# Basement Wall – BWA+

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## Basic documentation - overview

In addition to the individual program manuals, you will find basic explanations on how to operate the programs on our homepage www.frilo.eu in the download area (Manuals).

*Tip: Go back - e.g. after a link to another chapter/document - in the PDF with the key combination "ALT" + "arrow key left"*

# Application options

The BWA application allows the design of basement walls of reinforced concrete, which can be loaded by vertical loads and moments as well as earth pressure on one side.

At the same time, the program performs the simplified verification in accordance with DIN 1054:2021.

The bending design and shear design of the foundation are put out.

## Available standards


- DIN EN 1992
- BS EN 1992
- ÖNORM EN 1992
- EN 1992
- NTC 1992
- PN EN 1992

Furthermore

- DIN 1045-1
- ÖNorm B4700

Foundation engineering standards:

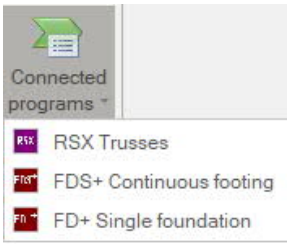
- DIN 1054
- DIN EN 1997-1 in combination with DIN 1054:2021

## Structural system

- Ceiling - wall – foundation
  *Note: It is currently not possible to enter a base plate. Only a foundation can be defined with a ratio of foundation thickness to foundation width that must not be less than 1/3.*
- The floor above can have either have a pinned support or be partially or fully restrained.
- Concentrated loads applying to the wall top and the inner foundation border
- Concentrated moments applying at the wall top
- Structural load on the ground
- Slope
- Block loads
- Soil layers
- Water

## Interfaces

Interfaces to the programs Framework RSX, Strip and Isolated Foundation FDS+/FD+ are available.



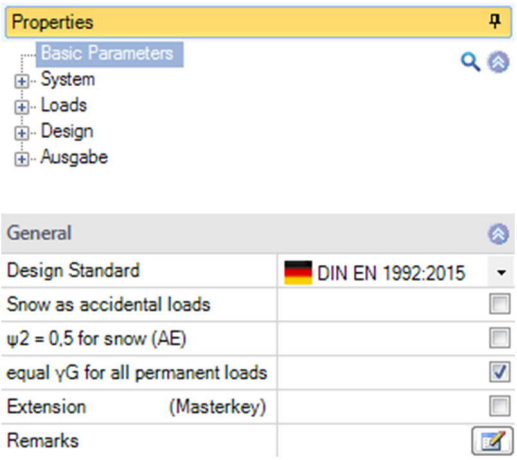

# Basis of calculation

The basement wall is considered as a vertical member with a pinned or restrained top and a base restrained between two bedded members simulating the foundation.

# Data entry

The wizard is launched automatically when you start the application program. You can enter quickly the most important key figures of the frame system in the displayed window. These values can be edited subsequently in the input area or on the interactive graphic user interface (GUI).

## Basic parameters




Design standard
: defines the design standard the structural safety analysis is based on. If you use Eurocodes and specify the national version the associated National Annex is also referred to.

Accidental snow load
: you can select whether the snow loads should be considered as accidental action in addition to the normal design situations. You can either specify a load factor for the accidental snow loads or have it determined automatically by the software.

Load factor for snow
: toggles between automatic and user-defined determination of the load factor that should be used to include snow load as an accidental action relative to its characteristic value.

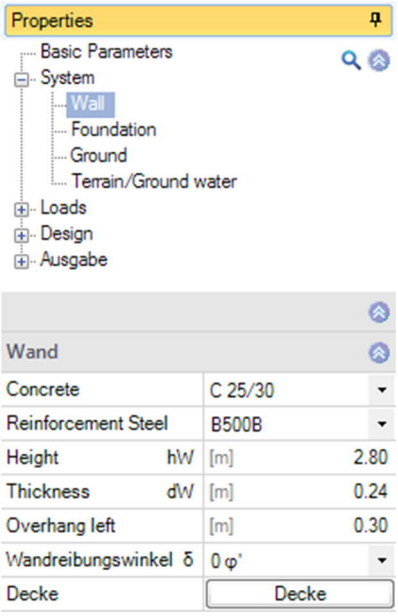
ψ2
: you can select whether the combination coefficient ψ2 in the seismic design situation (AE) should be raised to the value 0.5 for the snow action. (See introductory decrees of the German federal states, e. g. Baden-Württemberg).

same γG...
: you can select whether all permanent loads and/or load cases should be considered with the same partial safety factor (γG,sup or γG,inf). Otherwise, all permanent loads and/or load cases are combined with each other using γG,sup and γG,inf

Remarks
: you can call up a data-entry field for the comment text.

# Structural system

Remarks — Remarks on the system with the remark editor.




## Wall

You can define the material and the dimensions (height, thickness, projection) for the wall as well as the corresponding parameters for the floor above ("Ceiling" button).

Projection — distance from the outer edge of the foundation to the outer face of the wall.

Wall friction angle δ — friction angle δ between wall and soil. δ is in the range -1 · φ´ and +1 · φ´. ± 0φ´ , 1/3φ´, 2/3φ´ or 3/3φ´ are offered for selection or you can enter a coefficient - 1.00 to 1.00 - φ´ via "Input".

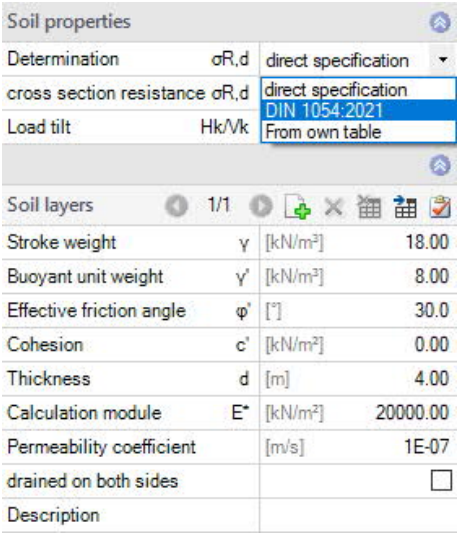
## Foundation

You can define the material and dimensions for the foundation and the value for the subgrade reaction modulus *cb*.

## Soil

### Soil properties

Determination σR,d — select whether to define the design value of the base pressure resistance by entering a user-defined value or by taking a value from a standard table or from a self-defined table - see the paragraph below.




Cross section resistance permissible base pressure $\sigma_{R,d}$

### Soil layers

You can define several soil layers.

You can create an additional soil layer using the  icon.

See also the chapter “Data entry via tables” in the document Basic Operating Instructions-PLUS.pdf

Alternatively, you can also display the entered data on the "Soil layers" tab below the GUI in the form of a well-structured table.

Stroke weight — γ — specific weight of the soil.

Buoyant unit weight — γ´ — specific weight of the soil layer under buoyancy. Define groundwater to enable this data-entry field.

Effective friction angle — φ´ — friction angle of the soil in this layer.

Cohesion — c' — soil cohesion.

Thickness — d — thickness of the soil layer

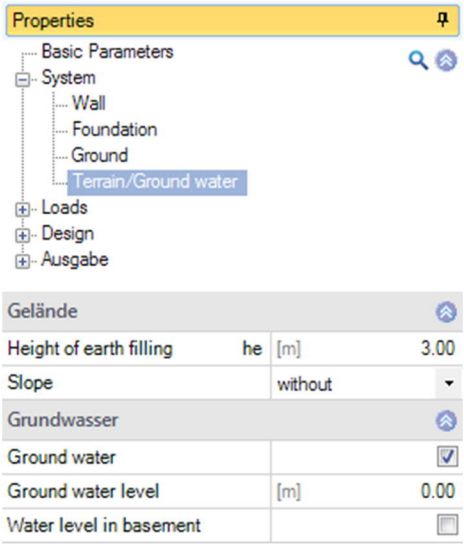
Calculation module — E* — module to be used as calculation value for settlement calculation for this soil layer.

Permeability coefficient — permeability coefficient for the speed of consolidation. The value can be taken from the soil expertise.

| | |
|---|---|
| Drained on both sides | for the calculation of the time until the approximate decay of the consolidation settlements, the full layer thickness is applied in the case of drainage on one side, and only half the layer thickness in the case of drainage on both sides. |
| Designation | you can optionally specify a name for the soil layer. |

## Ground surface/groundwater

### Ground surface




| | | |
|---|---|---|
| Height of earthfill *he* | | height of the earthfill measured from the base of the wall. |
| Slope | without | no inclination i.e. no slope; |
| | continuous | the slope has a uniform inclination; |
| | discontinuous | the slope can be divided into several sections with different inclinations. |
| Height | | height of the slope section in z-direction. The height adjusts automatically via the slope. |
| Inclination | | enter the inclination angle of a continuous slope. |
| Slope | | if a slope is entered, the height/slope are automatically adjusted. |

### Slope sections

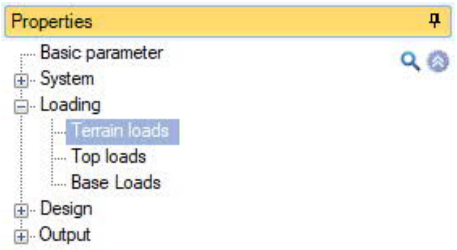
If you have selected a discontinuous slope, you can define the individual sections and their inclination in this dialog box.
For basic information concerning the data entry via tables:
see Data entry via tables (Basic Operating Instructions).

### Groundwater

If this option is selected, a groundwater load is assumed. Specification of the groundwater level measured from the upper edge. The load due to water level can be optionally applied in the basement.

# Loads

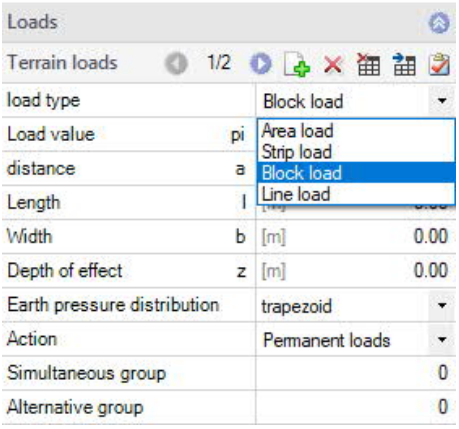
Self-weight — automatic consideration of the self-weight.




## Terrain loads

You can define several ground loads in the dialog box or via the "Ground loads" tab below the GUI.

See also the chapter “Data entry via tables” in the document
Basic Operating Instructions-PLUS.pdf




Load type — area load, strip load, block load or line load.

Load value *pi* — enter the load value or call up the load value summary via the "arrow symbol" - see description.

Distance *a* — distance from the wall edge.

Length *l* — load length parallel to the wall.

Width *b* — load width perpendicular to the wall.

Application depth *z* — distance of the load in the z-direction from the ground top level (values below ground are negative).

Earth pressure distribution — in combination with limited live loads, you can select either a rectangular or a trapezoidal load distribution in accordance with EAB (Recommendations of the Construction Pits Working Group). The ordinates of the trapezoidal distribution result from a linear interpolation that depends on the distance to the wall and the width of the load.

Action — assignment of an action to this load.

Simultaneous group — the loads of a concurrency group always apply simultaneously.
A concurrency group is defined by the number (0, 1, 2, ...) that is assigned to it.

Alternative group — various variable load cases with the same actions can be grouped into 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.

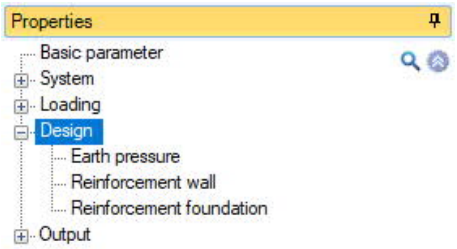
## Top loads

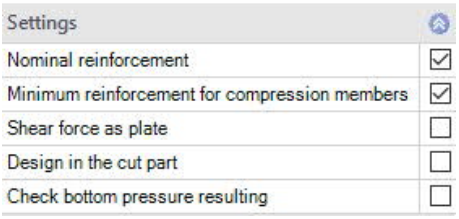
You can define concentrated loads / concentrated moments applying on the wall top.

## Base loads

You can define concentrated loads applying on the foundation.

# Design




| | |
|---|---|
| Minimum reinforcement | ductility reinforcement in accordance with DIN EN 1992-1-1, 9.2.1.1 (1). |
| Shear force as slab | performs the shear resistance verification for a slab instead of a beam, also with a beam cross-section. |
| Design at support face | the bending design of the foundation can be carried out either in the wall axis or in the support face of the wall. |

## Earth pressure

| | |
|---|---|
| Type of earth pressure | the earth pressure can be calculated either for the active state or for the state at rest. |
| Compaction earth pressure | if soil is filled layer by layer and then compacted intensively the earth pressure due to compaction will exceed the earth pressure caused by the self-weight of the soil. |
| Settings | the parameters for the compaction earth pressure are displayed. |

In accordance with
- DIN 4085 intensive / light,
- ÖNorm B 4434.

The compaction earth pressure for strong compaction is calculated as per DIN 4085. For light compaction (vibrating plate with an operating mass of up to 250 kg) "light" should be selected. Alternatively, you can include the compaction earth pressure as per ÖNorm in addition to the earth pressure at rest.

- Compaction width *B*:

  Width of the space to be filled. *B* has only an influence in combination with earth pressure at rest and increased active earth pressure (with low-yielding walls).

- Curved sliding surfaces:

  The depth from which the full compaction earth pressure is considered is determined by comparing the compaction earth pressure to the passive earth pressure. The associated passive earth pressure coefficient can be determined if linear and curved planes of rupture are assumed.

- Yielding of the wall:

  value displayed for information. It is automatically determined and depends on the type of earth pressure.

## Reinforcement foundation / wall

You can define the concrete cover, the reinforcement layer, the minimum diameter and the durability.

Read the information displayed in the info area.

# Output

## Scope of the output and options

By activating the corresponding options, you can define the scope of the output.

## Output as a PDF document

On the “Document” tab, a PDF document is displayed.

See also the document "Output and Printing".