MWP - Masonry Column

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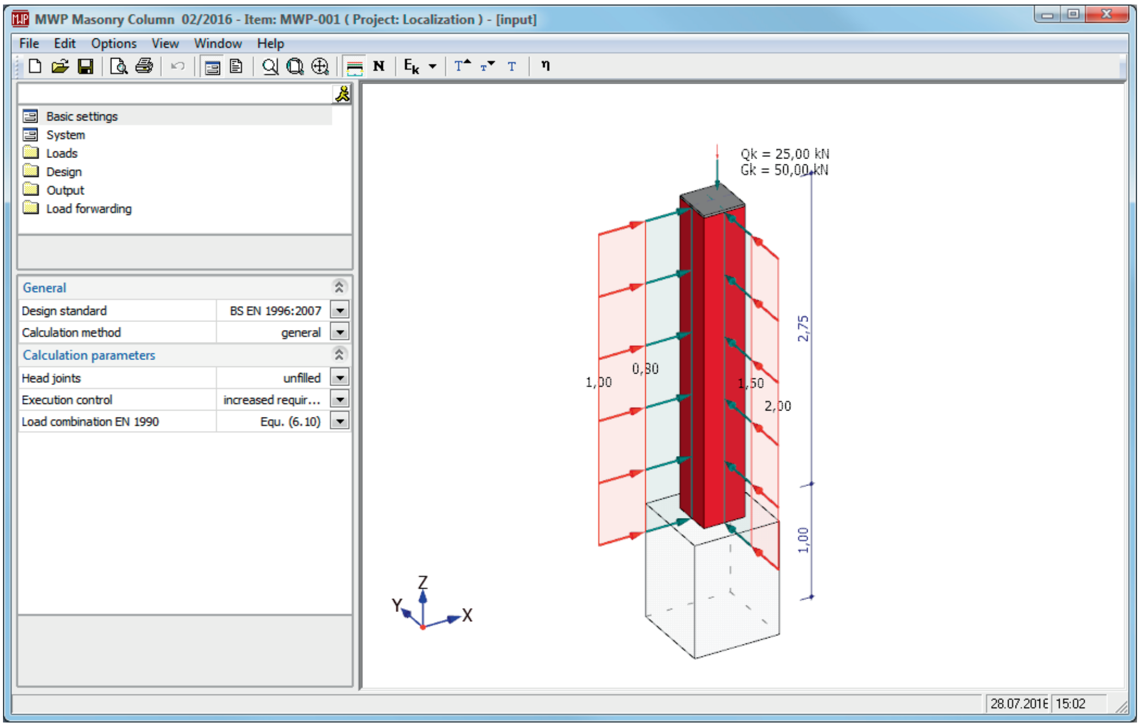


MWP - Masonry Column

Contents

Application options

Masonry columns are bar-shaped components with a rectangular cross section that are mainly exposed to systematic uniaxial and biaxial bending stress under compression.

The application *MWP* performs structural safety analyses of columns of artificial masonry. You can perform the design either in accordance with

- DIN 1053-1:1996-11 (global safety concept) or
- DIN 1053-100:2007-09 (partial safety concept) or
- EN 1996-1-1 (more accurate calculation method)
- EN 1996-3 (simplified calculation method)

as desired, in combination with the national appendices

- ÖNORM B 1996-1-1 and ÖNORM B 1996-3
- NA to BS EN 1996-1-1 and NA to BS EN 1996-3

You can apply the simplified calculation method in the analysis of columns under a systematic centric loading. If other loading conditions apply, the analysis must be based on the more accurate calculation method. A biaxial eccentricity is taken into consideration for the analysis if applicable.

You can select whether the masonry column should be a

- cantilever column,
- a hinged column or
- a restrained column

in the calculation. The bearing conditions are specified separately for the two main axis in this calculation.

The masonry column to be verified can be exposed to

- centric or eccentric vertical concentrated loads at its head

and/or

- uniformly distributed horizontal loads,
- concentrated horizontal loads or
- horizontal trapezoidal loads.

MWP generates automatically the appropriate load cases and load case combinations depending on the defined actions and performs the necessary analyses, whereby the decisive load case combination is determined for each individual analysis.

The design is performed in the form of a structural safety analysis for the defined system in accordance with the engineering standard selected by the user.

The characteristic bearing forces can be transferred to the FD Single Foundation application.

Basis of calculation

General notes

The standard series DIN 1053 in its current versions (DIN 1053-1; 1996-11 and DIN 1053-100:2007-09) constitutes the basis of calculation in the MWP application. In addition to this, the design can be performed in accordance with Eurocode 6, particularly its parts EN 1996-1-1, EN 1996-1-2 and EN 1996-3. The National Annexes for Austria and Great Britain are implemented in the current version of the application.

We like to draw your attention to an expert documentation about masonry construction that illustrates in detail the design procedure of masonry structures. The design in the MWP application is also based on these procedures. Therefore, we are not going to deal with questions of design in this chapter but concentrate on the description of the calculation procedures of the design values determined by the effects of actions.

Recommendations of literature (only available in German)

[1] Wagner, Ingo, Dipl.-Ing., Dipl.-Wirt.-Ing. (FH), Hoffmann, Jens, MSc: „Berechnung von Mauerwerk - Vergleich DIN 1053-1 / DIN 1053-100“ in FRILO-Magazin 2008, Friedrich+Lochner GmbH: Stuttgart, 2008.

[2] Wagner, Ingo, Dipl.-Ing., Dipl.-Wirt.-Ing. (FH), Hoffmann, Jens, MSc: Berechnung von Mauerwerk nach ÖNORM EN 1996, in: FRILO-Magazin 2010, Sonderheft Mauerwerk ÖNORM EN 1996, Friedrich+Lochner GmbH: Stuttgart, 2010.

[3] Wagner, Ingo, Dipl.-Ing., Dipl.-Wirt.-Ing. (FH), Hoffmann, Jens, MSc: Berechnung von unbewehrten Mauerwerkspfeilern aus künstlichen Steinen nach DIN 1053 und EN 1996, in: FRILO-Magazin 2010, Friedrich+Lochner GmbH: Stuttgart, 2010.

Design values of the action-effects

The term "design value" of an action or an effect of action such as internal forces and stresses was established with the introduction of the partial safety concept. In the following, the term "design value" refers to the effects of actions that are included in the analyses independently of whether they have been multiplied by partial safety factors or not. A moment applying to a column/ceiling node, for instance, that is used in the design of a column in accordance with DIN 1053-1 is considered as a design value in this respect.

Load cases for the calculation of the action-effects

The application generates load cases from the loads entered by the user irrespective of the selected standard and calculation method. The selected standard and calculation method have an effect on the layout of the structural system (which varies for the simplified and the more accurate calculation method) on the one hand, and the calculation of the superposition factors that are included in the calculation together with the load cases (partial safety factors and combination coefficients for actions) on the other.

For the generation of the load cases, a difference is made between vertical and horizontal actions. The classification scheme is illustrated in detail in the table on the next page. The symbols shown in the table are also used in the documentation and the printout of the load case combinations decisive for the analysis.

Code	Description
$G_{v,Inf}$	Self weights of the structure and all permanent portions of vertical head loads, which are included in the calculation via the lower partial safety factor (γ_G=$\gamma_{G,inf}$). Under normal conditions, the following applies: $\gamma_G = \gamma_{G,inf} = 1.00$.
$G_{v,sup}$	Self weights of the structure and all permanent portions of vertical head loads, which are multiplied with the difference of the upper and the lower partial safety factors for permanent actions ($\gamma_G = \gamma_{G,sup} - \gamma_{G,inf}$). Under normal conditions, the following applies: $\gamma_G = \gamma_{G,sup} - \gamma_{G,inf} = 1.35 - 1.00 = 0.35$.
$G_{h,inf}$	As $G_{v,inf}$, but referring to permanent portions of horizontal loads. Only used in combination with the more accurate calculation method.
$G_{h,sup}$	As $G_{v,inf}$, but referring to permanent portions of horizontal loads. Only used in combination with the more accurate calculation method.
Q_v	Permanent portions of vertical head loads, which are included in the calculation via the upper partial safety factor for variable actions ($\gamma_Q = \gamma_{Q,sup}$). Under normal conditions, the following applies: $\gamma_Q = \gamma_{Q,sup} = 1.50$.
Q_h	As Q_V, but referring to variable load portions of horizontal loads. Only used in combination with the more accurate calculation method.
A_h	As Q_V, but referring to accidental horizontal loads. MWP generates the following load cases as a standard when you perform the design in accordance with DIN 1053: $H_x = \pm 0{,}5$ kN $H_y = \pm 0{,}5$ kN

Permanent actions

When applying the partial safety concept in accordance with DIN 1053-100, the permanent actions are consequently included partially with their lower and partially with their upper values. Therefore, always two separate load cases are generated for the permanently vertically and the permanently horizontally acting loads, whereby the G_{sup} load cases are treated like variable load cases with the combinations of actions. This ensures that they are cancelled if they act favourably and only the lower values are taken into account. When applying the global safety concept in accordance with DIN 1053-1, the G_{sup} load cases are not generated because this is not necessary.

When using the simplified calculation method, horizontal loads must not be taken into account. Therefore, the load cases $G_{h,inf}$ and $G_{h,sup}$ are only generated in combination with the more accurate calculation method.

Variable vertical actions

A separate load case Q_v is generated for each variable vertical action.

Variable horizontal actions

The load cases Q_h are only generated in combination with the more accurate calculation method. These load cases include the variable portion of a single typical horizontal action each. Accidental horizontal actions are assigned to one load case A_H each.

For the analysis in combination with slender walls in accordance with DIN 1053-1, para. 6.9.1 and/or 7.9.2 and DIN 1053-100, para. 8.9.1.4 and/or 9.9.1.4, the MWP application generates internally two alternating load cases for each main axis. When the design is performed in accordance with Eurocode 6, such an analysis is not performed.

Concurrent and alternative groups

In most cases, the user defines loads in MWP that do not comply with the load cases required for combination. He can control the application-internal generation of these load cases via the assignment of loads to concurrent and alternative groups.

Loads that are assigned to the same concurrent group always apply simultaneously. The variable portions of the loads applying simultaneously are included in one and the same load case. This means that loads of the same concurrent group must never represent different actions because the limiting condition that all loads of a the group must always apply simultaneously would not be fulfilled in this case. Different partial safety factors and combination coefficients can neither be taken into consideration within the same load case. You can only define concurrent groups among horizontal loads. The main reason for this resides in the fact that the action-effects caused by vertical and horizontal loads are calculated on different structural systems and treated differently (e.g. moment redistribution) in the design. If vertical and horizontal loads were assigned to the same concurrent group, the action-effects of both load types would have to be calculated on the same structural system. A moment redistribution could not take place in this case because you may only redistribute moments resulting from horizontal loads.

Loads that are assigned to the same alternative group never act simultaneously. Combinations of actions including load cases of the same alternative group are excluded from the analysis. You can assign any type of load to an alternative group.

Loads that the user has erroneously assigned to the same concurrent group and the same alternative group are treated as concurrent loads. Concurrent groups have priority in practice.

Loads that have been assigned to the same load case because they belong to the same concurrent group can additionally be assigned to an alternative group. As a consequence, the load cases generated from several variable loads may exclude each other.

Due to this effect, the combination of concurrent and alternative groups allows you to define complex loading situations. This option is particularly suitable for the examination of wind loads from different directions or loads resulting from one and the same action, for instance.

Example for the effects of concurrent and alternative groups

The following example is intended to demonstrate the effects of concurrent and alternative groups:

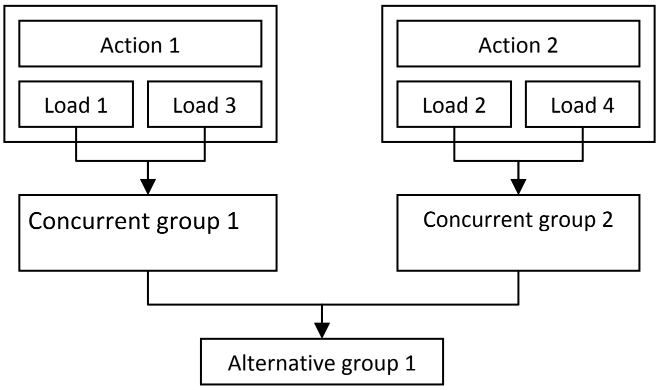


Illustration 1: Effects produced by concurrent and alternative groups

Load 1 is a horizontal load applying in x-direction and load 2 applies in the opposite direction. The loads 3 and 4 should produce the same situation in y-direction in this notional example. The loads in both directions should apply simultaneously. You cannot include loads applying in opposite directions into the same approach. Therefore, the loads 1 and 3 as well as the loads 2 and 4 should apply simultaneously. The loads 1 and 2 should exclude each other as well as the loads 3 and 4.
As a consequence, two load cases are generated, the first one includes the loads 1 and 3, the second one the loads 2 and 4. Both load cases apply alternatively, however.

Load case combinations for the calculation of the action-effects

Design situation

In masonry construction, a particular number of analyses is required due to the variety of possible system definitions and actions. For each of these analyses, one single decisive load case combination exists.

If the design is performed in accordance with the partial safety concept; the following design situations can be distinguished:

- the permanent design situation,
- the transient design situation,
- the accidental design situation and
- the design situation under seismic effects of actions.

If the design is performed in accordance with DIN 1053-1 (global safety concept), this distinction can be dispensed with.

Load combinations

The table below gives an overview of the assignment of load case combinations to the corresponding analyses.

Code	DS[1)]	Description
SigmaD	Ed[2)] EdA[3)]	Analysis of resistance to compression. For the analysis of resistance to partial area compression, no separate load case combination is generated. This analysis includes the upper design values of all vertical loads[4)]
TauP	Ed[2)] EdA[3)]	Analysis of shear resistance. If the design is performed in accordance with DIN 1053, this verification corresponds the analysis of resistance to slab shear.
Ex	Ed[2)] EdA[3)]	Limitation of the gaping joint in x-direction. Only when designing in accordance with DIN 1053.
Ey	Ed[2)] EdA[3)]	Limitation of the gaping joint in y-direction. Only when designing in accordance with DIN 1053.

1) Design situation. A difference is only made when the analysis is based on the partial safety concept

2) Permanent and transient design situation

3) Accidental design situation

4) Alternative groups and the corresponding combination rules are taken into consideration.

Calculation of the characteristic values of the bar action-effects

General notes

The characteristic values of the action effects are calculated separately for each load case. To do this, different structural systems are used depending on the action-effects to be verified. In general, the calculation of action-effects is performed on a plain equivalent system (bar theorem).

Particularities of masonry structures

The design of masonry components distinguishes itself by several particularities. One of these particularities is the approach to the calculation of the effects of actions.

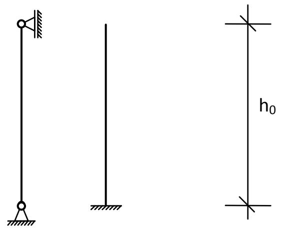
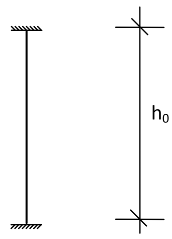
Action-effects from horizontal loads may be calculated on the pinned bar whereby a redistribution of the field moment to the head and foot moments is permissible when the balance is preserved and the cracking of cross sections up to full restraint is taken into consideration.

Load cases for the calculation of the action-effects

The action-effects due to vertical and horizontal loads are calculated either on the pinned bar or the cantilever arm depending on the defined bearing conditions.

If you have selected the *restrained* bearing condition, the moments of the fully fixed end resulting from the horizontal loads are calculated on the restrained bar assuming uncracked cross sections. In this case, the moments of the fully fixed end constitute the limiting criterion for the redistribution of moments.

The calculation of the moments in the column/ceiling nodes can be dispensed with due to the system definition. Therefore, up to two structural systems are generated. Subsequently, the action-effects are calculated separately for each load case on these systems (linearly elastic, first-order analysis, no shear deformations).

System options	Description	System sketch
System II	Calculation of the action-effects resulting from vertical and horizontal loads on the hinged column or cantilever column system. The bearing conditions are defined separately for each of the two cross sectional axes.	
System III	Calculation of the moments of the fully fixed end resulting from column loads on the restrained bar system. The moments of the fully fixed end are only calculated for the cross sectional axis for which the *restrained* bearing condition was selected.	

Redistribution of moments

Action-effects from horizontal loads may be calculated on the pinned bar whereby a redistribution of the to the head and foot moments is permissible when the balance is preserved and the cracking of cross sections up to full restraint is taken into consideration.

In this case, the moments of the fully fixed end constitute a mechanical limiting criterion for the redistribution. Another limiting criterion is the cracking of the cross sections.

When performing the design in accordance DIN 1053, the resulting eccentricity is limited to the value at which the cross section is cracked up to the centre of gravity.

The following applies: $$\sqrt{\left(\frac{e_y}{d_y}\right)^2 + \left(\frac{e_z}{d_z}\right)^2} \le \frac{1}{3}$$

When performing the design in accordance with EN 1966-1-1, the resulting eccentricity is limited to the value 0.45. The cross section may be cracked beyond the centre of gravity in this case.

The following applies: $$\sqrt{\left(\frac{e_y}{d_y}\right)^2 + \left(\frac{e_z}{d_z}\right)^2} \le 0{,}45$$

Calculation of the design values of the action-effects

According to DIN 1055-100 or EN 1990, you may apply the combination rules either to the actions or their effects.

The bar action-effects of the described load cases are available as characteristic values. They are combined to design values of the bar action-effects giving consideration to the stipulations of the applicable design standard. This means that the combination rules are applied to the effects in the MWP application.

Basic parameters

General notes

Standard

Defines the design standard that constitutes the basis of the structural safety analysis.

Method of analysis

Specification whether the simplified or more accurate calculation method should be used for the verification of the column.

DIN 1053-1 and also DIN 1053-100 describe a simplified and a more accurate calculation method for the analysis of masonry.

The design in accordance with EN 1996-1-1 is based on the more accurate method. EN 1996-3 includes a simplified method.

The simplified method is only available for columns that fulfil the following conditions:

- minimum thickness of 24 cm in both directions,
- clear maximum height of 3.2 m,
- under systematic centric loading.

When the simplified method is selected, the application checks whether the limiting conditions on which the analysis is based are complied with. In the case of non-compliance, a corresponding message is displayed and no analysis is performed. The user must manually switch over to the more accurate method in this case.

Calculation parameters

Transversal joint solidification

Specification whether the transversal joints of the masonry bond are solidified. This option has an effect on the magnitude of the bond shear resistance of the masonry.

Execution supervision (only in combination with BS EN 1996)

EN 1996-1-1, A(1) allows each national state that applies this standard to prescribe individual partial safety factors for resistances that depend on the verification of the execution. Currently, Great Britain profits from this option in the British National Annex. The corresponding class must be selected when this NA is applied.

System options

Column

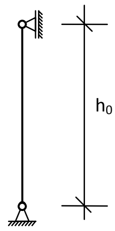
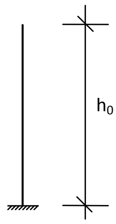
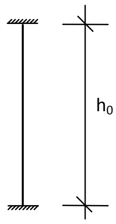
Material

The option displays a dialog that allows you to define prescribed masonry, select masonry according to approval or enter a user-defined material if DIN 1053 was selected for the design.

If EN 1996 was selected, the input dialog for a user-defined material is displayed by default to provide for special national regulations.

Bearing in x, y-direction

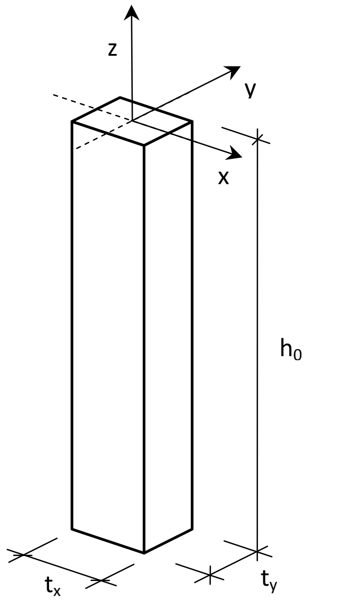
The bearing conditions are specified separately for the two cross sectional axes in this calculation.

Option	Description	System sketch
Hinged column	The calculation is based on the structural system of the hinged column. Moment redistribution is not available.	
Cantilever column	The calculation is based on the structural system of the cantilever column. Moment redistribution is not available.	
Restrained	The calculation of the action-effects is based on the structural system of the hinged column. For the moment redistribution, the moments of the fully fixed end are calculated on a bar restrained on top and bottom.	

The effective height of the column h_k is determined on the basis of the bearing conditions.

Column dimensions

The option defines the decisive dimensions of the masonry column. For more details, see the table below.

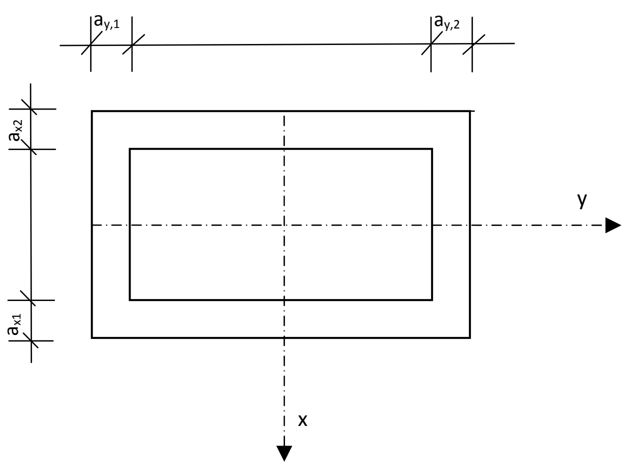
Value	Description	System sketch
h0	Clear column height	
tx	Column thickness in x-direction	
ty	Column thickness in y-direction	

SW addition

Self weight addition for surface flashings such as plaster. The value is specified in [kN/m²] The application converts the self weight addition into a tangential load.

Load introduction

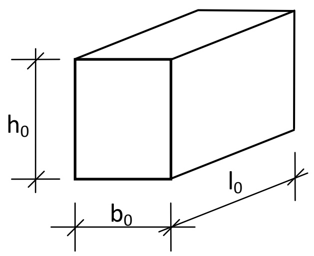
The load is introduced at the column head either over the total cross sectional area (normally in combination with reinforced concrete beams) or a partial area that is defined by specifying the distances to the edges in each cross sectional axis.

Option	Description	System sketch
Distance to the edge in x-direction	ax1	
	ax2	
Distance to the edge in y-direction	ay1	
	ay2	

If a beam is fully supported all distances to the edges must be set to zero. If a beam projects over the edge of the column, the edge distance in this direction must be set to zero.

Foundation

You can pre-define an isolated foundation for the foundation structure in the MWP application. This definition serves the purpose of representing the foundation graphically and pre-assigning geometric values for the export to the FRILO foundation applications. MWP does not perform a design of the foundation.

Option	Description	System sketch
Foundation height	h_0	
Foundation width	b_0	
Foundation length	l_0	

Comments

... concerning the system

The option displays a dialog for the input of text. You can describe and explain system inputs in this text.

Loads

Vertical loads

Type

Option	Description
Cancel	The option displays the insert row for vertical loads. If you have already defined a vertical load in this row, it is deleted when you select this option.
Concentrated load	This option adds a new vertical load to the list.

Load values

Value	Description
G	permanent portion of the concentrated vertical load.
Q	variable portion of the concentrated vertical load.
ex	eccentricity of the load application point in x-direction
ey	eccentricity of the load application point in y-direction

ActGrp

Action group.

Number of the action group of the variable load portion. The permanent load portion is always assigned to the permanent action. When the analysis is performed in accordance with DIN 1053-1, the assignment of action groups can be dispensed with.

AltGrp

Alternative group.

Loads that are assigned to the same alternative group exclude each other. Combinations of actions including load cases of the same alternative group are excluded from the analysis.

Text

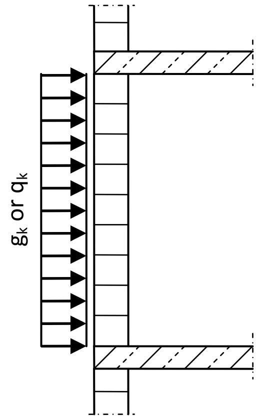
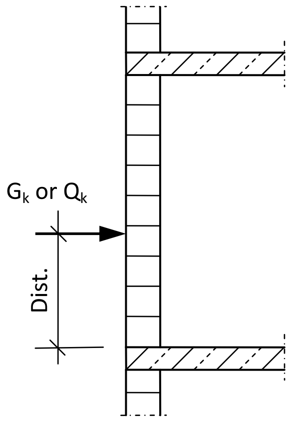
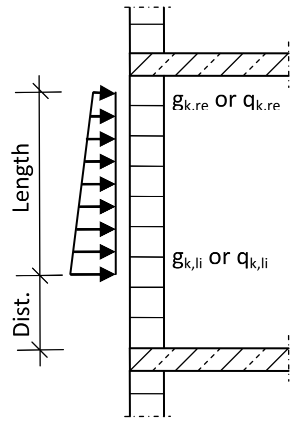
You can optionally enter a short note or item description that appears in the output.

Horizontal loads

Type

Option	Description
Cancel	The option displays the insert row for horizontal loads. If you have already defined a horizontal load in this row, it is deleted when selecting this option.
Concentrated load	This option adds a new horizontal load to the list.

Load definitions

Option	Description	System sketch
Uniformly distributed load	A linear load that applies constantly over the total height of the column.	
Concentrated load	A concentrated load applying at the distance a from the foot point.	
Trapezoidal load	A linear load that is variable over the height of the column.	

Load direction

Option	Description
In x-direction	The horizontal loads apply in the global x-direction. In the definition of a wall, this direction corresponds to the wall thickness.
In y-direction	The horizontal loads apply in the global y-direction. In the definition of a wall, this direction corresponds to the wall length.

ActGrp

Action group.

Number of the action group of the variable load portion. The permanent load portion is always assigned to the permanent action. When the analysis is performed in accordance with DIN 1053-1, the assignment of action groups can be dispensed with.

ConGrp

Concurrent group.

Loads that are assigned to the same concurrent group always apply simultaneously. The variable portions of the loads applying simultaneously are included in one and the same load case. This means that loads of the same concurrent group must never represent different actions because the limiting condition that all loads of a the group must always apply simultaneously would not be fulfilled in this case. Different partial safety factors and combination coefficients can neither be taken into consideration within the same load case.

AltGrp

Alternative group.

Loads that are assigned to the same alternative group exclude each other. Combinations of actions including load cases of the same alternative group are excluded from the analysis.

Text

You can optionally enter a short note or item description that appears in the output.

Comments

... concerning the loads

The option displays a dialog for the input of text. You can describe and explain loads inputs in this text.

Design

Calculation and analysis

The analyses are performed at the column head, half of the column height and the column foot as well as the points decisive for the analysis. If eccentric loads apply, MWP includes the horizontal section at which a local maximum of the resulting eccentricity occurs as an additional point of verification unless this horizontal section is identical to half of the wall height. The buckling analysis always produces less favourable results in this case.

Analyses based on the simplified calculation method

You can only use the simplified calculation method if systematic centric loads apply to the column. In other cases, the more accurate method must be used.

Verification point	Analyses	Comment
Column head	Resistance of cross sections to axial loads[1)]	The permissible compressive strain is included with the factor k_3 = 1.0.
	Resistance to bearing stress	
Half of the column height	Resistance of cross sections to axial loads	The permissible compressive strain is included with the factor k_2. This analysis corresponds to the buckling analysis.
Column foot	Resistance of cross sections to axial loads	The permissible compressive strain is included with the factor k_3 = 1.0.
1)	When performing the design in accordance with DIN 1053-1, this analysis corresponds to the verification of the resistance to compressive axial stress.	

Analyses based on the more accurate calculation method

Verification point	Analyses	Comment
Column head	Resistance of cross sections to axial loads[1)]	
	Shear stress resistance	
	Gaping joint	
	Resistance to bearing stress	
Half of the column height	Resistance of cross sections to axial loads[1)]	
	Shear stress resistance	
	Gaping joint	
Column foot	Resistance of cross sections to axial loads[1)]	
	Shear stress resistance	
	Gaping joint	
1)	When performing the design in accordance with DIN 1053-1, this analysis corresponds to the verification of the resistance to compressive axial stress.	

Load combinations

The accidental combination is always verified when either the user has assigned loads to an accidental action or the accidental horizontal load H=0.5 kN must be included in the analysis of the resistance of cross sections to axial loads (is done automatically). In each case, the analysis in the permanent/transient design situation is performed before.

Comments

... concerning the results

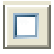
The option displays a dialog for the input of text. You can describe and explain calculation results in this text.

Output

The main menu item "Output" allows you to specify in detail the scope of data to be printed. The individual options are briefly described below.

Function key bar

As with all other FRILO applications, the available output media include the monitor display, MS Word and the printer. You can launch the output on the display or the printer via the corresponding menu items in the main tree.

Options	**Description**
	Selects all outputs.
	Deselects all outputs.
	Output directly in Microsoft Word (the editor must be installed on the local computer)
	Displays the values in a text window on the screen The result graphics are not shown, you can access them via the tool bar below the menu bar.
	The option starts the output on the printer
	The currently selected output profile is stored in the registry.
	The output profile stored in the registry is loaded.

General notes

Option	**Description**
System graph	Printing of the system graph
Scale	This option allows you to select a scale for printing. For other output media, MWP determines the scale internally.
Legends	When you select this option, all tables are described in detail via legends in the output.

System options

Option	**Description**
Comments	Output of the comments to the system.
Column	Output of all system parameters

Loads

Option	**Description**
Comments	Output of the comments to the loads.
Actions	Output of the actions including their partial safety factors and combination coefficients.
Vertical loads	Output of the vertical loads that are defined on the column head. The self weights and self weight additions are put out together with the pier.
Horizontal loads	Output of the horizontal loads

Results

Option	Description
Comments	Output of the comments to the calculation results.
Load case combinations	Output of the load case combinations on which the analyses are based.
Action-effects	Output of the design values of the action-effects on which the analyses are based.
Compression loading	Output of the analysis of the compression load resistance. Always included under normal conditions.
Shear stress	Output of the shear stress analysis.
Gaping joint	Analysis of the gaping joint Structural safety analysis IAW DIN 1053-1 and DIN 0153-100.

Result graphs

Option	Description
Action-effect drawings	Output of the action-effect drawings for each analysis in the ultimate limit state.
Scale	This option allows you to select a scale for printing. For other output media, MWP determines the scale internally.

Load transfer

A feature for the transfer of loads to the analysis application

- FD Isolated Foundation

is implemented in MWP. The feature allows the user to use the bearing forces of columns for the analysis of the foundations immediately underneath, if this is required.

After selection of the appropriate foundation application it is launched automatically and the loading is generated in the form of the individual load cases used in MWP. The user must simply add the foundation specific details and check the transferred load values.

Examples of calculation

You can find calculation examples in acc. with DIN 1053 and DIN EN 1996 in the following publications (only available in German):

[1] Wagner, Ingo, Dipl.-Ing., Dipl.-Wirt.-Ing. (FH), Hoffmann, Jens, MSc: „Berechnung von Mauerwerk - Vergleich DIN 1053-1 / DIN 1053-100“ in FRILO-Magazin 2008, Friedrich+Lochner GmbH: Stuttgart, 2008.

[2] Wagner, Ingo, Dipl.-Ing., Dipl.-Wirt.-Ing. (FH), Hoffmann, Jens, MSc: Berechnung von Mauerwerk nach ÖNORM EN 1996, in: FRILO-Magazin 2010, special edition Mauerwerk ÖNORM EN 1996, Friedrich+Lochner GmbH: Stuttgart, 2010.

[3] Wagner, Ingo, Dipl.-Ing., Dipl.-Wirt.-Ing. (FH), Hoffmann, Jens, MSc: Berechnung von unbewehrten Mauerwerkspfeilern aus künstlichen Steinen nach DIN 1053 und EN 1996, in: FRILO-Magazin 2010, Friedrich+Lochner GmbH: Stuttgart, 2010.

Frequently asked questions

How can I take the additional horizontal load $H_{x,y}$ = 0.5 kN in combination with slender walls into account when using the simplified calculation method?

You should note that the horizontal load $H_{x,y}$ = 0.5 kN possibly required when performing the design in accordance with DIN 1053 is an accidental but however systematic load. Therefore, it does not comply with the application criterion for the simplified method, which requires a systematic centric loading. You can perform the buckling safety analysis at half of the wall height in accordance with the stipulations of DIN 1053 but consider the horizontal load by using the equations of the more accurate method. As equivalent system for the horizontal loading you should assume a bar with pinned connection at the wall head and foot in this connection, because the fixed-end moments are not covered by the simplified method.