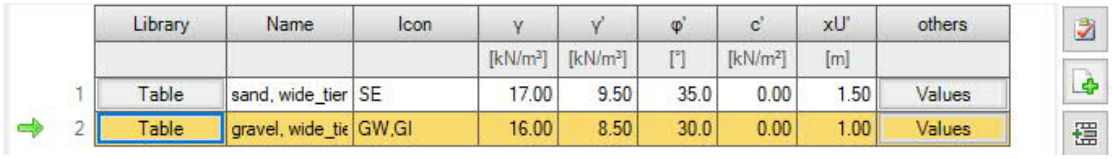
For additional soil layers click the Button “Dialog – open”.



Stroke weight	γ	Specific weight of the soil.
Buoyant unit weight	γ´	Specific weight of the soil layer under buoyancy. This value is only used if groundwater was defined (▸ System ▸ Soil)
Friction angle	φ´	Friction angle of the soil in this layer.
Cohesion	c'	Soil cohesion.

Further soil layers / additional values (▸ Dialog „open“)

Additional soil layers can be added in a table via the "Open" button.



	Library	Name	Icon	γ [kN/m³]	γ' [kN/m³]	φ' [°]	c' [kN/m²]	xU' [m]	others
1	Table	sand, wide_tier	SE	17.00	9.50	35.0	0.00	1.50	Values
2	Table	gravel, wide_tie	GW,GI	16.00	8.50	30.0	0.00	1.00	Values

Table	Defined layers/values can be selected via a soil layer library.
Name	A name for the soil layer can be assigned here.
Icon	An abbreviation for the soil layer can be assigned here.
xU	thickness of the soil layer. Soil layers smaller than 0.10 m are not provided.

Other Values

Additional parameters can be entered using the "Values" button. You will be asked whether the settlement calculation should be activated (the table will be expanded accordingly).

Allgemein								Settlement Analysis					Konsolidierung	
Library	Name	Icon	γ	γ'	φ'	c'	xU'	ν	Procedure	E*	Es	x	ks	both sides drained
			[kN/m³]	[kN/m³]	[°]	[kN/m²]	[m]			[kN/m²]	[kN/m²]		[m/s]	
Table	sand, wide_tier	SE	17.00	9.50	35.0	0.00	1.50	0.20	direct specification	400000.00	200000.00	0.50	1E-05	☐
Table	gravel, wide_tie	GW,GI	16.00	8.50	30.0	0.00	1.00	0.20	direct specification	400000.00	200000.00	0.50	0.002	☐

Settlement analysis

Poisson's ratio v	The Poisson's ratio defines the ratio of a change in thickness to a change in length as soon as a stress is applied. The Poisson's ratio or transverse contraction coefficient has the formula υ or μ. It is one of the elastic material constants and bears the name of the physicist Siméon Denis Poisson.
Procedure	Direct specification or from constrained modulus: To define the compressibility of the soil (Em-module) select - directly in E* or - from the constrained modulus - Em will be calculated from stiffness/constrained modulus Es and correction factor x (from DIN 4019 T1).
E*	Compression modulus. The compressibility of the soil can be specified by a pressure settlement line or calculated from the constrained modulus in connection with a correction factor.
Es	Stiffness/constrained modulus.
x	Correction factor.

Settlement analysis: Consolidation

k	Permeability coefficient of the rate of consolidation. The value can be extracted from the soil report.
Both sides drained	For the calculation of the time to approximate decay of consolidation settlement in unilateral drainage the full layer thickness is set, in bilateral drainage only half the layer thickness.
Cα'	The creep coefficient Cα can be determined from a time-settlement test according to DIN 18135. Usual value range 0.001 to 0.00001.

See also chapter Design – Foundation engineering - settlements

NF EN 1992

If the NF EN 1992 standard is selected, the following parameters are also available.

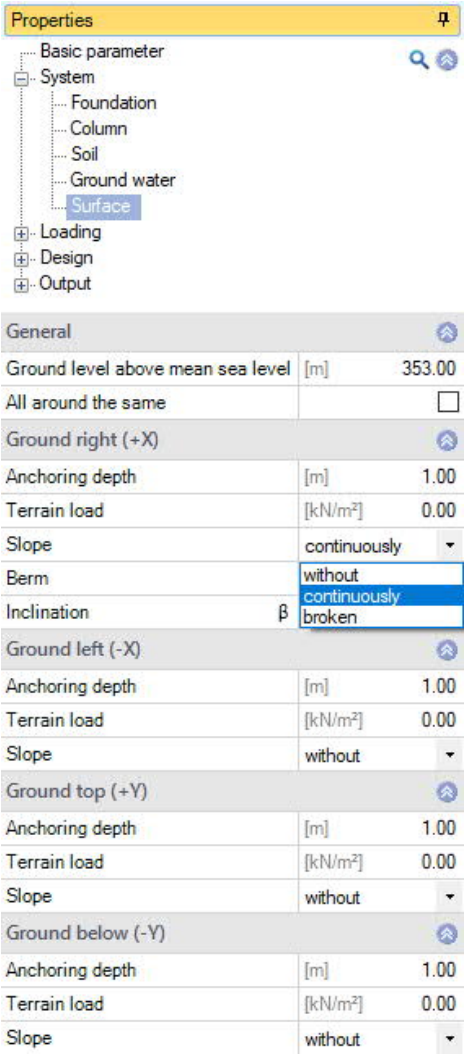
Category	Soil category according to Annex A of standard NF P94-261. It is important for the bearing capacity calculation from values of the pressiometer test according to Annex D of NF-P94-261.
Em	Define the pressiometric modulus according to Ménard here. It is needed for the settlement calculation from data of a pressiometer test.
Pl	The representative value of the limit pressure according to Ménard in the foundation base of the shallow foundation.
α	Rheological factor for settlement calculation from results of a pressiometer test.
qc	The peak pressure resistance comes from the pressure test and derives modulus of elasticity and friction angle for base failure and settlement calculation.

Ground water

Ground water existing — This option allows you to define whether groundwater exists (displays the entry “Ground water”).

Ground water — Only if ticked option “Ground water existing”.
Absolute depth of the groundwater below the bottom edge of the foundation body.
Negative values can be used to define a groundwater level below the base of the foundation.

Surface



Ground level... — The ground level above mean sea level refers to the top edge of the earth embankment on the left side of the foundation or in the negative X area. It is positive for ground above sea level.

Anchoring depth — Anchoring depth of the foundation body.

Terrain load — Additional characteristic permanent area load on the bearing failure figure, which increases the characteristic punching shear resistance.

Slope — The ground level can be modeled as horizontal, with a continuous slope, or with a broken embankment.

Berm — The width of berm is the distance between the outer edge of the foundation and the beginning of the slope.

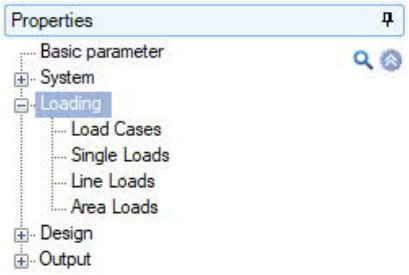
Inclination β — The terrain inclination indicates the angle of inclination of a slope from the defined berm. The inclination affects the ground failure verification and defines exclusively downsloping terrain.

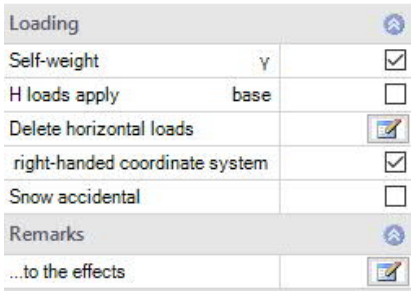
Input of the embankment sections. The "+" symbol creates a new table row for a further section. Parameters are length, height or inclination or rise.

Four-sided different terrain definition with the additional option FD-PRO

With an existing FD-PRO license, the terrain can be defined differently for each of the four foundation faces. To do this, remove the tick from the “All around the same” option – the entry will be extended accordingly.

Loading





Eigengewicht γ
: Automatische Berücksichtigung des Eigengewichtes. Bei Grundwasser oberhalb der Sohle lässt sich das Eigengewicht nicht deaktivieren.

H loads base
: ☐ Option not ticked:
The horizontal loads apply at the top edge of the base and generate a moment with a particular lever arm
☑ Option ticked:
The horizontal loads apply directly in the base joint without generating a moment.

Delete horizontal loads
: Delete all horizontal loads with one click!
This is useful if many load cases from other applications (GEO, B5...) have been imported.
Note: The horizontal loads of the individual load cases can be found/entered under the following point "Load Cases".

Right-hand coordinate system (new standard)
: Coordinate system based on the right-hand rule, also referred to as right-hand coordinate system. The signs comply with the sing definitions in engineering mechanics. Positive moments about the x-axis generate pressure on the bottom and/or in the negative area of the foundation. Positive moments about the y-axis generate pressure on the right and/or in the positive X-area of the foundation. If this option is unchecked (default setting until recently) positive moments generate pressure on top right and/or in the positive X/Y-area of the foundation. In the graphic representation, both variants are shown with their absolute values. The arrows indicate the actual direction of action. The values in the data entry fields and in the output documents are indicated with their signs. If you change the sign definition, the sign of the moments about the y-axis changes as well.

Accidental snow load
: When you check this option, snow loads are automatically included as accidental action in addition to the typical design situations. The user can either specify a freely selectable load factor for the accidental snow loads or have it determined automatically by the software. The default value is 2.3

Remarks

The remarks editor is called up via the  button. This text appears in the output.

Load Cases

Enter the data of the first load case via the data-entry mask or directly in the load case table, which can be displayed by activating the Load case tab (below the graphic).

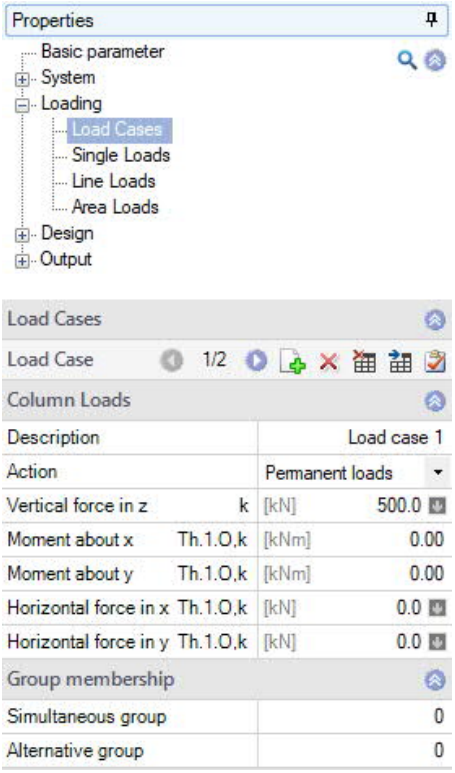
Load case toolbar: Load case 1/2

See Data entry via tables

To add additional load cases, click on the button once more (a new empty input mask is displayed each time).

Tip: *A description is displayed in the status line each time you click into an input field.*

By clicking on the arrow icon you can access a load value compilation.



Column Loads

Description	Optional text to the selected action can be entered. This text is included in the output.
Action	The appropriate actions can be selected from a list: Permanent loads ... seismic loads (calculation method "characteristic").
Vertical force in z	Vertical force in the centre of the column
Moment about x/y	Positive moments generate pressure on top right or in the positive x/y section of the foundation.
Horizontal Force in x/y	Horizontal loads apply to the top edge of the foundation or the top edge of the column, if a column height was defined. These horizontal loads generate moments on their way down to the foundation base, which are taken into account automatically by the software.

If "Design values" was selected under Type of actions, the following input fields appear:

Type	G/G+Q. For consideration in the calculation of the gaping joint. For permanent loads no gaping joint may occur, for permanent and variable loads the gaping joint may reach the foundation centre point at the most. For permanent loads from 2nd order theory only, the gaping joint is also tolerated up to the centre of the foundation.
Limit state	STR - internal failure of components e.g. bending measurement. GEO - failure of the foundation soil e.g. bearing resistance failure. EQU - Loss of stability. UPL - Verification against uplift or floating. SLS - Verification of serviceability e.g. settlement or verification of gaping joints. The limit state together with the design situation provides sufficient information for the safety factors to be used. If there are no 4 load cases with the same designation for the limit states STR/GEO-2, EQU, UPL and SLS, missing load cases are automatically generated with the help of the reduction factors. For some basic construction verifications, the limit states SLS and STR/GEO-2 are required simultaneously. Missing limit states are generated by offsetting with reduction factors. SLS x reduction factor = STR/GEO-2 and STR/GEO-2 / reduction factor = SLS.
Design situation	Selection of the design situation (permanent, temporary, exceptional, earthquake).

Reduction factors

These input fields are enabled if "Design values" was selected as calculation method.

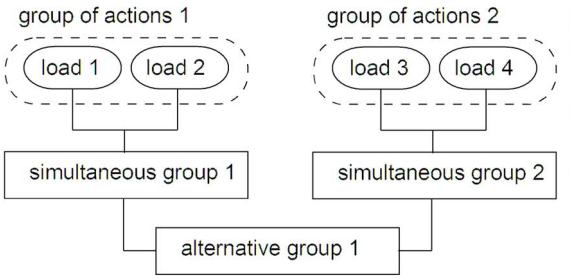
Reduction Factor N	Reduction coefficient for the forces acting in the z-direction (axial force in the column) and loads (additional concentrated loads, line loads and surface loads).
Reduct. Factor Others	Reduction factors for other internal forces. If a column was designed in a second order analysis, the internal forces are only available on the design level. In order to make verifications in soil engineering available on the characteristic level, the reduction factors are used to adjust the internal design forces to a characteristic level. When using the characteristic calculation method (▸ Basic parameters ▸ Calculation method) in combination with first-order columns, the afore-mentioned situation does not occur.

Group membership

The assignment to a group is displayed if "characteristic" has been selected under ▸ Basic parameters ▸ Type of actions.

Simultaneous (concurrent) group

Loads of a particular action group can be defined as "always acting simultaneously"
by assigning them to simultaneous (concurrent) groups.



Ill.: Example for the functioning of alternative and simultaneous groups

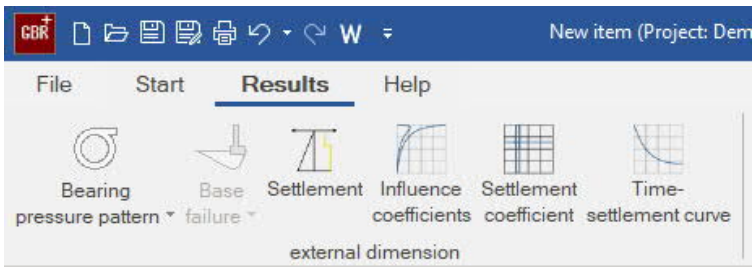
Alternative group

Different variable load cases with similar actions can be assigned to an alternative load case group via the allocation of an alternative group number. Only the decisive load case of this alternative load case group is invoked in the superposition.

Bearing pressure / Actions from the column

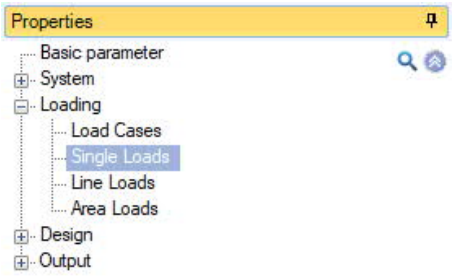
Display of the bearing pressure pattern

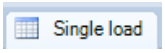
To ensure traceability, the bearing pressure pattern with stress can be shown for all load cases and superpositions decisive in the verifications. Click the symbol “Bearing pressure pattern” to display the graphic. See also ▸ Design ▸ Foundation engineering.



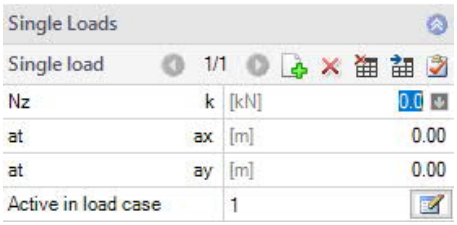
Single Loads

Define a new concentrated (single) load by activating the button (the corresponding input mask is displayed).



Activating the  tab displays the "Single load table" giving an overview of the defined loads.

Toolbar:  - see also Data entry via tables



Tip: *A description is displayed in the status line each time you click into a particular input field.*

In all LC: For "Type of actions" = design values: if the option is marked, the concentrated load acts in all load cases.

Nz,k Value of the axial force of the additional single load. Characteristic (1.0-fold) value from a support. Alternatively, the type of stress can be changed in the basic parameters to 'Design values'. By clicking on the arrow icon  you can access a load value compilation.

at ax/ay Position of the additional single load in x or y direction referenced to the foundation centre.

Active in LC Assignment of the additional single load to load cases.

Activating the button  displays a dialog with the corresponding options.

Notes:

If a single load is assigned to one or several load cases it acts only in combination with the load case(s).
In the case of the calculation method design values single loads are processed with the corresponding reduction factors.
Single loads that are not assigned to load cases are not taken into account in the calculation.

All verifications are referenced to the column loads. Additional single loads are defined only to check the effects on the bearing pressure, tilting, position stability, sliding and ground failure.

For the verification of punching shear resistance, the loads that apply in the area of the punching cone must be summarized to a resulting load, because the shear design would be unsafe otherwise.

With foundations for twin columns you should combine both columns to a single column instead of defining the second column as an additional single- or line load. Otherwise, you will obtain incorrect results in the verification of punching shear resistance .

Line Loads

General operation as described under single loads.

In all LC: For "Type of actions" = design values: if the option is marked, the load acts in all load cases.

P1,k Value at the begin of the line load.
Alternatively, the type of action can be changed to 'Design values' in the basic parameters. If parts of the line load are located in examined circular sections of the punching shear check, these are taken into account when determining the shear stress. No extra punching shear check for a wall end or similar is carried out for the line loads. The punching shear check always refers to the column load.

at x1/y1 Position of P1 relative to the foundation center

P2,k Value at the end of the line load

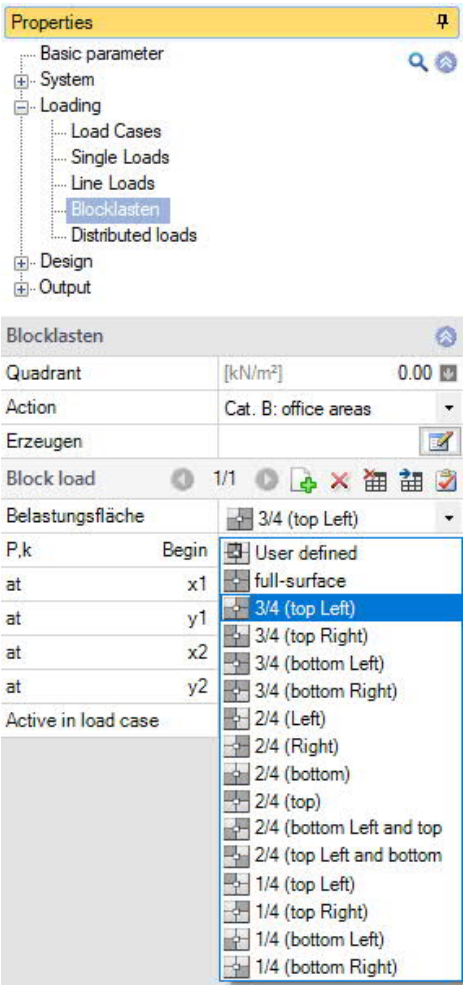
at x2/y2 Position of P2 relative to the foundation center

Active in load case As described under single loads.

Block Loads

Block loads can be arranged automatically in quadrants or defined individually.

Caution. This load is not automatically used in conjunction with superpositions. If you click on Generate (Erzeugen) below, 15 alternatively acting load cases with block loads in different load positions are generated. This load coordinate and the action selected below are used.



Area Loads

In all LC: For "Type of actions" = design values: if the option is marked, the load acts in all load cases.

Loads by soil on the foundation Height of the earth surcharge, if applicable. In combination with the weight density γ, the soil load generates an area load on the foundation, which is taken into account in the calculation.
Explanatory note: The earth surcharge load refers to the top edge of the foundation. If a wall, column, wall base or pocket exists, the earth surcharge load is reduced in accordance with the geometry of the structural component.

Note: This value has nothing to do with the self-weight of the foundation.

Density γ,k Weight density of a possible soil load.

Area Load q,k Additional area load on the foundation body.
Explanatory note: The area load acts on the surface of the foundation. If a wall, column, wall base or pocket exists, the area load is reduced in accordance with the geometry of the structural component. If a top-mounted pocket exists, the area load also acts on the pocket, but not in the area of a column casted in the pocket. See the description of the option "Earth surcharge height" for more information.

Active in load case As described under single loads.

Design / Verifications

Settings

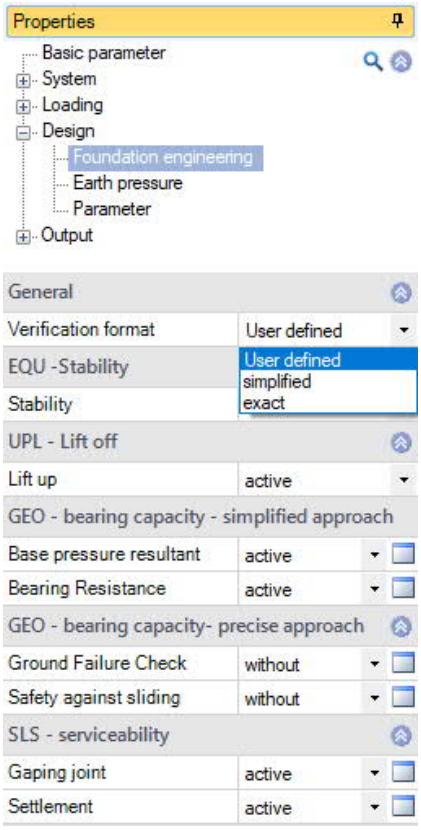
Earthquake: Psi_2=0.5	In accordance with the introductory decree of DIN 4149 for Baden-Württemberg, the combination coefficient Psi2 = 0.5 for snow loads should be used in the superpositions with seismic loads.
Round out...	This setting only affects the graphic representation of the course of the internal forces. It has no influence on the calculation results.
Transient situation	When you check this option, the transient design situation is used. When you uncheck the option, the persistent situation is used. The accidental situation and the seismic situation are automatically considered if corresponding actions have been defined.

Foundation engineering

Verification format

Define here whether a
- simplified verification, an
- exact verification or a
- user-defined verification

is to be carried out.
The simplified verification includes compliance with the design value of the bearing resistance with limitation of the inclination of the load resultants.
The exact verification format includes a foundation failure verification, a sliding safety verification and a settlement calculation.

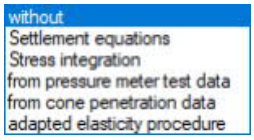


User-defined verification format

All verification options are offered here for individual selection.

Stability	Comparison of destabilizing and stabilizing design values of the effects related to a fictitious tilting edge at the foundation edge in the EQU limit state. With decreasing stiffness and shear strength of the subsoil, the tilting edge moves into the foundation. Therefore, the gaping joint must also be investigated.
Lift up	Comparison of destabilizing and stabilizing vertical design values in the UPL limit state.
Base pressure resultant	Requirement for the simplified verification: the inclination of the characteristic or representative bearing pressure resultant complies with the condition H/V <0.2.
Bearing resistance	The verifications for the limit states ground failure, sliding and serviceability (verification of the settlement) are replaced by empirical design values of the base pressure resistance.
Limitation of eccentricity	Verification according to NF P 94-261 13.3 for the eccentricity of the load.
Ground failure check	In the ground failure analysis the shear resistance of the soil below the foundation level are considered. The soil layers above the foundation level are considered as a top load when the soil plane and the ground top level are horizontal.
Seismic	With the additional option FD-PRO: if the option is selected, a seismic bearing failure analysis according to DIN EN1998-5:2010 Appendix F is performed. A dialog with the appropriate selection/input parameters is displayed.

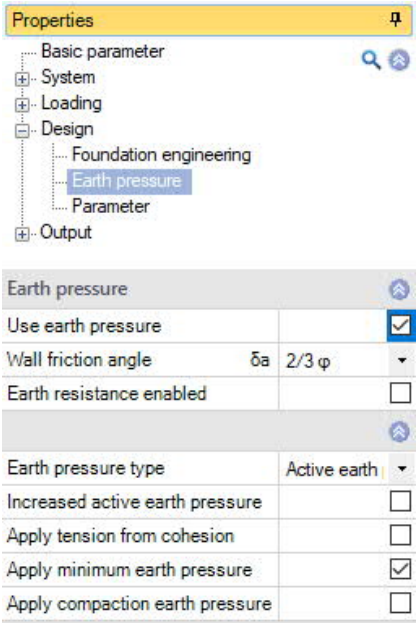
Depth coefficients	The depth coefficients take into account the favorable influence of the shear strength in the fracture joint above the foundation base in the ground failure verification. In some European countries, this effect can be taken into account with coefficients > 1.
Safety against sliding	When the load vector is not perpendicular to the base surface, the resistance of the foundations against sliding in the base area must be verified.
Calculate settlement	For the settlement analysis, the compression of the soil should be taken into account down to the settlement influence depth ts. The depth ts may be assumed at the level at which the additional perpendicular stress generated by the mean settlement effective load has an amount of 20% of the effective vertical output stress of the soil. One of 5 calculation methods can be selected.
Gaping joint	Optional verification of the gaping joint.



Earth pressure (with the add-on FD-PRO)

Enables the application of earth pressure.

See FD-PRO



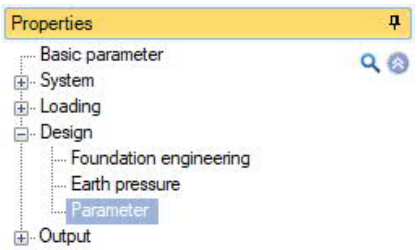
Parameter

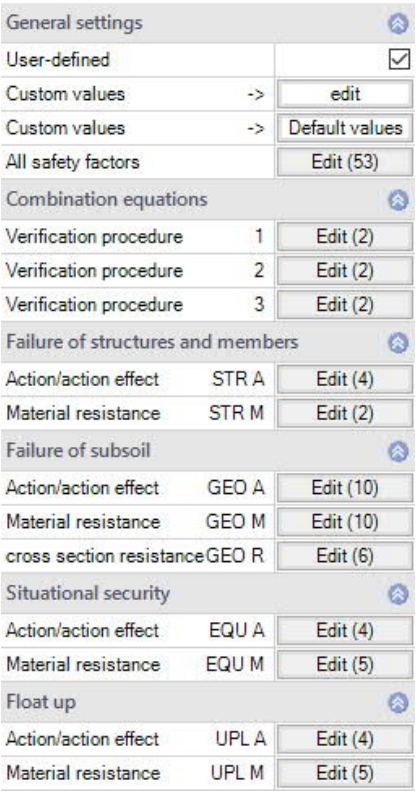
User defined

Mark this option if you want to change the safety factors and design rules that deviate from the set standards.

The corresponding input fields/editing buttons are then displayed.

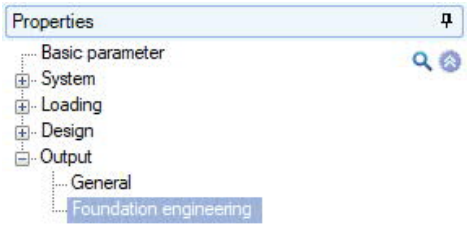
Use the "Edit" button to open the respective tables for changing the values - the information texts for the individual parameters are displayed in the lower window area when you click in an input field.





- Support of all 3 verification methods according to Eurocode 7, adjustable for all national annexes.
- The partial safety factors and combination equations for the geotechnical verifications can be edited.
- Since all table values can be changed, the standard setting for a specific country (e.g. India, Sweden, etc.) can be easily defined.

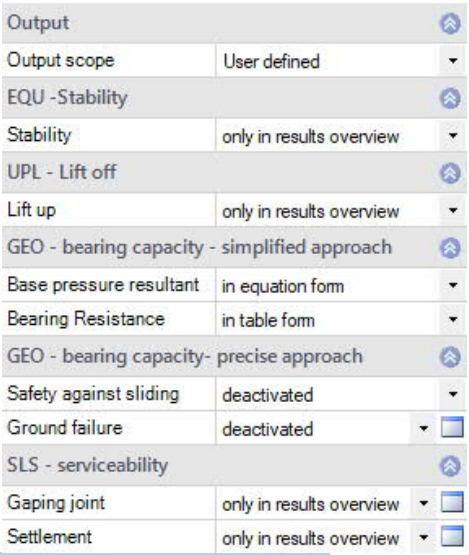
Output



Output scope / options

By checking the desired options, you can determine the scope of output.

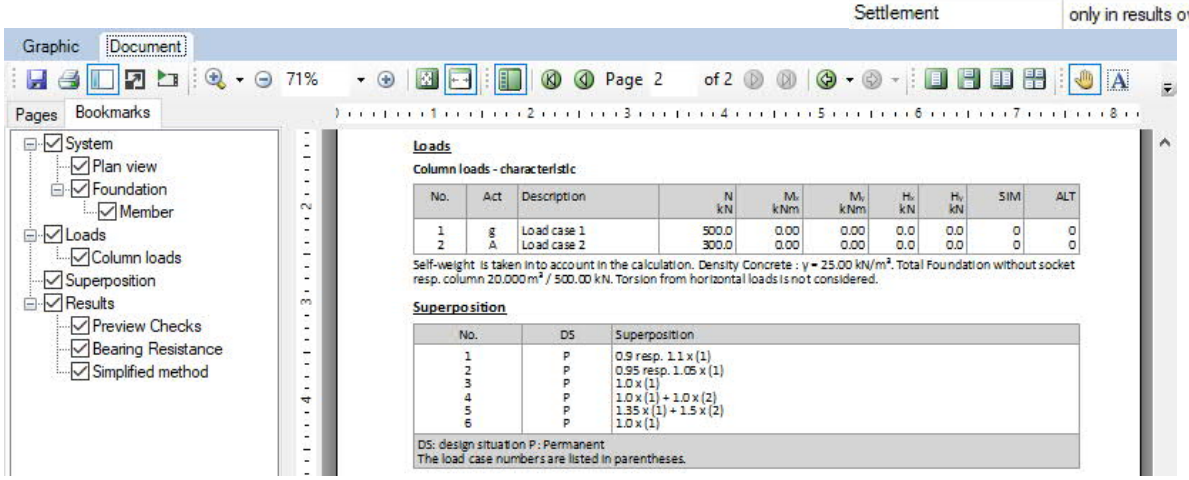
Font size and scale can be adjusted for the graphic.



Output as PDF document

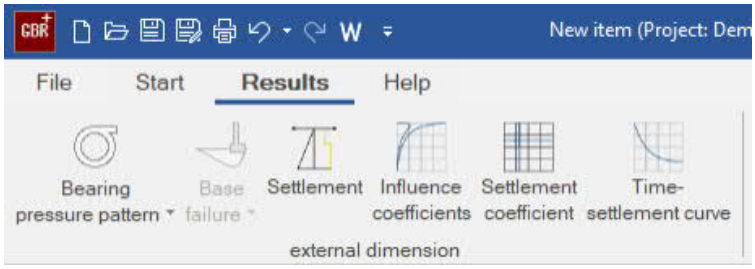
The Document tab displays the document in PDF.

See also Output and printing.



Results graphics

You can display result graphics via the "Results" tab.



Allplan Export

Under File - Export you can export a file that can be imported into Allplan.