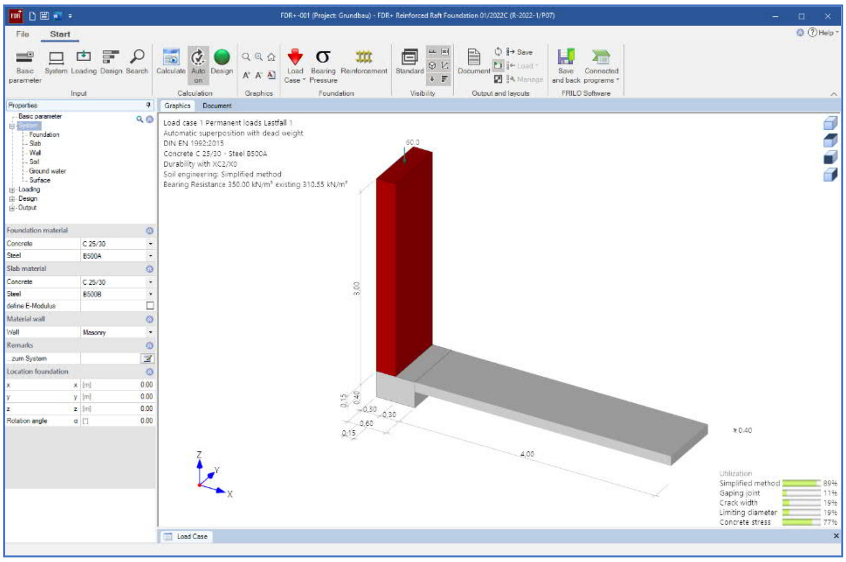
Reinforced Raft Foundation FDR+

Contents

Application options

The FDR+ application allows the design of eccentrically loaded boundary foundations that are connected to a reinforced concrete slab with a rigid joint. In the design, the centring moment, the centring tensile force and the soil pressure are determined with consideration to deformations.



Properties

- Selection options concerning the durability requirements
- Load definition: moments, axial forces, horizontal loads
- Different load cases, that apply alternatively or simultaneously according to the user's selection, are automatically superimposed
- Determination of the base pressure as well as the design value of the base pressure resistance with the help of tables in the selected soil engineering standards or of user-defined tables taken from a soil expertise, for instance
- Examination and consideration of a gaping joint
- Consideration of the accidental design situations BS-A and BS-E
- Interface to the FRILO Building Model (GEO)
- The self-weights of the wall, the facing masonry and the foundation can be selected independently of each other
- Optional calculation of the connecting reinforcement of the rising wall to the foundation
- Bending design of the foundation and verification whether reinforcement could be dispensed with in the lower layer of the foundation
- Centring in the rigidly connected reinforced concrete slab in accordance with J. Kanya, Bautechnik 05/1969
- Simultaneous restraint in the wall and the slab is optionally selectable
- Bending design at the connection between the foundation and the reinforced concrete slab
- Calculation of settlement effects
- Calculation of the foundation's deformation
- Verification of the concrete compression stress and the steel tensile stress at the connection to the slab
- Crack width verification at the connection to the slab
- Ground failure verification with consideration of berms and the anchoring depth of the foundation
- Simplified verification using the design value of the base pressure resistance as a rule
- Reinforcing steel mesh, steel bar or user-defined As values are the available reinforcement options

Limits of application

The following conditions in accordance with Kanya, Bautechnik 05-1969 are to be complied with when using the software:

- The foundation of the building is designed in such a way as to ensure that all foundations are subject to the same average settlement in the centre of gravity of their surface areas (no settlement variations).
- The eccentrically loaded border foundation can rotate around the fulcrum “D”.
- The adjacent central foundation is torsionally stiff.
- A pure structural system is assumed, i.e. there are no disturbing connecting devices parallel to the supporting direction of the centring plate.
- The centring plate is appropriately reinforced and softly supported. No external influence acts additionally on the centring plate.
- The border foundation is infinitely stiff in itself.
- The self-weight of the centring plate is negligibly small compared to the applying load.

Note: *The stiffness modulus should be selected with utmost care.*
Because the cross section in the connection between the floor slab and the foundation can tear off widely, you can reduce the stiffness of the floor slab with a pre-factor. You can also define a factor for the bending stiffness of the wall.

Actions and loads

Loads are always defined with characteristic values. You can define loads as acting alternatively. The alternative group numbers are available for this. When you assign the alternative group 0 to the defined load, this means that it can participate in all load combinations generated with the combination rules. If two or more loads are members of the same alternative group, they never act simultaneously.

For the structural components wall, facing masonry and foundation, you can activate or deactivate the self-weight separately. The activated self-weight portions, which are calculated automatically, are included in the combinatorial analysis.

Verifications in the ultimate limit state

You can select different concrete types and reinforcing steels for the wall, the foundation and the connected reinforced concrete slab. You can also define masonry for the wall. In order to provide for the required reinforcement, you can define woven steel fabric and/or rebar. If the selected reinforcement exceeds the required quantity in the ultimate limit state, it is included in the verification of the serviceability limit state instead of the required reinforcement. Dialogs for the selection of the exposure classes and the determination of the shrinkage coefficient and the creep factor are available in connection with the durability and serviceability requirements. The resulting concrete coverage and reinforcement layers are taken into account. The bending design is based on the kh (kd) method. If the wall is connected to the foundation in a deflection-resistant manner, the foundation is dimensioned in the contact face of the wall. Otherwise, the bending moment centrally underneath the wall is taken into account in the design. The minimum reinforcements of the wall, the foundation and the slab can be selected independently of each other. The software checks whether the foundation can be installed without reinforcement in the lower layer. The shear force analysis is performed at the distance from the wall that is equal to the structurally effective height d. The user can select whether the foundation should be designed as a reinforced concrete slab or a reinforced concrete beam. The shear design as a reinforced concrete beam produces the minimum shear reinforcement in each case.

Verifications in the serviceability limit state

The deformation of the foundation is calculated for the quasi permanent and infrequent load combinations. In this calculation, the displacement of individual points in the foundation is indicated as a fraction of the foundation width (e.g. L/500) and torsion is specified in degrees. In addition to the deformation analysis, verifications are performed in accordance with the selected reinforced concrete standard. They include verifications of the compressive concrete stress, the tensile steel stress as well as the calculation of the existing crack width and the limit diameter of the reinforcement at the connection of the reinforced concrete slab and the foundation. In these calculations, a creep factor that can optionally either be defined by the user or be calculated by the software is taken into account.

Verifications in the ultimate limit state

Simplified verification, normally using the design value of the base pressure resistance

Based on the calculation method by Kanya, the software calculates a trapezoidal or, if a gaping joint occurs, a triangular base pressure distribution, which is compared to the selected design value of the base pressure resistance. Optionally, the permissible base pressure can be taken from a table in the selected foundation engineering standard, a table in a soil expertise or the user can enter a user-defined value. As far as the gaping joint is concerned, the software checks whether a gaping joint occurs when only permanent loads apply and whether the gaping joint produced by permanent and variable loads is greater than half of the foundation width.

Ground failure analysis

In addition to the verification of the base pressure, the FDR+ software offers the possibility of performing a ground failure analysis as per DIN 4017 [2006-03] or ÖNORM B 4435-2 [1999-10]. In this verification, a homogenous soil layer above the foundation base and a homogenous soil layer underneath the foundation base are assumed. These layers are determined by the ground failure pattern calculated from the individual soil layers. A berm adjacent to the foundation can be taken into consideration. The relation of the foundation thickness *d* to the foundation width *b* should not exceed 2 in this calculation.

Basis of calculation

Available standards

- DIN EN 1992-1-1/NA:2011/2012/2013/2015
- ÖNORM B 1992-1-1:2011
- NA to BS EN 1992-1-1/A2:2015/2009
- EN 1992-1-1:2004/A1:2014
- DIN EN 1997-1/A :2010
- ÖNORM B 1997-1:2013
- NA to BS EN 1997-1/A1:2014

National design standards

- DIN 1054 [2005-01]
- DIN 1054 [2010-12]
- DIN 4017 [2006-03]
- DIN 4019 [2014-01]
- ÖNORM B 4435-2 [1999-10] sowie
- J. Kanya / Bautechnik 05/1969

Basis of calculation in accordance with Kanya, Bautechnik 1969

Initial values

a	= foundation height
b	= foundation width
c	= load distance from outer edge of the foundation
d	= slab thickness
l	= clear distance between two neighbouring strip foundations
E_b	= modulus of elasticity of the concrete
I_b	= moment of inertia of a slab cross section with a width of 1 cm
I_b	= surface area of a slab cross section with a width of 1 cm
E_{Bo}	= stiffness modulus of the subsoil
C_{Bo}	= subgrade reaction modulus of the subsoil
S_{Bo}	= shear modulus of the subsoil
P	= resulting vertical load

Initial values – foundation restrained in the slab

$$\alpha = 3{,}2 \cdot \frac{E_b \cdot I_b}{l \cdot E_{Bo}}$$

$$\beta = \alpha - d/2$$

$$\gamma = P/b$$

$$\delta = \frac{2 \cdot \beta^2}{3 \cdot F_b \cdot E_b + 2{,}5 \cdot l \cdot E_{Bo}} \cdot F_b \cdot E_b$$

Special case – foundation restrained in the wall and the slab, wall hinged on top

$$\zeta = \left(\frac{l_{Wall}}{3 \cdot E_{Wall} \cdot I_{Wall}} \right) / \left(\frac{l_{Slab}}{4 \cdot E_{Slab} \cdot I_{Slab}} \right)$$

$$\alpha = 3{,}2 \cdot \frac{E_b \cdot I_b}{l \cdot E_{Bo}} \cdot \frac{1}{1+\zeta}$$

$$M_{Wall} = \frac{\zeta \cdot M_Z}{1+\zeta}$$

$$M_{Slab} = M_Z - M_{Wall}$$

Special case – foundation restrained in the wall and the slab, wall restrained on top

$$\zeta = \left(\frac{l_{Wall}}{4 \cdot E_{Wall} \cdot I_{Wall}} \right) / \left(\frac{l_{Slab}}{4 \cdot E_{Slab} \cdot I_{Slab}} \right)$$

$$\alpha = 3{,}2 \cdot \frac{E_b \cdot I_b}{l \cdot E_{Bo}} \cdot \frac{1}{1+\zeta}$$

$$M_{Wall} = \frac{\zeta \cdot M_Z}{1+\zeta}$$

$$M_{Slab} = M_Z - M_{Wall}$$

Exterior base pressure

$$\sigma_2 = \frac{\frac{2}{3} \cdot b^2 - c \cdot b + \delta + \alpha}{\frac{b^2}{6} + \delta + \alpha} \cdot \gamma$$

Interior base pressure

$$\sigma_1 = 2 \cdot \gamma - \sigma_2$$

Special case - gaping joint

$$b' = \frac{+c \pm \sqrt{c^2 + 4/3(\delta + \alpha)}}{2} \cdot 3$$

$$\sigma_2 = 2 \cdot \gamma' = 2 \cdot \left(P/b'\right)$$

$$\sigma_1 = 0$$

Distance of the base pressure resultant from the outer edge of the foundation

$$s = \frac{1}{3}\left(\frac{\sigma_1}{\sigma_1 + \sigma_2} + 1\right) \cdot b$$

Base pressure underneath the calculated equivalent area

$$\sigma' = \frac{(\sigma_1 + \sigma_2) \cdot b}{4 \cdot s}$$

Internal forces inside the centring plate

$$M_z = (\sigma_2 - \gamma) \cdot \alpha$$

$$H_z = (\sigma_2 - \gamma) \cdot \delta/\beta$$

Subgrade reaction modulus

$$C_{Bo} = 2{,}5 \cdot E_{Bo}/b$$

Angle rotation due to the centring moment

$$\phi = \frac{1}{4} \cdot \frac{M_z}{E_b \cdot I_b} \cdot l$$

Vertical displacement on the interior side

$$\Delta_1 = \frac{\sigma_1}{C_{Bo}}$$

Vertical displacement in the foundation centre

$$\Delta_v = \frac{\sigma_1 + \sigma_2}{2 \cdot C_{Bo}}$$

Vertical displacement on the exterior side

$$\Delta_2 = \frac{\sigma_2}{C_{Bo}}$$

Horizontal displacement on the bottom

$$\Delta_H = \phi\left(a - \frac{d}{2}\right) - \Delta_Z$$

Horizontal displacement on the top

$$\Delta_Z = \frac{H_Z \cdot l}{F_B \cdot E_b}$$

Other parameters to be included

Self-weights of the foundation, the wall and the facing masonry

You can active or deactivate separately the self-weights of the wall, the foundation and the facing masonry. Permanent loads always act simultaneously. The self-weight portions of the foundation, the wall and the facing masonry result from the defined values for the volume and the specific weight.

The self-weight is taken into account by generating a resulting load P, which is composed of the vertical loads of the respective load combination considering the associated combination rule and of the respective activated self-weight portions.

In this connection, a new resulting load distance C of the load P from the outer edge of the foundation is also calculated.

$$P = N_{Ed} + F_{Wall} + F_{facing} + F_{Foundation}$$

$$c = \frac{\left(N_{Ed} + F_{Wall}\right) \cdot l_{distance\ to\ axis,Wall} + F_{facing} \cdot l_{distance\ to\ axis,Facing} + F_{Foundation} \cdot l_{distance\ to\ axis,Foundation}}{N_{Ed} + F_{Wall} + F_{Facing} + F_{Foundation}}$$

Consideration of horizontal loads

In the calculation, horizontal loads are applied to the top of the foundation in the central axis of the wall. In the calculative approach of the software, they generate a moment with a lever arm that is as great as half the height of the connected reinforced concrete slab. The horizontal load itself is transferred through the foundation and considered in the design of the connection of the foundation to the reinforced concrete slab.

Consideration of moments

If moments are defined in addition to vertical loads or if moments result from the horizontal loads at the base of the wall, they influence the position of the resultant of the vertical loads. Moments defined as positive rotate the foundation clockwise towards the inside of the building. The resultant of the vertical loads is displaced by the length $e = M_{Ed} / P$ towards the inside of the building. Moments defined as negative act inversely because of the negative sign of e.

Data entry – Basic parameters

You can enter values and define control parameters in the menu on the left screen section. The effect of the entered values is immediately shown in the graphical representation on the right screen section. Before entering any data, you can edit the dimensional units (cm, m ...) via the options File ▸ Program settings.

Wizard

The definition wizard is automatically launched when you start the software. You can disable the wizard in the settings menu.

Input options in the three-dimensional GUI

The data entry via the GUI is described in the document "Basic operating instructions-PLUS."

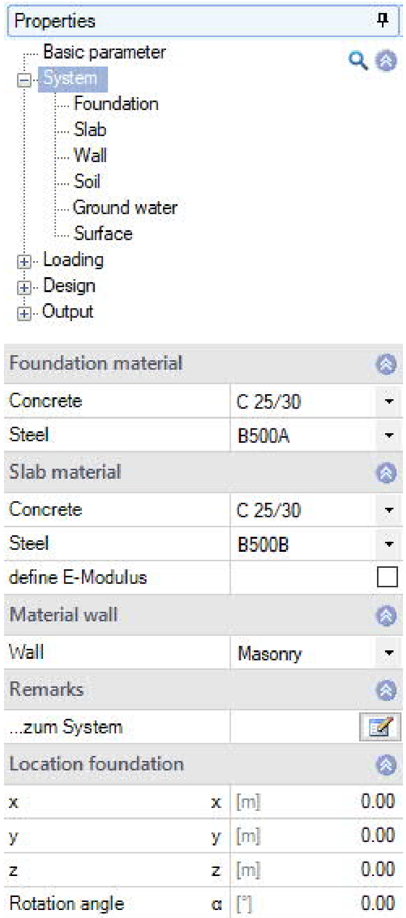
Basic parameters

Reinforced Concrete

Select the desired reinforced concrete standard:
See Basis of calculation.

According to the selected reinforced concrete standard, the software selects the corresponding standards for foundation engineering and ground failure automatically.

Structural system



Material

Select the quality of the concrete and the reinforcing steel grade as well as the material of the wall (masonry or concrete).

For the calculation of internal forces, of soil pressure and base pressure as well as of deformations, the modulus of elasticity of the connected reinforced concrete slab is used as a standard. Optionally, you can specify a user-defined modulus.

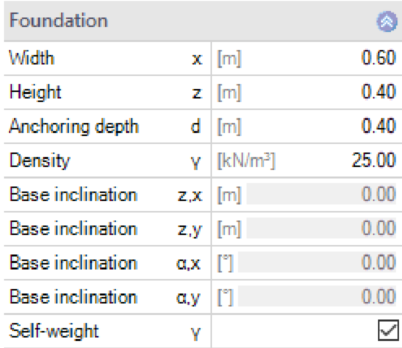
Remarks

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

Location foundation

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

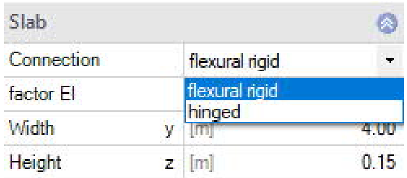
Foundation



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.

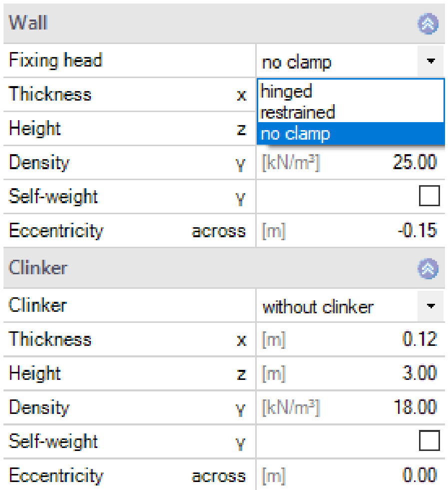
Width	x foundation dimension in x-direction
Height	z foundation height
Anchoring depth d	Lowest foundation depth below the ground level or below the top edge of the basement floor.
Specific weight γ	Gamma concrete
Base inclination	Additional anchoring depth from base inclination.
Self-weight	Automatic inclusion of the self-weight of the foundation.

Slab



Connection	The connection of the slab to the foundation can be flexurally rigid or hinged.
Factor EI	When selecting "flexurally rigid", it is the factor for the bending stiffness of the slab. It refers to the stiffness of the cross section in state I. Values up to 1.2 are possible.
Area load…	When selecting "hinged" it refers to the permanent load portion of the reinforced concrete slab that is supposed to act on the foundation.
Width	Clear distance between the foundations.
Height	Height of the slab. The height affects the flexural rigidity of the slab and thus the torsion of the foundation.

Wall



Fixing on top	Specifies how the wall impedes torsion of the foundation: hinged, restrained, no fixing/clamp.
Factor EI	Hinged: factor for the flexural rigidity of the slab. It refers to the stiffness of the cross section in state I.
Thickness x	Thickness of the wall.
Height z	Height of the wall.
Density γ	Specific weight of the wall.
Self-weight	Automatic inclusion of the self-weight of the foundation.
Eccentricity, transverse	Eccentricity in the x-direction. *Note: No positive values are intended for the eccentricity, because that would mean that the connected reinforced concrete slab is bedded on the ground. This is not taken into account in the calculation approach. For such cases it is recommended to calculate the system as bedded beams.*

Clinker / Wall facing

Clinker — Allows you to select whether facing masonry should be included in the calculation.

Thickness — Thickness of the facing masonry.

Height — Height of the facing masonry.

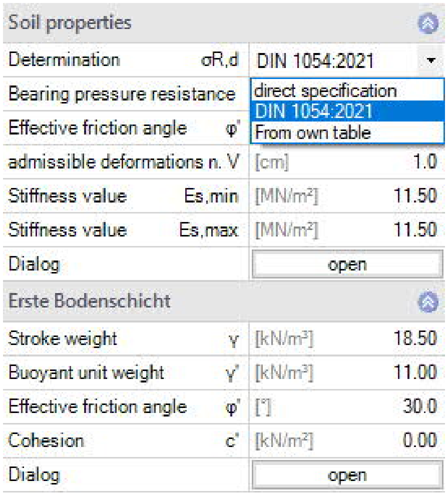
Density — Specific weight of the soil.

Self-weight — Activate this option to include the self-weight of the facing masonry automatically.

Eccentricity — Eccentricity of the facing masonry in the transverse direction.

Soil

Soil properties



Determination $\sigma_{R,d}$ — 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.

Bearing pressure resistance — Specification of the permissible bearing pressure $\sigma_{R,d}$
In the case of “direct specification”, input of the design value of the bearing pressure resistance σR,d for the permanent design situation BS-P. For the design situations BS-A, BS-E and BS-T, the design value is increased according to the ratio of the partial safety factors of the bearing capacity. For example 1.4/1.2 = approx. 116% or 1.4/1.3 = approx. 107%.

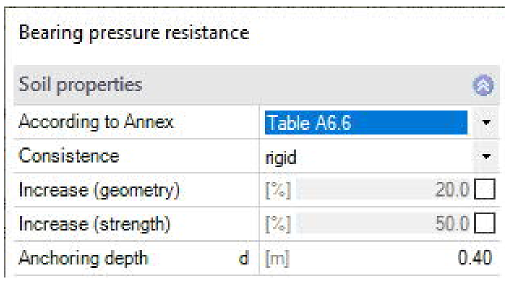
Eff. friction angle φ´ — Friction angle of the drained soil underneath the foundation base.

adm. deformations V — Permissible displacement. It is compared to the maximum displacement of the foundation in the vertical direction.

Stiffness value — Es,min/max.; upper/lower limit of the stiffness modulus. You can define the upper and lower limits for the stiffness modulus. In each superposition, the most unfavourable values are used. If the calculation should be performed without limits, enter the same value for the upper and the lower limit. The stiffness modulus is provided by the soil expert. Betonkalender 1998, part 2, p. 472 specifies guiding values for the stiffness modulus Es in MN/m²: gravel, pure: 100.0 to 200.0 - sand, pure: 10.0 to 100.0 - coarse clay: 3.0 to 15, clay 1.0 to 60.0 - peat 0.1 to 1.0

Load tilt — With "direct specification" you can enter (if the option is ticked) the maximum inclination of the characteristic or representative base pressure resultant H/V, which is to be checked in the simplified verification. Otherwise, default values are used.

Dialog — 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” Button to open the tabledialog.



Parameters by standard table DIN 1054:

According to Annex — Selection of the table in the selected soil standard or the currently active NAD. The permissible base pressures are taken from this table.

Consistency — Consistency of the soil: rigid, semi-solid, solid.

Increase (geometry)	The permissible soil pressure can be increased by 20 % if the corresponding border conditions (b/d) specified in the standard are complied with.
Increase (strength)	Optional increase by 50 % if the soil is sufficiently solid. *Note: The values are added up under particular conditions (70 %).*
Anchoring depth d	Lowest foundation depth below the ground level or the top edge of the basement floor.

Defining an own table:
To enter the design value of the base pressure resistance, you can add a new row to the self-defined table by pressing the button. This value should be taken from a soil expertise and should ensure sufficient safety against ground failure and a sufficient limitation of the settlement. Enter the corresponding foundation width and anchoring depth in addition. The functions of the buttons are explained in the tool tips.

First soil layer

The first soil layer is entered directly. Additional soil layers can be added to the table via the “open” button .

Erste Bodenschicht			
Stroke weight	γ	[kN/m³]	18.50
Buoyant unit weight	γ'	[kN/m³]	11.00
Effective friction angle	φ'	[°]	30.0
Cohesion	c'	[kN/m²]	0.00
Dialog			open

Stroke weight	γ	Specific weight of the soil.
Buoyant unit weight	γ´	Specific weight of the soil layer under buoyancy. Define ground water to enable this data-entry field.
Eff. friction angle	φ´	Friction angle of the soil in this layer.
Cohesion	c'	Soil cohesion.

Additional soil layers / additional parameters (Dialog “open”)

	γ [kN/m³]	γ' [kN/m³]	φ' [°]	c' [kN/m²]	xU' [m]	others
1	18.50	11.00	30.0	0.00	1.50	Values

xU	Thickness of the soil layer. You cannot define soil layers with less than 0.1 m thickness.

Activating the “Values” button accesses a dialog with additional parameters:

Calculation of the settlement

Procedure	User-defined / based on stiffness modulus Select whether to enter a user-defined value for the modulus of compressibility *E** or have it calculated from the stiffness modulus and the correction factor (DIN 4019 P1).
E*	Modulus of compressibility. The compressibility of the soil can be obtained from a pressure settlement line or be calculated using the stiffness modulus and the correction factor.
Es	Stiffness modulus
x	Correction factor

Soil layer			
Settlement analysis			
Procedure			direct specification
Compresses modulus	E*	[kN/m²]	4946.00
Stiffness module	Es	[kN/m²]	2473.00
Correction factor	x		0.50
Settlement analysis: Consolidation			
Permeability factor	k	[m/s]	1E-09
Both sides drained			☐

Settlement analysis: Consolidation

k — Coefficient of permeability for the consolidation speed. You can take the value from a soil expertise.

Both sides drained — For the calculation of the time until the consolidation settlement subsides approximatively, the full layer thickness is taken into account with drainage on one side. With drainage on both sides, only half of the layer thickness is taken into account.

Groundwater

Groundwater existing — Check this option when groundwater exists in the subsoil - the data-entry field for the depth of the ground water is displayed subsequently.

Groundwater — Absolute depth of the groundwater below the bottom edge of the foundation body.

Surface

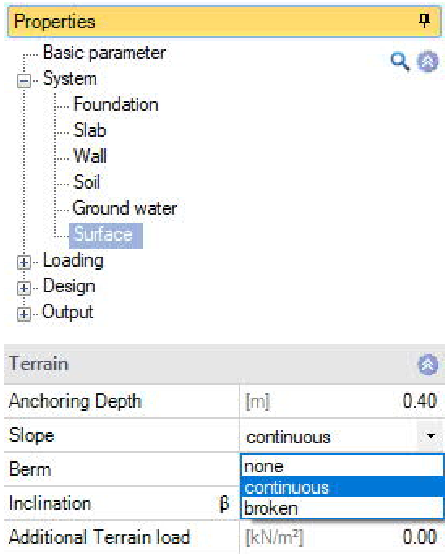
Anchoring depth — Anchoring depth of the foundation body.

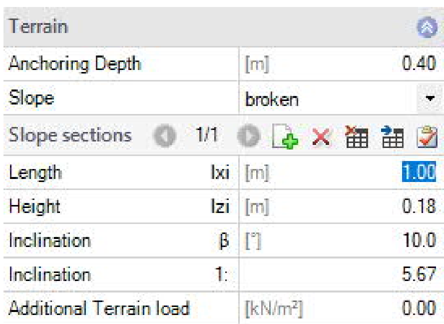
Slope — The ground level can be modeled as horizontal, with a continuous slope, or with a broken embankment.

Continuous:
Here you can define a berm and the slope - see advanced foundation dialog.

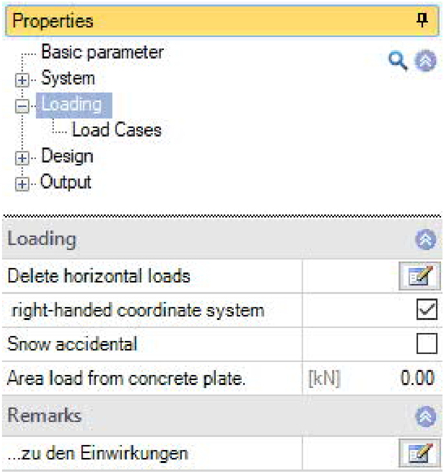
Broken:
Input of the embankment sections. The "+" symbol creates a new table row for a further section. Parameters are length, height or inclination or rise (the height adjusts automatically to the incline).

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





Loads



Delete horizontal loads: The button allows you to delete all horizontal loads at once! This function can be helpful when importing load cases from other software applications (GEO, B5+...). You can define horizontal loads in the Load Cases dialogs.

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.

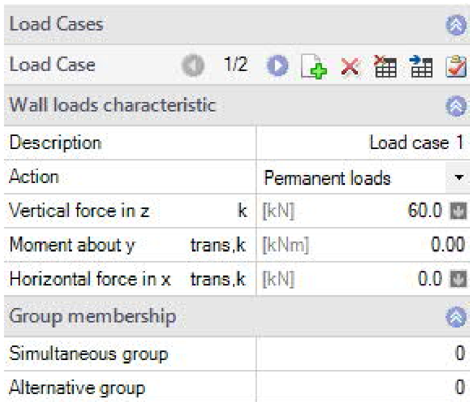
Accidental snow load: When you check this option, snow loads are automatically included as accidental action in addition to the typical design situations. The user can either specify a freely selectable load factor for the accidental snow loads or have it determined automatically by the software. The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

Area load from concrete plate: Enter the permanent load component of the reinforced concrete slab here, which should act on the foundation.

Remarks

Click on the button to enter your own comments on the actions.

Load Cases



Enter the data of the first load case either in the corresponding data-entry mask or directly in the load case table, which you can display below the graphic by activating the Load Case button.

Load case toolbar: Load case 1/2

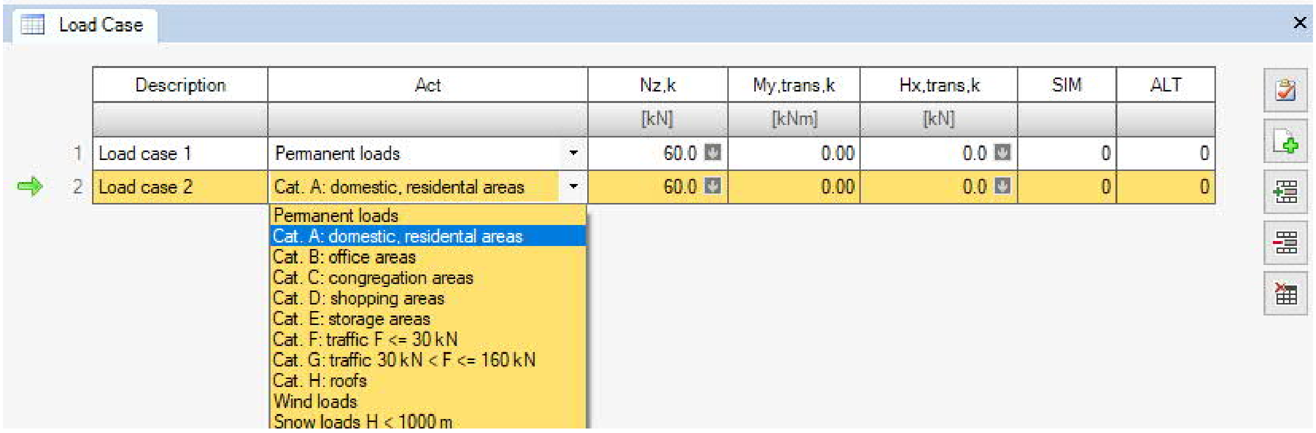
To add load cases, always set up a new load case first by activating the button (a data-entry mask for the new load case is displayed each time).

- See also Data entry via tables in the Basic operating instructions PLUS.pdf

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

Characteristic wall loads

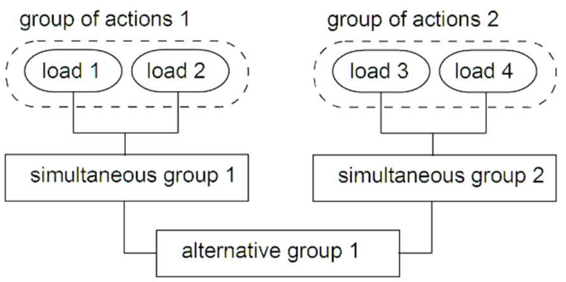
Description	Optional text to the selected action can be entered. This text is included in the output.
Action	The appropriate actions can be selected from a list: Permanent loads ... Earthquake.
Vertical force in z	Vertical force Nz in the centre of the wall
Moment about y	Moment $M_{y,trans}$ defined with for the wall.
Horizontal force in x	Horizontal loads act on the top edge of the foundation. These horizontal loads generate moments on their way down to the foundation base, which are taken into account automatically.



Grouping

Simultaneous group (SIM)

Loads of a particular action group can be defined as "always acting simultaneously"



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

Alternative group (ALT)

Different variable load cases with similar actions can be combined to an alternative load case group by assigning an alternative group number to them. Only the decisive load case of this alternative load case group is invoked in the superposition.

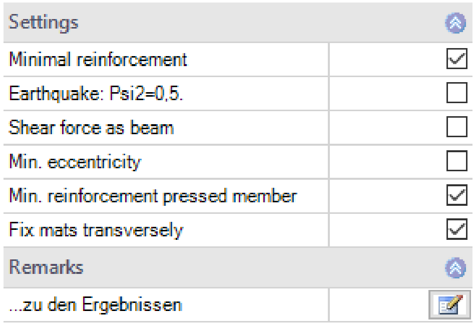
Base pressure

Displaying the base pressure pattern

To ensure traceability, the base pressure pattern with stress ordinates (red and blue arrow icons in the multifunction bar) can be displayed in the 3D representation of the load arrangement for all load cases and superpositions decisive in the verifications. Click on the base pressure icon to activate the function. The graphic is displayed in a pop-up window. See chapter ▸ Design ▸ Soil Engineering.

Design

Settings



Minimum reinforcement — Ductility reinforcement in accordance with the selected reinforced concrete standard

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 earthquake loads.

Shear force as beam — Specification whether the shear resistance should be verified on a slab or a beam.

Min. eccentricity — Considering minimum eccentricities for compression member by EN 1992-1-1 6.1 (4).

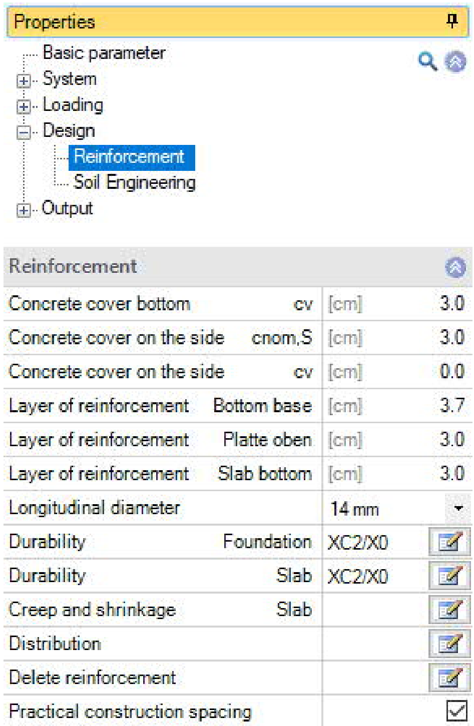
Minimum reinforcement for column — This option allows you to take a minimum reinforcement for compression members into account.

Fix mats transversely — Ticked option means: the mats in the transverse direction are also taken into account for the increase of the predefined reinforcement.

Remarks

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

Reinforcement



The software allows you to define non-specifically up to two layers of fabric and two layers of bar steel distributed over the entire foundation on top and bottom.

cv,u — Laying dimensions of the specified reinforcement on the underside of the foundation. The specified reinforcement is designed into the foundation body according to this laying dimension. Based on this, 2D and 3D graphics are created.

cV,s — Laying dimensions of the specified reinforcement on the outside of the foundation.

cv,t — Laying dimensions of the specified reinforcement at the top of the foundation.

Reinforcement layer:

Bottom base — Reinforcement layer on the bottom of the foundation. The software uses this diameter to calculate a reinforcement that covers the requirements. If the minimum and maximum spacing cannot be realised with the initially defined diameters, higher diameters are used.

Slab top/bottom — Reinforcement layer on the top/bottom of the slab.

Longitud. diameter — Selection list of the diameter that shall be used for the generation of the longitudinal reinforcement. The software generates sufficient reinforcement of this diameter to comply with the required reinforcement. If the minimum and maximum spacing cannot be realised with the defined diameter, a greater diameter is used.

Durability — Activating the button displays the corresponding Durability dialog. When you confirm your settings in this dialog with OK, the concrete cover, reinforcement layers and their diameter are checked and adjusted accordingly.

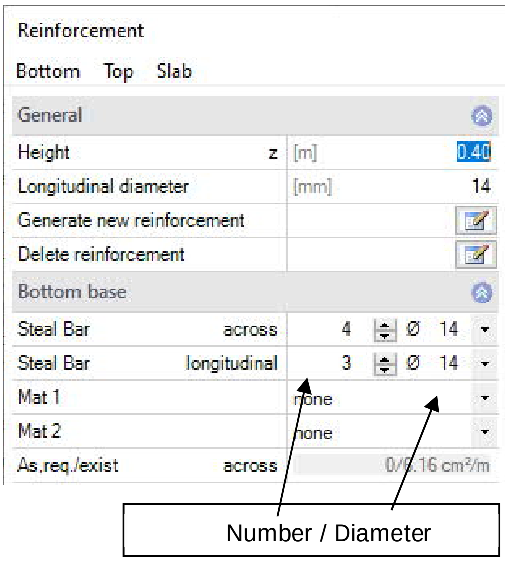
Creep and shrinkage — Displays the dialog to define the creep factor and the shrinkage strain.

Distribution — Displays the enhanced reinforcement dialog for top/bottom/slab.

Delete reinforcement — Deletes the default reinforcement.

Practical construction spacing — As a standard, the bar spacing is calculated accurately, i.e. the resulting bar spacing is calculated precisely to the millimetre. If the option is ticked the bar spacing is adjusted to 5, 6, 7, 7.5, 8, 9, 10, 12.5, 15, 17.5, 20, 22.5, 25, 27.5 or 30 cm.

Enhanced reinforcement dialog



The enhanced reinforcement dialog can be accessed via the button or via ▸ Design ▸ Reinforcement ▸ Distribution.

Next to the tabs for the lower and the upper reinforcement the "Slab" tab is displayed.

General

Height — Height of the foundation in the x-direction.

Longitud. diamater — As described for the Reinforcement dialog.

Generate new reinforcement — The software calculates a reinforcement that satisfies the requirements as a minimum. If the minimum and maximum spacing cannot be realised with the selected diameter, a greater diameter is used. When you delete the default reinforcement, the automatic generation of the reinforcement is disabled and the default reinforcement remains unchanged. If it turns out to be insufficient, the software displays a warning message. If no reinforcement was pre-set, no warning is displayed. When generating the reinforcement automatically, the software starts with the default longitudinal diameter.

Delete reinforcement — Deletes the default reinforcement and the structurally required reinforcement is used in the calculations.

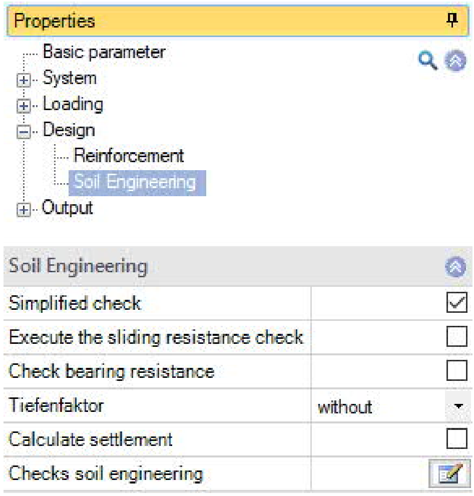
Foundation bottom/top/slab

Bar steel X/Y — Define the number of bars in the first column and the diameter of the bars in the second column separately for the x-direction and the y-direction.

Fabric (Mat) 1/2 — Selection of a reinforcement steel fabric

As, req./exist. — Informative indication

Soil Engineering



Simplified verification
The verification in the limit states of the ground failure, the slide stability and the serviceability (verification of the settlement) are replaced by empirical design values for the base pressure resistance.

Perform slide stability analysis
If the load vector is not perpendicular to the base surface the foundations must be examined for failure due to sliding in the base surface.

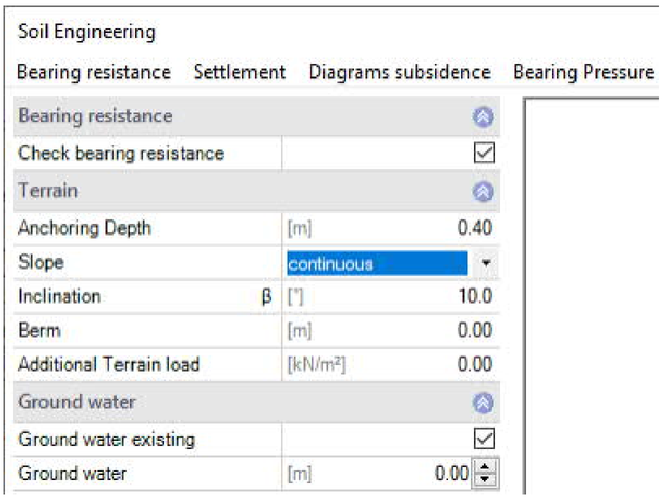
Perform ground failure analysis
In the ground failure analysis, the shear resistance of the soil underneath the foundation plane is taken into account. The soil layers above the foundation plane are included in the form of top loads if the base surface and the ground top surface are horizontal.

Depth coefficients (Tiefenfaktor)
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.

Calculate settlement
In the calculation of the settlement, the compressibility of the soil down to the settlement influence depth *ts* is to be considered. This depth can be assumed at the level at which the perpendicular additional stress of the average effective settlement load equals 20 % of the effective perpendicular initial stress of the soil.

Checks soil engineering
The option allows you to access the enhanced soil engineering dialog with graphical representations of the ground failure, settlements and the base pressure.

Ground failure – enhanced soil engineering dialog



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

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

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

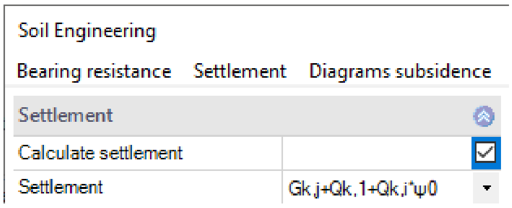
Berm
The width of berm is the distance between the outer edge of the foundation and the beginning of the slope.

Additional Terrain load
Additional characteristic permanent area load of the ground failure mode which increases the characteristic punching resistance.

Groundwater exists	Tick this option if groundwater exists in the area.
Groundwater Depth	Absolute depth of the groundwater measured from the bottom edge of the foundation.

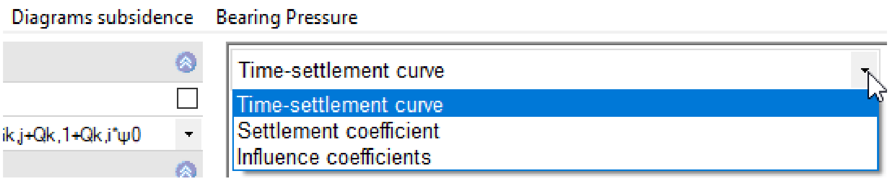
Settlements

Calculate settlements — In the calculation of the settlement, the compressibility of the soil down to the settlement influence depth *ts* is to be considered. This depth can be assumed at the level at which the perpendicular additional stress of the average effective settlement load equals 20 % of the effective perpendicular initial stress of the soil.



Settlement — Settlements can be calculated with permanent loads or with permanent and variable loads. You can use combination coefficients for variable loads in characteristic load cases. See also DIN 1054:2010 2.4.8 A (2.8a).

Diagrams subsidence

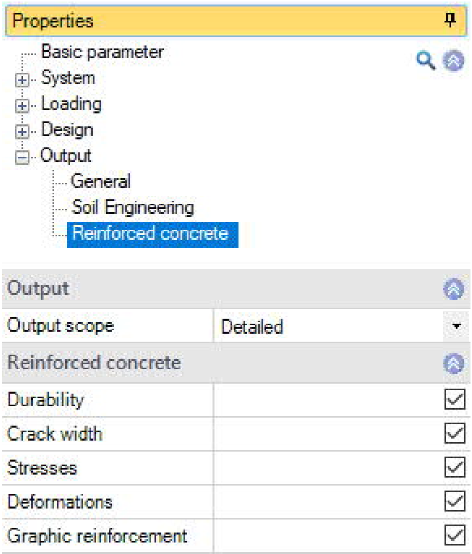


Bearing pressure

Display of the bearing pressure graphic. The input fields are explained in the chapter Soil.

Output

Scope of the output and options



By checking the desired options, you can determine the scope of texts to be put out. You can adjust the font size and the scale of the graphics to be put out.

Output as a PDF file

On the "Document" tab, a PDF document is displayed.

See also the document Output and printing.