What's New

ADVANCE BIM DESIGNERS 2020

REINFORCED CONCRETE

STEEL SERIES

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Welcome to GRAITEC Advance BIM Designers 2020 REINFORCED CONCRETE

GRAITEC is very pleased to present the latest version of Advance BIM Designers 2020, part of the Graitec Advance Suite.

The GRAITEC Advance BIM Designers Suite is a collection of advanced apps for automating structural design aiming to detail BIM workflows and to produce the technical documentation. The 2020 version brings new features and more rebar functionalities, whilst offering new innovative modules and considerably improving the BIM workflow for the concrete and steel industries.

The 2020 version of Advance BIM Designers introduces a completely **new module for the design of Reinforced Concrete Walls**. This new module allows for code analysis and automatic reinforcement generation in the case of both single and grouped walls that may act as either **Bearing** or **Shear Walls**. Just as the rest of the modules included in the Reinforced Concrete Series (namely **Footing Designer**, **Beam Designer** and **Column Designer**), the **BIM Designers Wall** module is also running as a standalone application and as a module embedded in the Advance Design and Autodesk Revit® environments.

Advance BIM Designers 2020 also introduces a **new module for the creation of reinforcement in Concrete Slabs** in the **Autodesk Revit®** environment. It allows for the definition of a 3D rebar cage based on theoretical reinforcement area imported from **Advance Design** or based on user input, using intelligent repartition of rebars and fabrics.

This version of Advance BIM Designers enhances a lot of new functionalities with high benefits for the end user, and is articulated around a few main subjects:

- **New precast sections for beams,** allowing elements verification and reinforcement generation;
- **New possibilities for designing corbels**, including code verification according to European and North American codes with rebar definition;
- **New possibilities for splitting rebars**, including automatic splitting rebars on the **Beam** module and an enhanced new rebar splitting functionality for reinforcement in Autodesk Revit®.
- **New options for reinforcement generation in Revit®**, including design and detailing of concrete walls and linear foundations.

Advance BIM Designers 2020 also comes with a big number of improvements and adjustments, following feedbacks received from users:

- improvements in drawings, including updated templates and better control;
- possibility to generate continuous longitudinal reinforcement in multi-span beams;
- improvements in the case of tables included in reports;
- and many other adjustments for a better user experience.

Advance BIM Designers 2020 is the invaluable tool for all your projects!

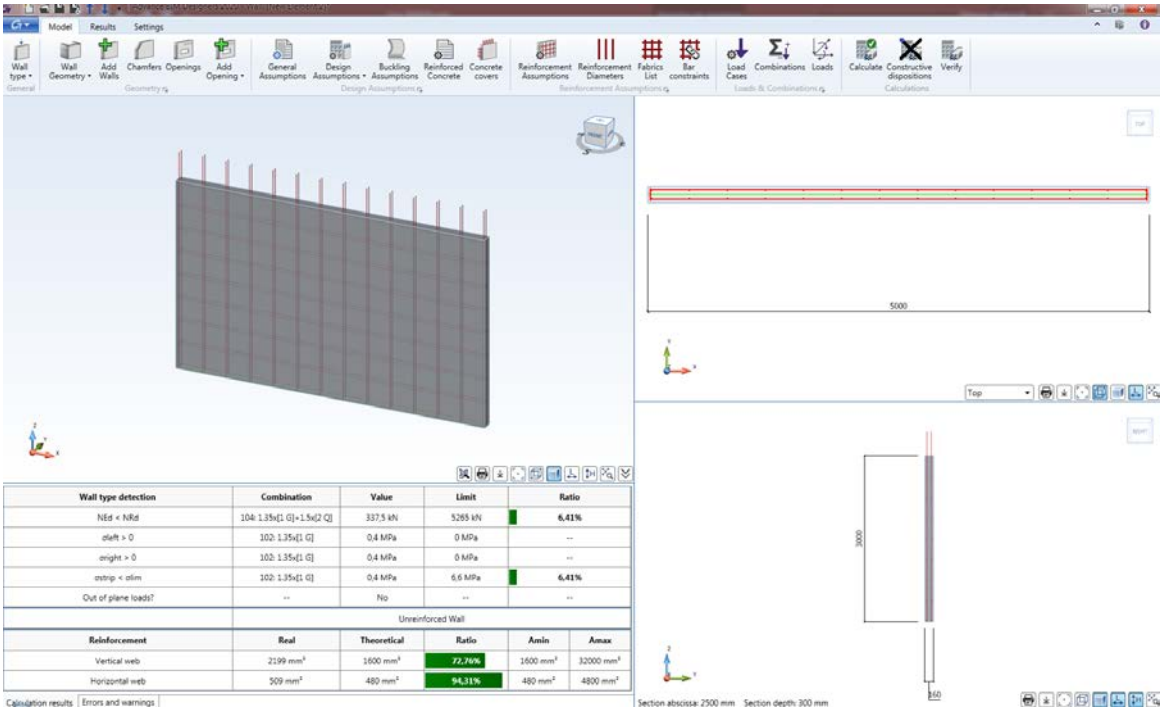
New RC Wall Module

Main features & benefits:

- Analysis and reinforcement generation for concrete walls
- Analysis of bearing walls and shear walls
- Analysis of individual walls and groups of walls
- Detailed design results, reports and drawings

Advance BIM Designers 2020 enables detailed analysis and generation of reinforcement for concrete walls, thanks to a new Reinforced Concrete Wall module.

Using the new BIM Designers Wall module, it is possible to design reinforcement walls that act as Bearing Walls or as Shear Walls which can be further analyzed as individual ones or as a group of walls.

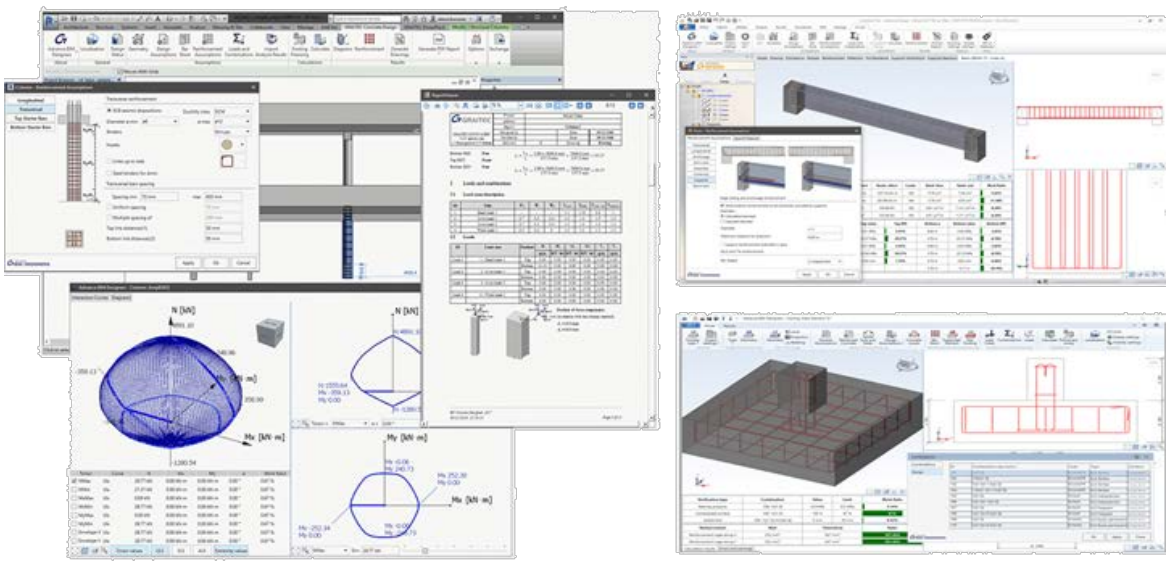


Wall type detection	Combination	Value	Limit	Ratio
NEd < NRd	104: 1.35x[1 G]+1.5x[2 Q]	337.5 kN	5265 kN	6.41%
σleft > 0	102: 1.35x[1 G]	0.4 MPa	0 MPa	--
σright > 0	102: 1.35x[1 G]	0.4 MPa	0 MPa	--
σstrip < σlim	102: 1.35x[1 G]	0.4 MPa	6.6 MPa	6.41%
Out of plane loads?	--	No	--	--
	Unreinforced Wall			

Reinforcement	Real	Theoretical	Ratio	Amin	Amax
Vertical web	2199 mm²	1600 mm²	72.76%	1600 mm²	32000 mm²
Horizontal web	509 mm²	480 mm²	94.31%	480 mm²	4800 mm²

Advantages of existing RC modules

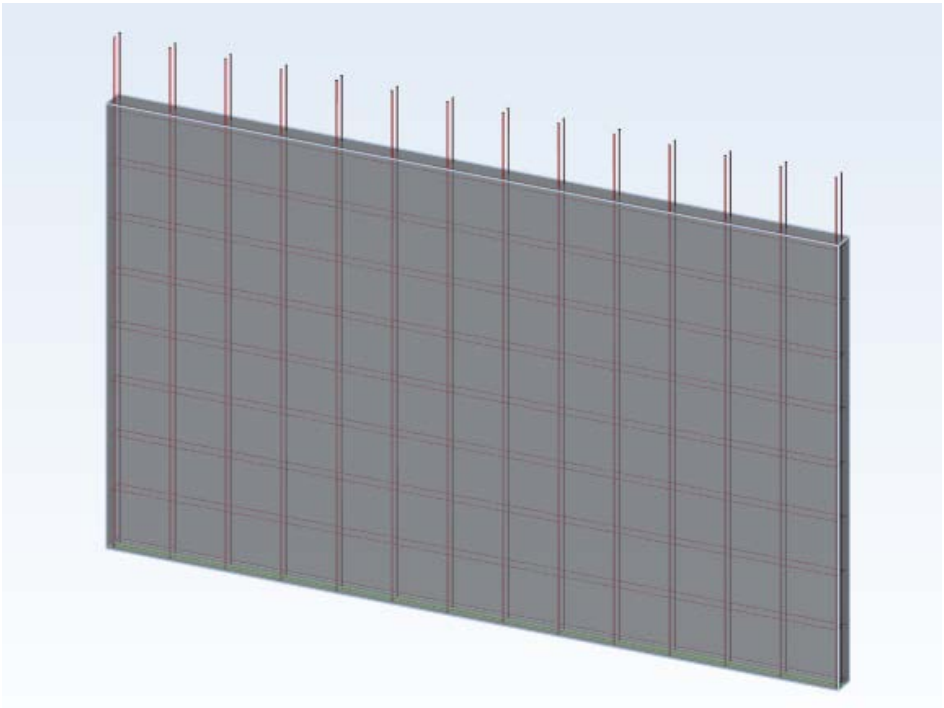
The new BIM Designers Wall module maintains all the benefits/advantages of the existing RC modules.



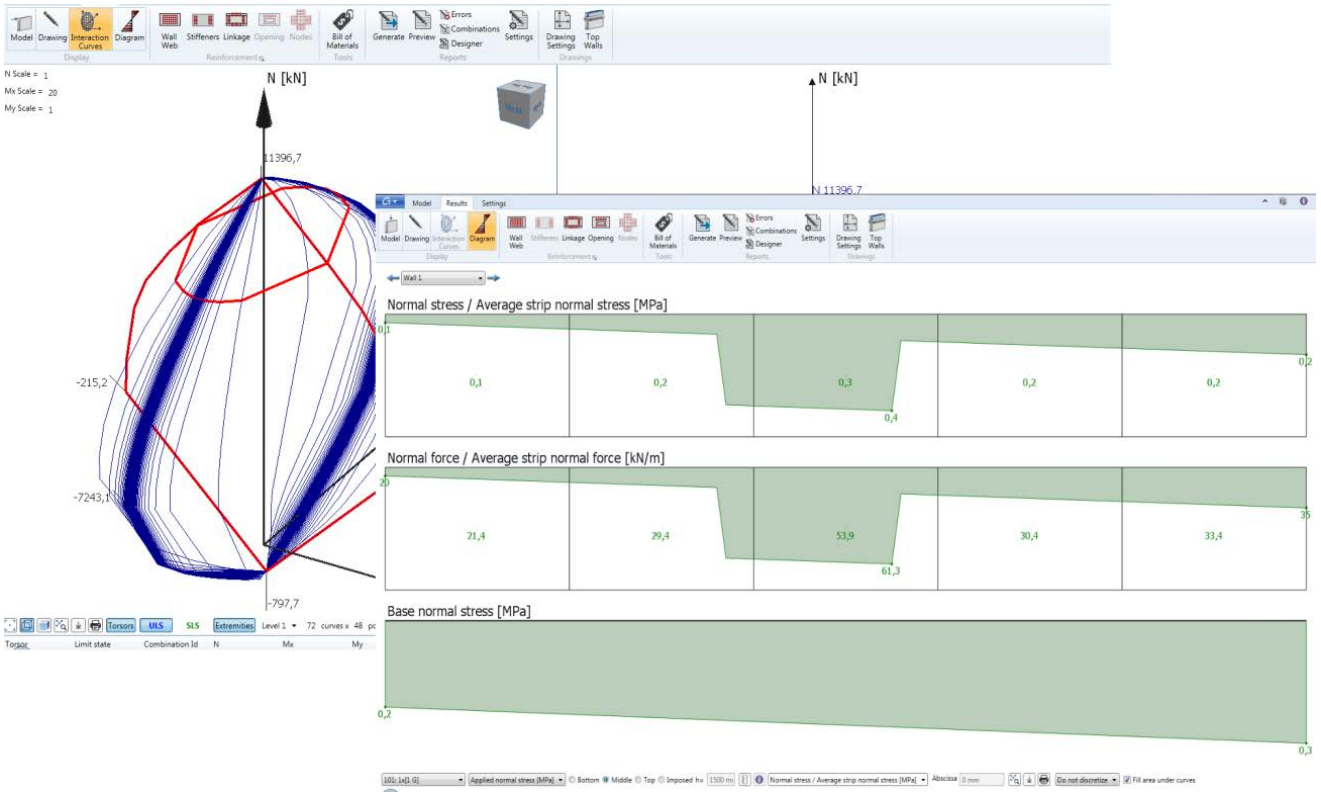
The following features are particularly worth mentioning:

- **Multi-platform compatibility and support for multiple workflows** – the Wall module can run integrated in Autodesk Revit® or in Advance Design, and can also operate as a standalone application. The module can be used at any stage of the process to support multiple workflows, from completely isolated processes to fully connected BIM.

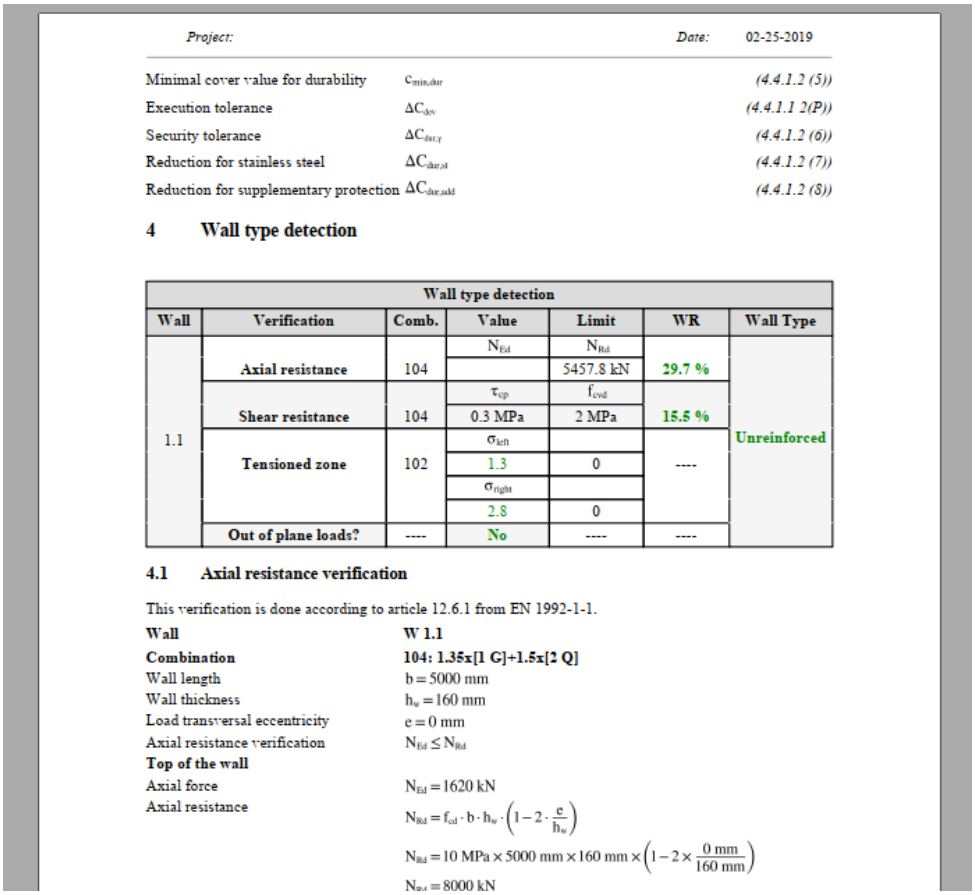
- **Automatic 3D rebar cage design and creation** - rebar cages can be created according to design calculations or defined according to user input, with a full range of editing options.



- **Detailed graphical results for performed checks** – the module displays graphical results for the performed verifications.



- **Detailed design reports** – calculation reports can be either detailed - including calculation formulas and links to paragraphs of codes - or can be synthetic, containing the summary info.



Project: *Date:* 02-25-2019

Minimal cover value for durability	$c_{min,dur}$	*(4.4.1.2 (5))*
Execution tolerance	ΔC_{dev}	*(4.4.1.1 2(P))*
Security tolerance	$\Delta C_{dur,\gamma}$	*(4.4.1.2 (6))*
Reduction for stainless steel	$\Delta C_{dur,st}$	*(4.4.1.2 (7))*
Reduction for supplementary protection	$\Delta C_{dur,add}$	*(4.4.1.2 (8))*

4 Wall type detection

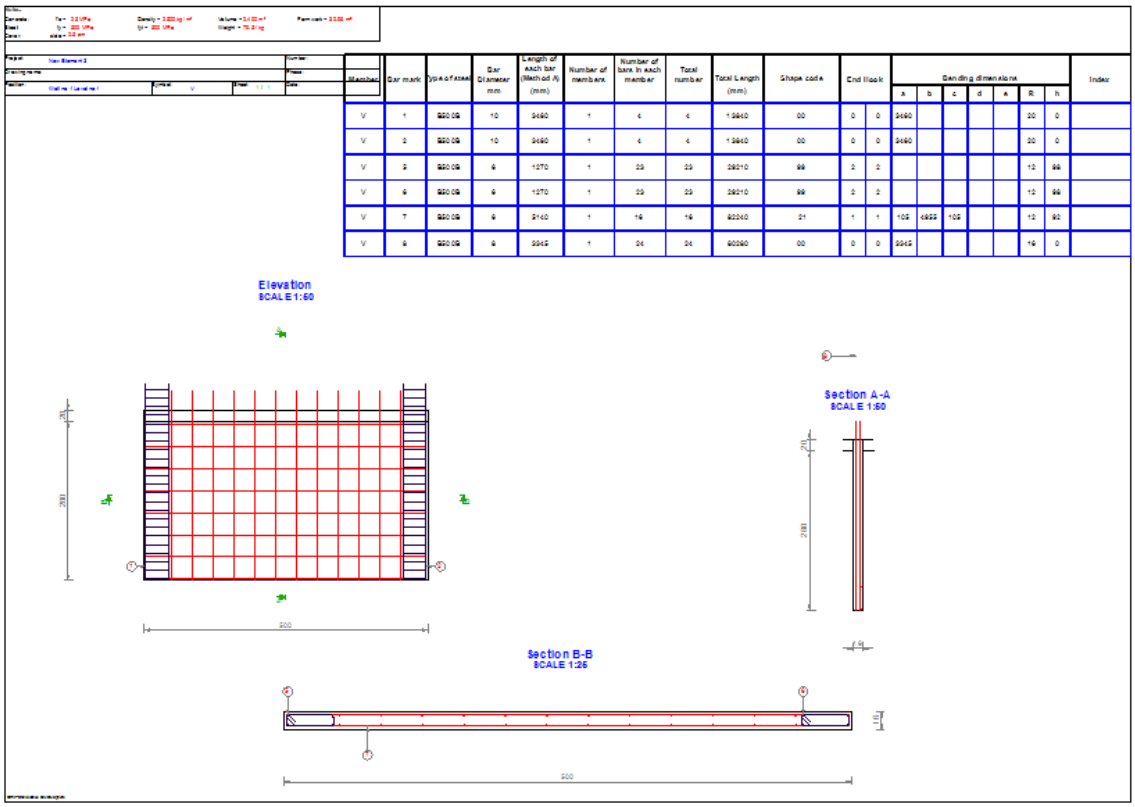
Wall type detection						
Wall	**Verification**	**Comb.**	**Value**	**Limit**	**WR**	**Wall Type**
1.1			N_{Ed}	N_{Rd}		Unreinforced
	Axial resistance	104		5457.8 kN	29.7 %	
			τ_{cp}	f_{cvd}		
	Shear resistance	104	0.3 MPa	2 MPa	15.5 %	
			σ_{left}			
	Tensioned zone	102	1.3	0	----	
			σ_{right}			
			2.8	0		
	Out of plane loads?	----	No	----	----	

4.1 Axial resistance verification

This verification is done according to article 12.6.1 from EN 1992-1-1.

Wall	**W 1.1**
Combination	**104: 1.35x[1 G]+1.5x[2 Q]**
Wall length	$b = 5000$ mm
Wall thickness	$h_w = 160$ mm
Load transversal eccentricity	$e = 0$ mm
Axial resistance verification	$N_{Ed} \leq N_{Rd}$
Top of the wall	
Axial force	$N_{Ed} = 1620$ kN
Axial resistance	$N_{Rd} = f_{cd} \cdot b \cdot h_w \cdot \left(1 - 2 \cdot \frac{e}{h_w}\right)$
	$N_{Rd} = 10 \text{ MPa} \times 5000 \text{ mm} \times 160 \text{ mm} \times \left(1 - 2 \times \frac{0 \text{ mm}}{160 \text{ mm}}\right)$
	$N_{Rd} = 8000$ kN

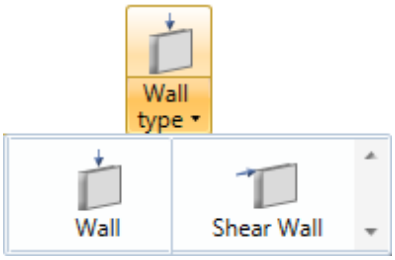
- **Drawings** – similar to the other RC modules, the Wall module automatically produces localized, configurable drawings.



- **Numerous international standards** – the Wall module is localized for Europe, Canada and North-America.

Wall types

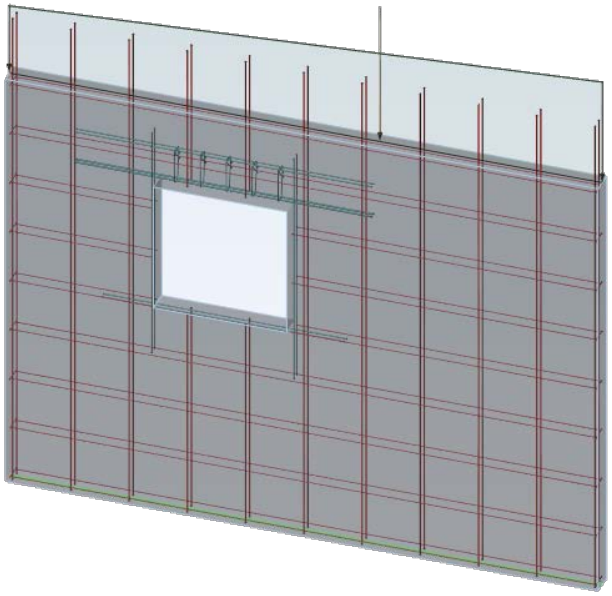
The Reinforcement Concrete Wall Designers module supports design of two types of walls: **Bearing Walls** and **Shear Walls**.



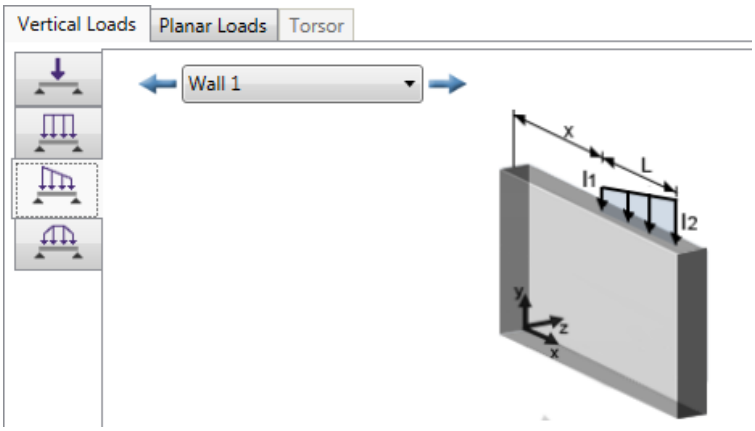
Bearing Wall - used for the transmission of vertical forces.

Choosing Bearing Wall type has its implications:

- it offers the possibility to define openings:

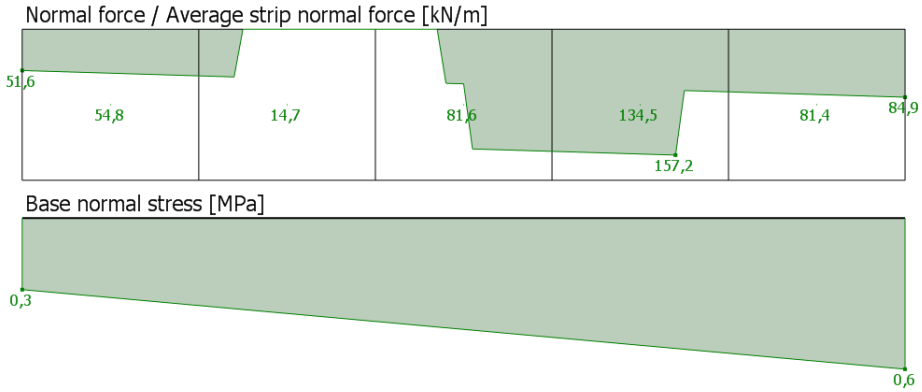


- it allows for the definition of vertical loads (point, linear, trapezoidal) and planar loads:



- bearing walls cannot be calculated using Seismic loads;

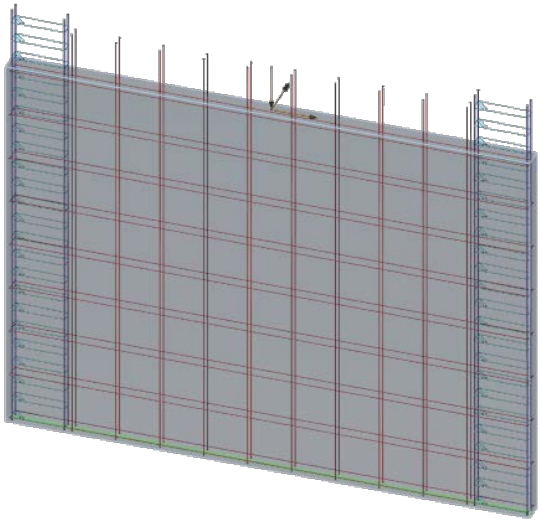
- the design efforts are obtained using the Strip method.



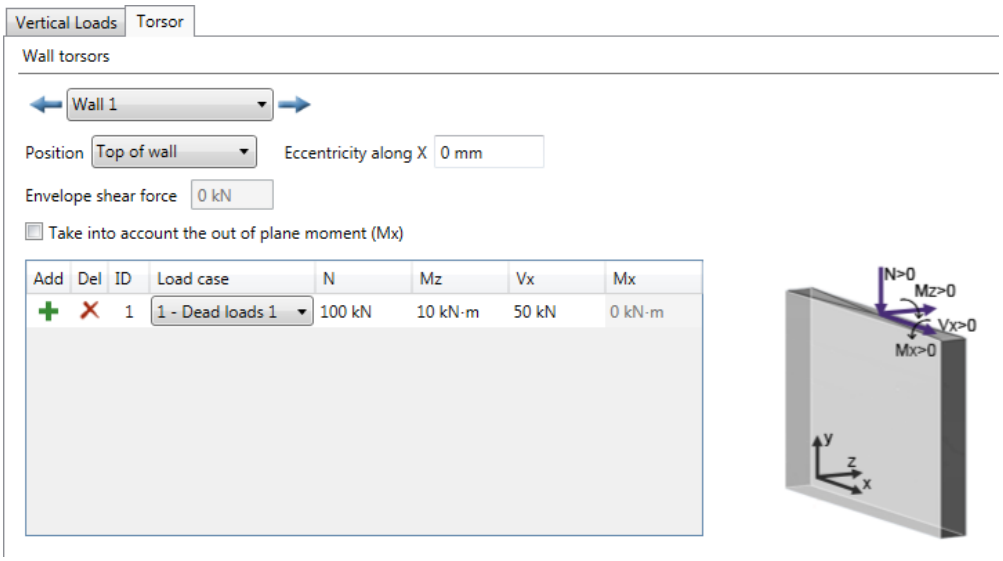
Shear Wall - used for the transmission of shear forces (in addition to vertical ones).

Choosing a wall as Shear Wall also has its implications:

- it is not possible to define openings;
- the vertical edge stiffeners reinforcement is being generated;

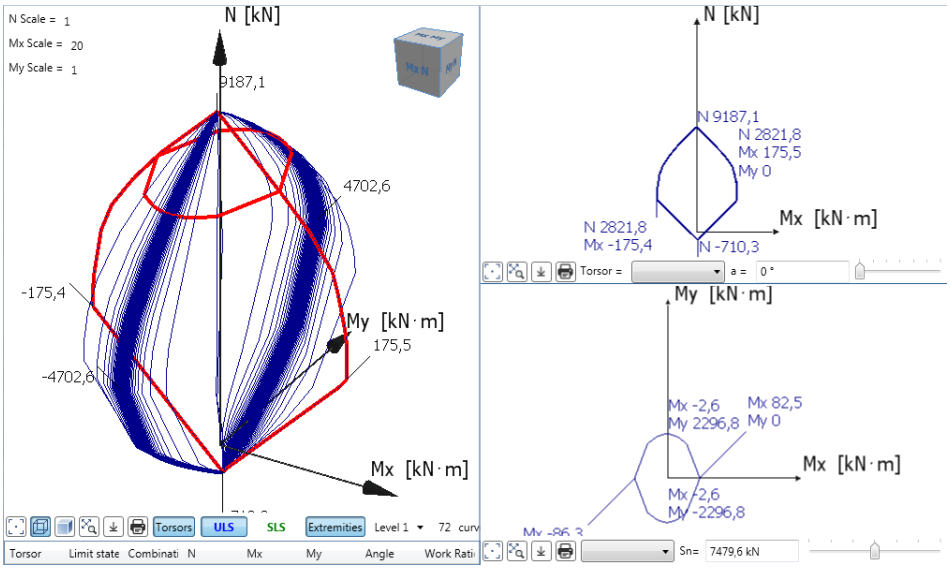


- it offers the possibility to define vertical loads (point, linear, trapezoidal) and resultant forces:



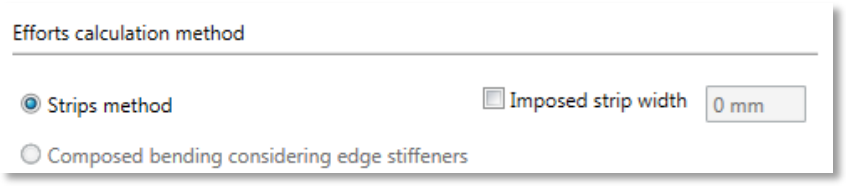
- it allows for the definition of Seismic loads;

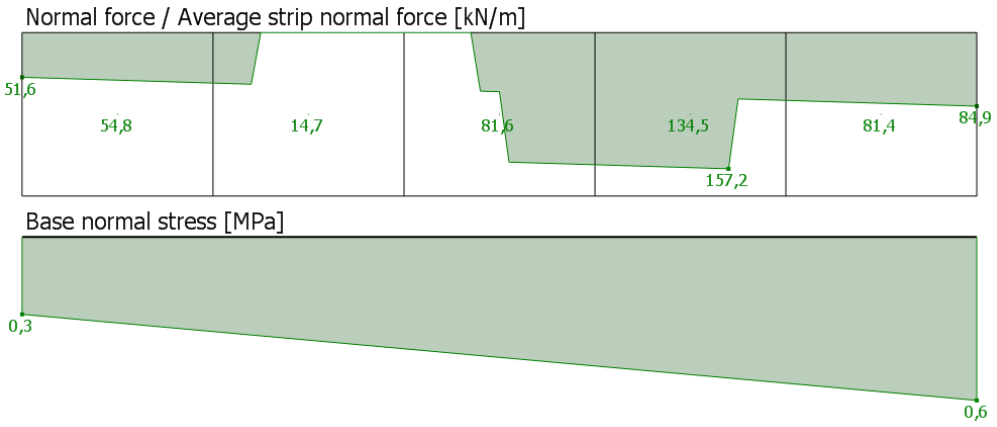
- the design calculation is done using composed bending considering Edge stiffeners:



Design

For **Bearing Walls,** the design efforts coming from the Strip method are being used. The wall is divided in several vertical strips and their width can be set by the user, or it can be determined automatically. Design efforts are automatically calculated according to applied loads, average stresses and normal loads - the axial verification and reinforcement are computed using the average efforts on strips.





For the design of **Bearing Walls** (plain or reinforced concrete walls in compression), the following code provisions are used (depending on the localization settings):

- EN 1992-1-1: Chapters 5, 6, 9, 12;
- ACI 318-14: Chapter 11;
- CSA A23.3-14: Chapter 14;
- DTU 23.1 (Strip method).

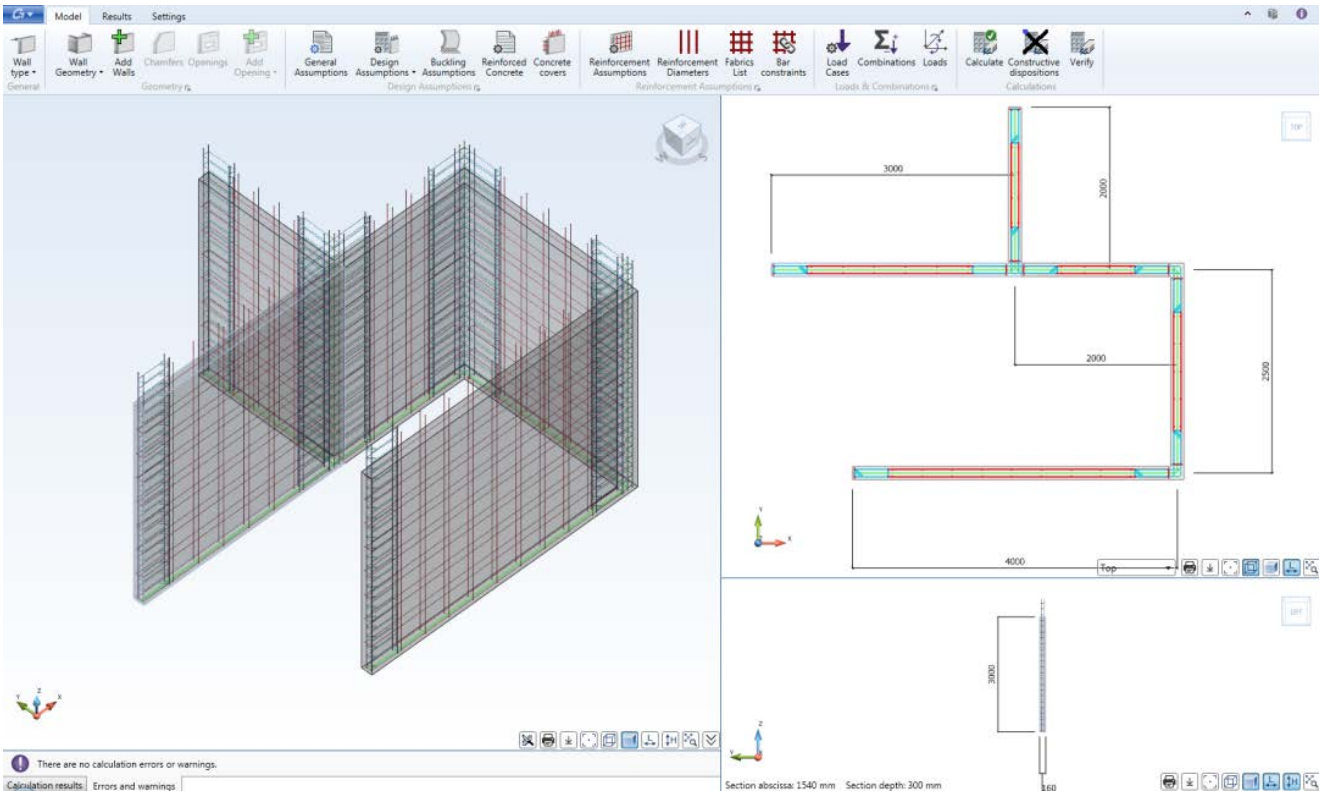
For **Shear Walls,** the vertical reinforcement is designed for composed bending, considering edge stiffeners. A horizontal wall section is used (wall thickness * wall length) as an element section, and the design forces are resulting forces: axial force (Ned) and moment (MEd), including the seismic forces from the Newmark combinations, as well as the 2nd order effects, if any. This results in reinforcement areas, created as stiffeners on each edge of the wall.

For design of shear walls (reinforced concrete walls subjected to resulting forces), the following code provisions are used (depending on the localization settings):

- EN 1992-1-1: Chapters 5, 6, 9
- EN 1998-1: Chapter 5
- ACI 318-14: Chapter 18.10
- CSA A23.3-14: Chapter 21.5 and 21.6

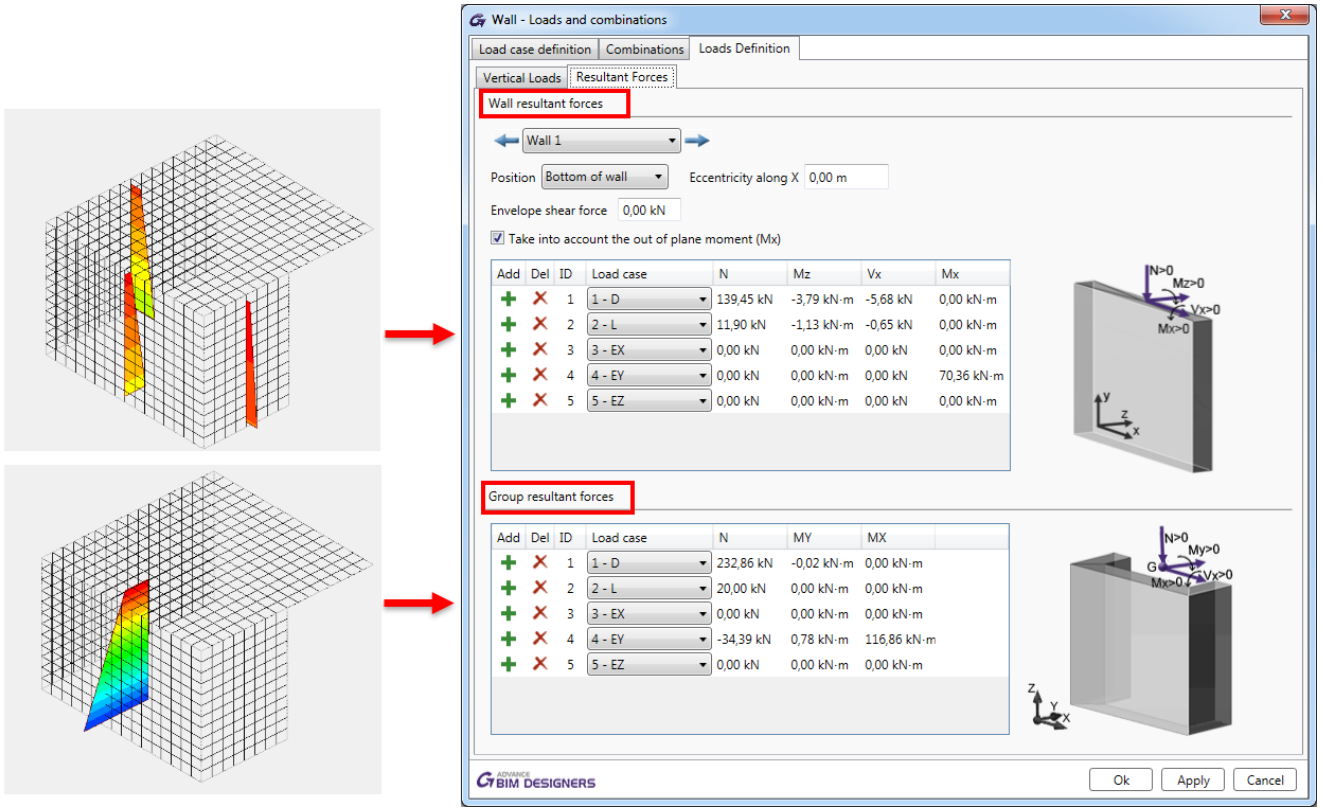
Single wall / group of walls

The BIM Designers Wall module can design single walls as well as groups of walls.
Walls in a group must be connected, either collinearly or orthogonally, and must intersect at the ends (for example, a T-shaped group must be modeled with the help 3 walls).



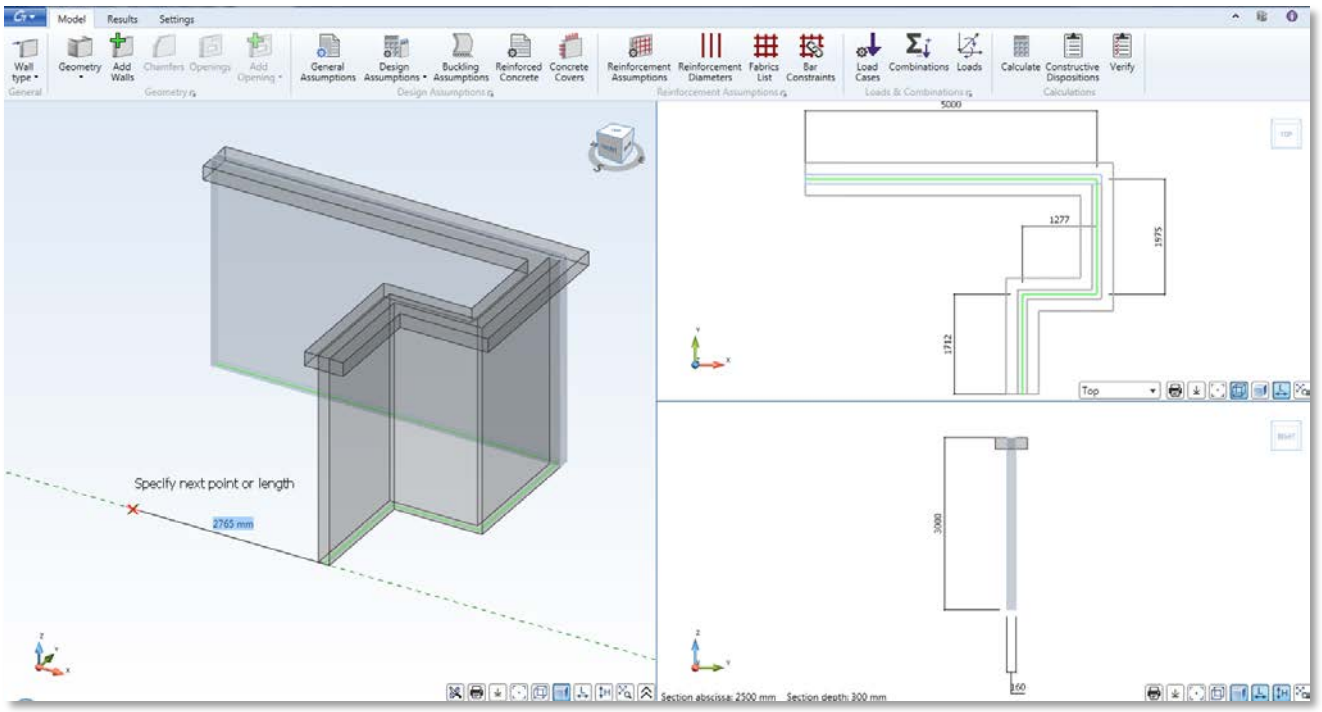
For a group of bearing walls, each wall is calculated individually, with design efforts calculated using the strip method.

For a group of shear walls, in addition to designing each wall individually according to its resultant forces, the whole group is verified with the resultant forces defined for the entire group.

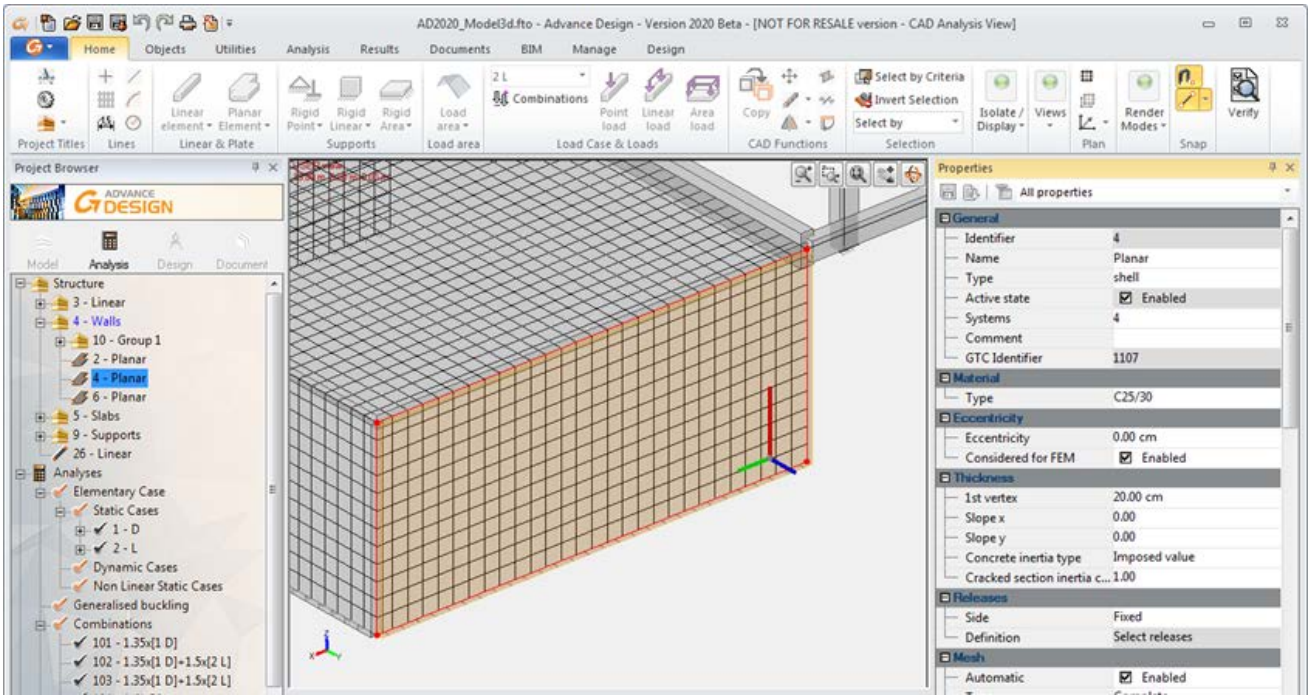


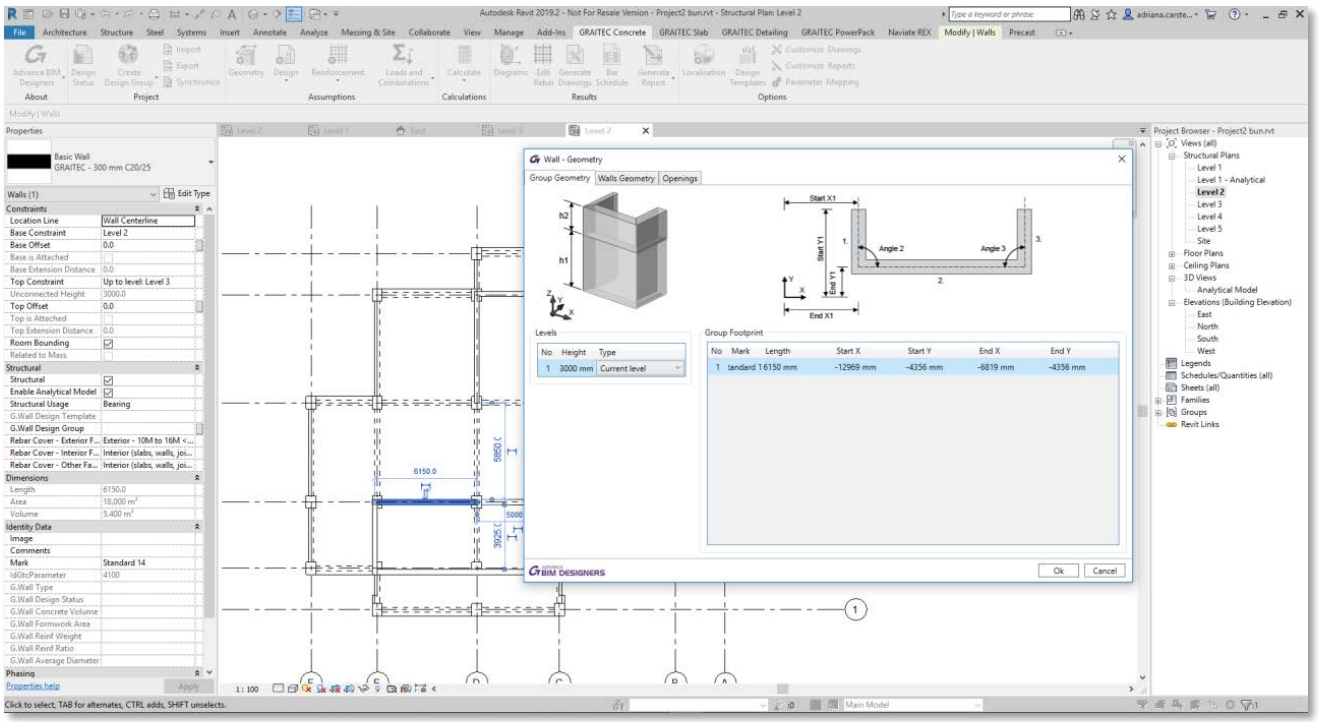
Modeling

In the standalone version of the BIM Designers Wall module, walls can be defined either graphically or using the dedicated dialog windows:



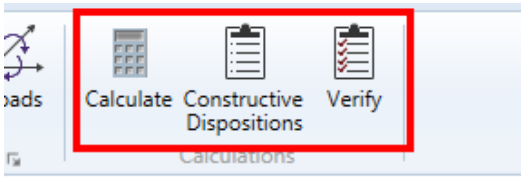
If the BIM Designers module is running in Advance Design and in Autodesk Revit®, the geometry of walls is imported from the host.





Calculations

The Wall module offers three methods of calculation, available on the Ribbon (**Calculations** panel):



- **Calculate**
  - All loads/resultant forces are considered;
  - Reinforcement is automatically created (required + minimal reinforcement);
  - All design checks are performed.

- **Constructive Dispositions**
  - Loads are not considered;
  - Reinforcement is automatically created (minimal reinforcement);
  - No checks, except the verification of the thickness of the wall.

- **Verify**
  - Requires that the reinforcement be already defined;
  - All loads/resultant forces are considered;
  - All design checks are performed.

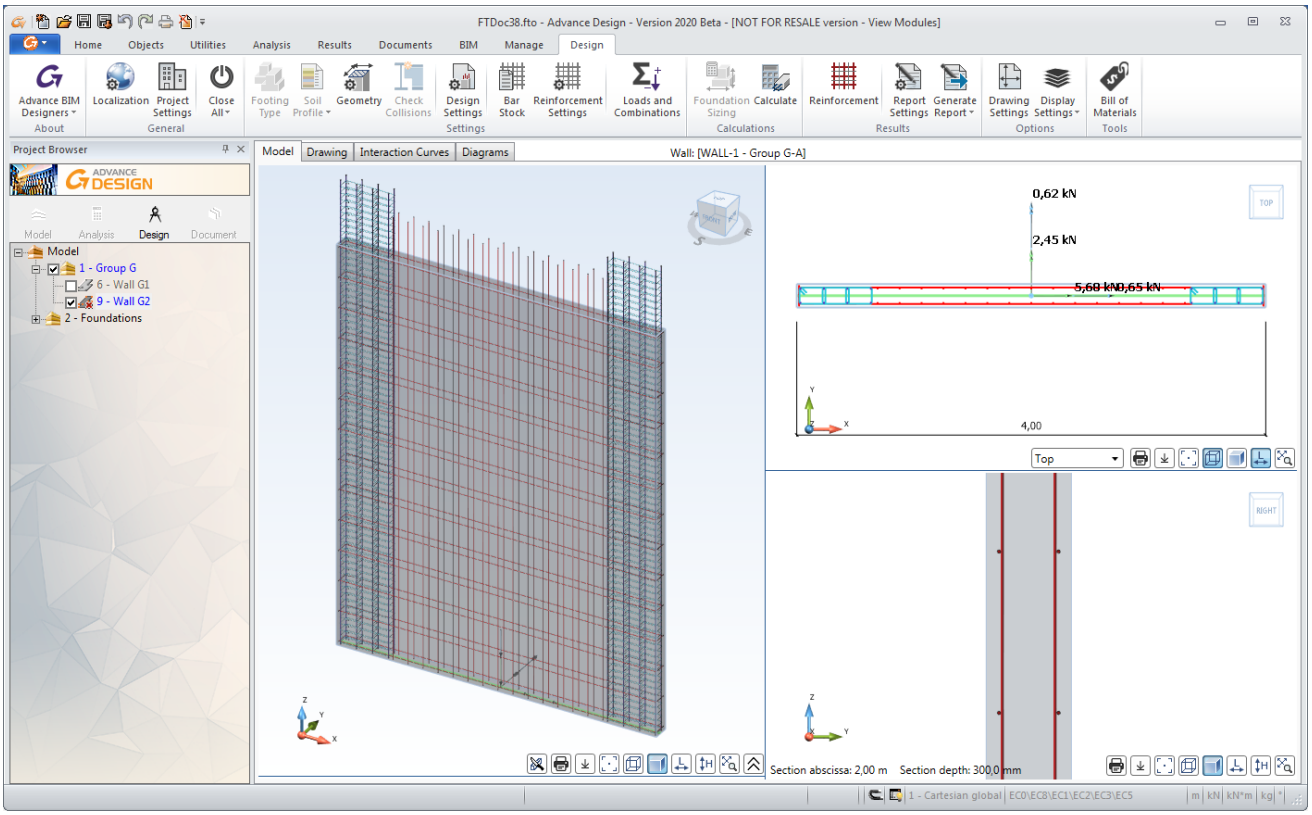
Using the available calculation methods, different scenarios can be covered. For example:

- To design a Single Wall with defined loads ***or*** resultant forces → use **Calculate;**
- To design a Group of walls with resultant forces on each wall and on a group of walls → use **Calculate;**
- To design a Group of walls with resultant forces only on the group of walls → use **Constructive Dispositions** and **Verify;**
- To verify edited or manually defined reinforcement → use **Verify.**

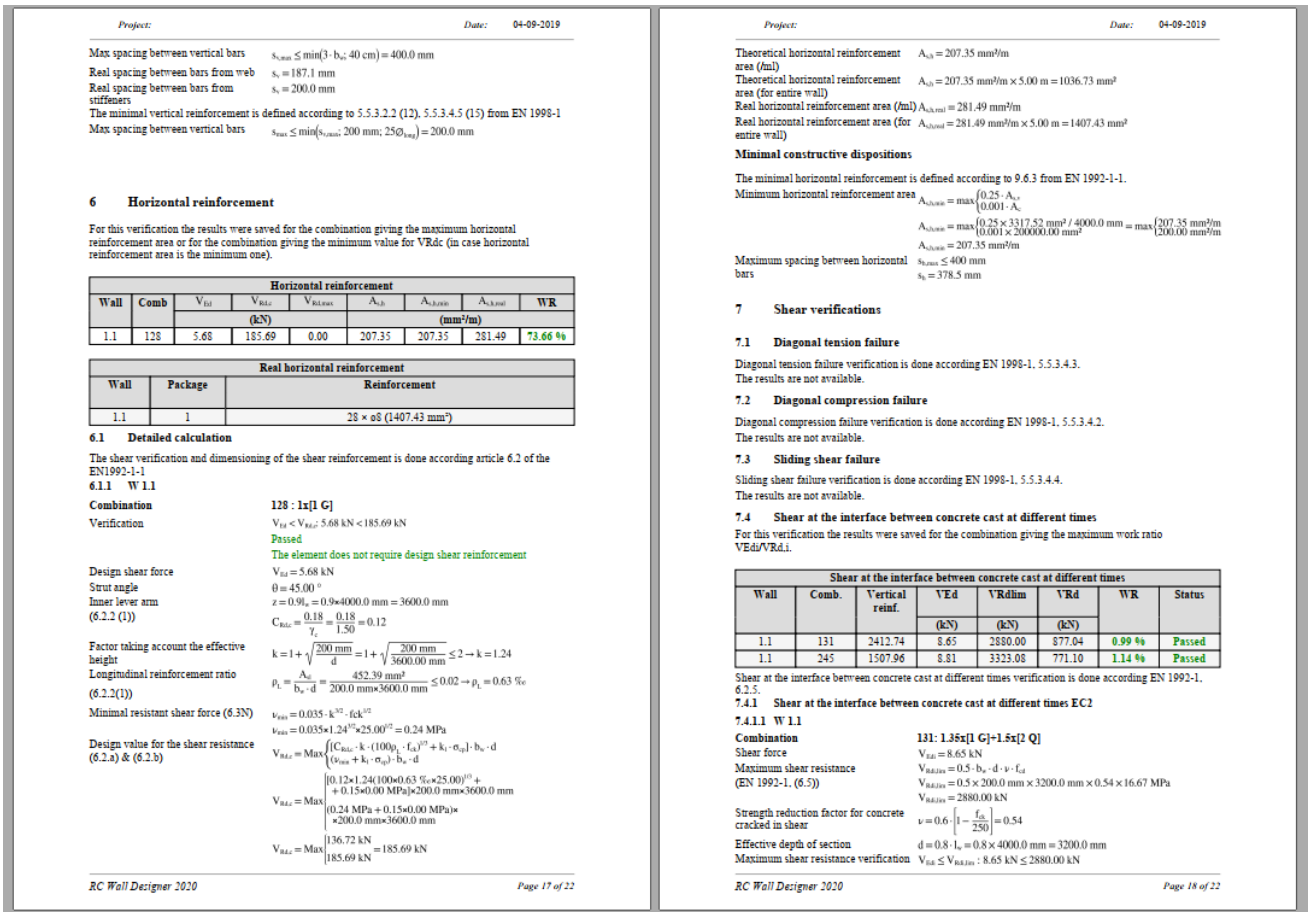
Results

The output of the Wall module depends on the wall type and is different if walls are analyzed as a group or individually:

- **3D rebar cage** – available for both wall types, (individual walls and groups of walls). The main reinforcement can be modeled using bars or fabrics. For shear walls, an additional reinforcement for edge stiffeners is generated.



- **Reports** – available for both wall types (individual walls and groups of walls). Both detailed and synthetic reports are available.



Project: *Date:* 04-09-2019

Max spacing between vertical bars $s_{v,max} \le \min(3 \cdot b_w; 40\ cm) = 400.0\ mm$
Real spacing between bars from web $s_v = 187.1\ mm$
Real spacing between bars from stiffeners $s_v = 200.0\ mm$
The minimal vertical reinforcement is defined according to 5.5.3.2.2 (12). 5.5.3.4.5 (15) from EN 1998-1
Max spacing between vertical bars $s_{max} \le \min(s_{v,max}; 200\ mm; 25\varnothing_{long}) = 200.0\ mm$

6 Horizontal reinforcement

For this verification the results were saved for the combination giving the maximum horizontal reinforcement area or for the combination giving the minimum value for VRdc (in case horizontal reinforcement area is the minimum one).

Horizontal reinforcement								
Wall	Comb	V_{Ed}	$V_{Rd,c}$	$V_{Rd,max}$	A_{ch}	$A_{ch,min}$	$A_{ch,real}$	WR
		(kN)			(mm²/m)			
1.1	128	5.68	185.69	0.00	207.35	207.35	281.49	73.66 %

Real horizontal reinforcement		
Wall	Package	Reinforcement
1.1	1	28 × ø8 (1407.43 mm²)

6.1 Detailed calculation

The shear verification and dimensioning of the shear reinforcement is done according article 6.2 of the EN1992-1-1

6.1.1 W 1.1

Combination **128 : 1x[1 G]**
Verification $V_{Ed} < V_{Rd,c}$: 5.68 kN < 185.69 kN
Passed
The element does not require design shear reinforcement
Design shear force $V_{Ed} = 5.68\ kN$
Strut angle $\theta = 45.00\ °$
Inner lever arm $z = 0.9 d_w = 0.9 \times 4000.0\ mm = 3600.0\ mm$
(6.2.2 (1)) $C_{Rd,c} = \frac{0.18}{\gamma_c} = \frac{0.18}{1.50} = 0.12$
Factor taking account the effective height $k = 1 + \sqrt{\frac{200\ mm}{d}} = 1 + \sqrt{\frac{200\ mm}{3600.00\ mm}} \le 2 \rightarrow k = 1.24$
Longitudinal reinforcement ratio $\rho_L = \frac{A_{sl}}{b_w \cdot d} = \frac{452.39\ mm^2}{200.0\ mm \times 3600.0\ mm} \le 0.02 \rightarrow \rho_L = 0.63\ ‰$
(6.2.2(1))
Minimal resistant shear force (6.3N) $v_{min} = 0.035 \cdot k^{3/2} \cdot fck^{1/2}$
$v_{min} = 0.035 \times 1.24^{3/2} \times 25.00^{1/2} = 0.24\ MPa$
Design value for the shear resistance (6.2.a) & (6.2.b) $V_{Rd,c} = Max\left\{[C_{Rd,c} \cdot k \cdot (100\rho_L \cdot f_{ck})^{1/3} + k_1 \cdot \sigma_{cp}] \cdot b_w \cdot d;\ (v_{min} + k_1 \cdot \sigma_{cp}) \cdot b_w \cdot d\right.$
$V_{Rd,c} = Max\left\{\begin{matrix}[0.12 \times 1.24(100 \times 0.63\ ‰ \times 25.00)^{1/3} + \\ + 0.15 \times 0.00\ MPa] \times 200.0\ mm \times 3600.0\ mm \\ (0.24\ MPa + 0.15 \times 0.00\ MPa) \times \\ \times 200.0\ mm \times 3600.0\ mm\end{matrix}\right.$
$V_{Rd,c} = Max\left\{\begin{matrix}136.72\ kN \\ 185.69\ kN\end{matrix}\right. = 185.69\ kN$

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Theoretical horizontal reinforcement area (/ml) $A_{ch} = 207.35\ mm^2/m$
Theoretical horizontal reinforcement area (for entire wall) $A_{ch} = 207.35\ mm^2/m \times 5.00\ m = 1036.73\ mm^2$
Real horizontal reinforcement area (/ml) $A_{ch,real} = 281.49\ mm^2/m$
Real horizontal reinforcement area (for entire wall) $A_{ch,real} = 281.49\ mm^2/m \times 5.00\ m = 1407.43\ mm^2$

Minimal constructive dispositions

The minimal horizontal reinforcement is defined according to 9.6.3 from EN 1992-1-1.
Minimum horizontal reinforcement area $A_{ch,min} = \max\left\{\begin{matrix}0.25 \cdot A_{s,v} \\ 0.001 \cdot A_c\end{matrix}\right.$
$A_{ch,min} = \max\left\{\begin{matrix}0.25 \times 3317.52\ mm^2 / 4000.0\ mm \\ 0.001 \times 200000.00\ mm^2\end{matrix}\right. = \max\left\{\begin{matrix}207.35\ mm^2/m \\ 200.00\ mm^2/m\end{matrix}\right.$
$A_{ch,min} = 207.35\ mm^2/m$
Maximum spacing between horizontal bars $s_{h,max} \le 400\ mm$
$s_h = 378.5\ mm$

7 Shear verifications

7.1 Diagonal tension failure

Diagonal tension failure verification is done according EN 1998-1, 5.5.3.4.3.
The results are not available.

7.2 Diagonal compression failure

Diagonal compression failure verification is done according EN 1998-1, 5.5.3.4.2.
The results are not available.

7.3 Sliding shear failure

Sliding shear failure verification is done according EN 1998-1, 5.5.3.4.4.
The results are not available.

7.4 Shear at the interface between concrete cast at different times

For this verification the results were saved for the combination giving the maximum work ratio VEdi/VRd.i.

Shear at the interface between concrete cast at different times							
Wall	Comb.	Vertical reinf.	VEd	VRdlim	VRd	WR	Status
			(kN)	(kN)	(kN)		
1.1	131	2412.74	8.65	2880.00	877.04	0.99 %	Passed
1.1	245	1507.96	8.81	3323.08	771.10	1.14 %	Passed

Shear at the interface between concrete cast at different times verification is done according EN 1992-1, 6.2.5.

7.4.1 Shear at the interface between concrete cast at different times EC2

7.4.1.1 W 1.1

Combination **131: 1.35x[1 G]+1.5x[2 Q]**
Shear force $V_{Ed} = 8.65\ kN$
Maximum shear resistance (EN 1992-1, (6.5)) $V_{Rd,lim} = 0.5 \cdot b_w \cdot d \cdot \nu \cdot f_{cd}$
$V_{Rd,lim} = 0.5 \times 200.0\ mm \times 3200.0\ mm \times 0.54 \times 16.67\ MPa$
$V_{Rd,lim} = 2880.00\ kN$
Strength reduction factor for concrete cracked in shear $\nu = 0.6 \cdot \left[1 - \frac{f_{ck}}{250}\right] = 0.54$
Effective depth of section $d = 0.8 \cdot l_w = 0.8 \times 4000.0\ mm = 3200.0\ mm$
Maximum shear resistance verification $V_{Ed} \le V_{Rd,lim}$: 8.65 kN ≤ 2880.00 kN

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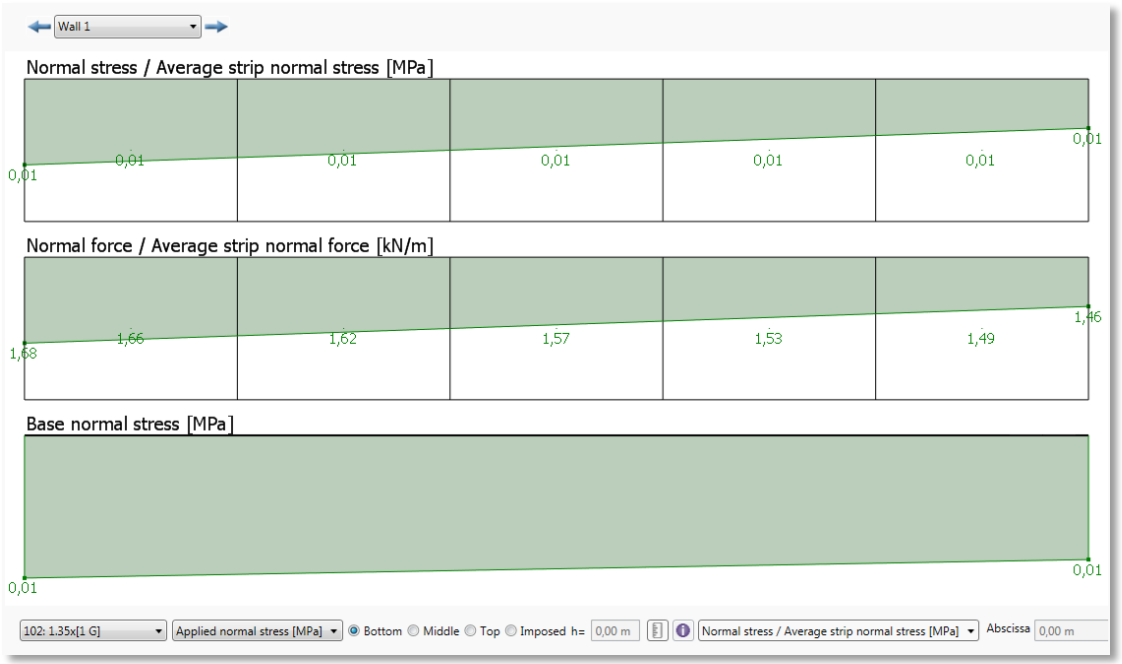
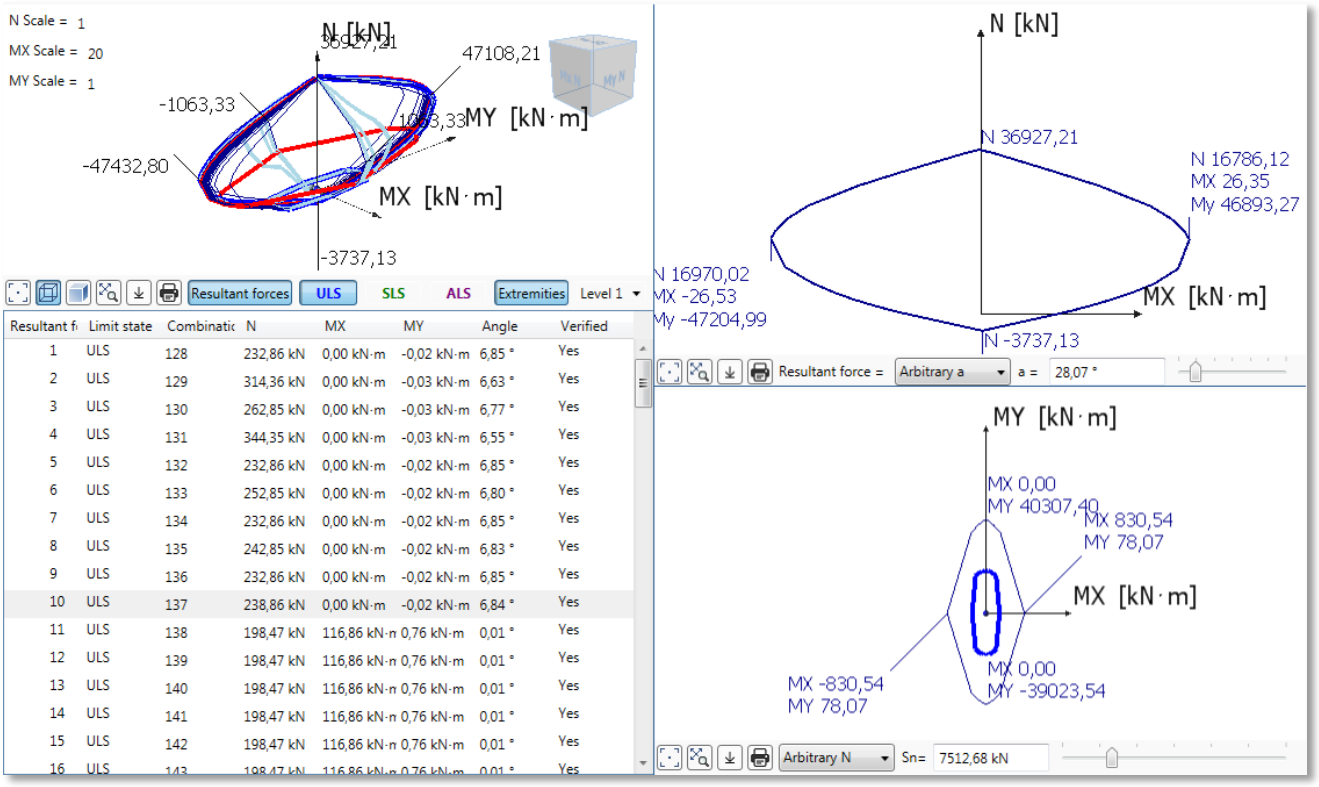
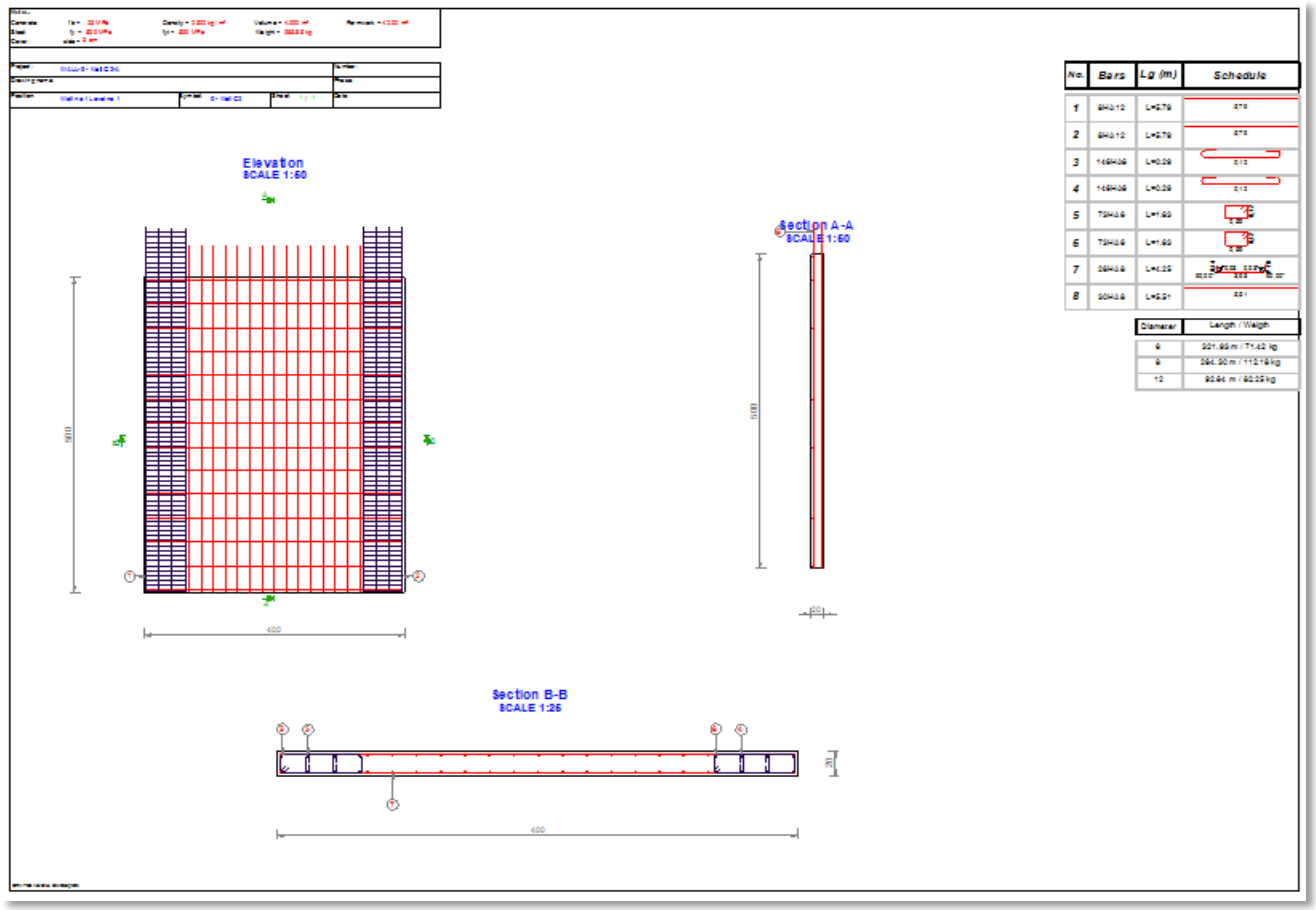
- **Diagrams** – available only for **Bearing Walls**. A wide range of diagrams is available: for normal forces, normal stresses and the stress on the wall base.



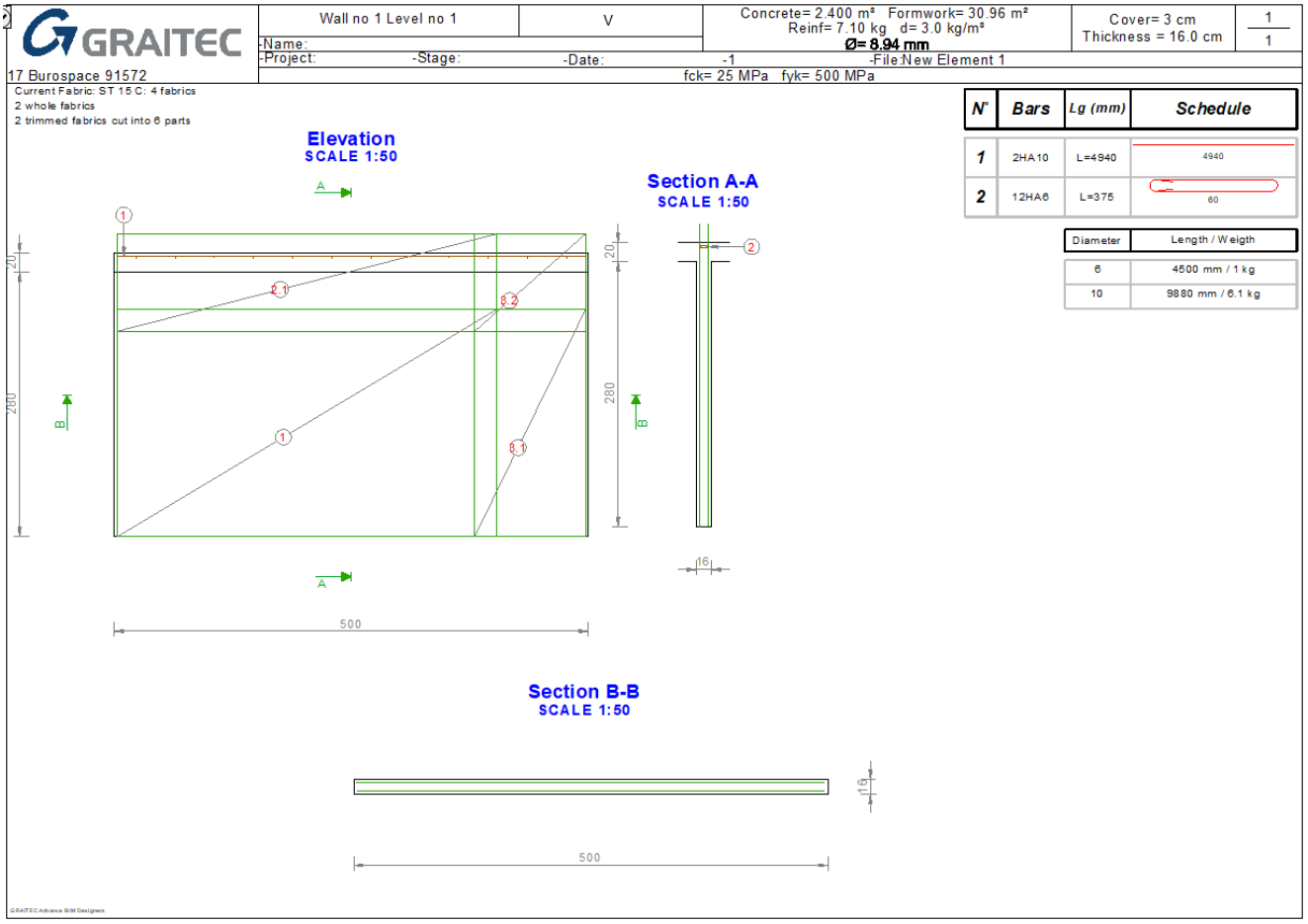
- **Interaction curves** – available for **Shear Walls** only.



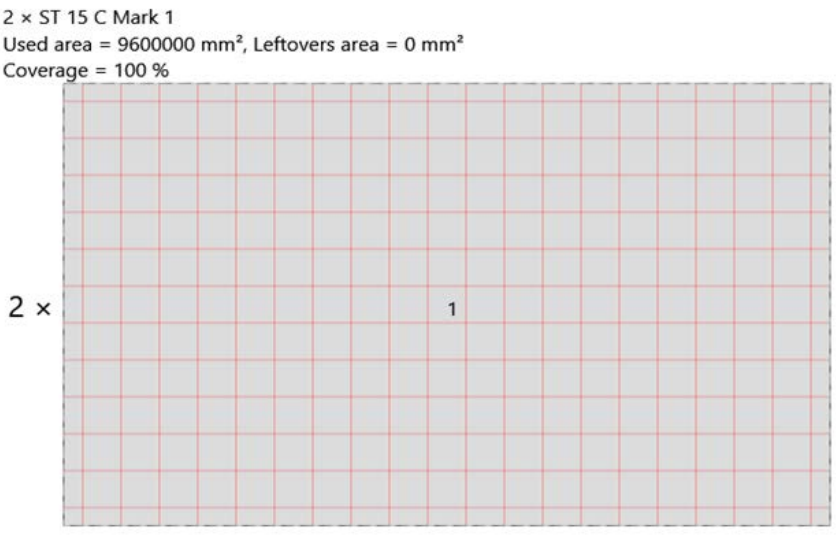
Drawings – available for individual walls only.

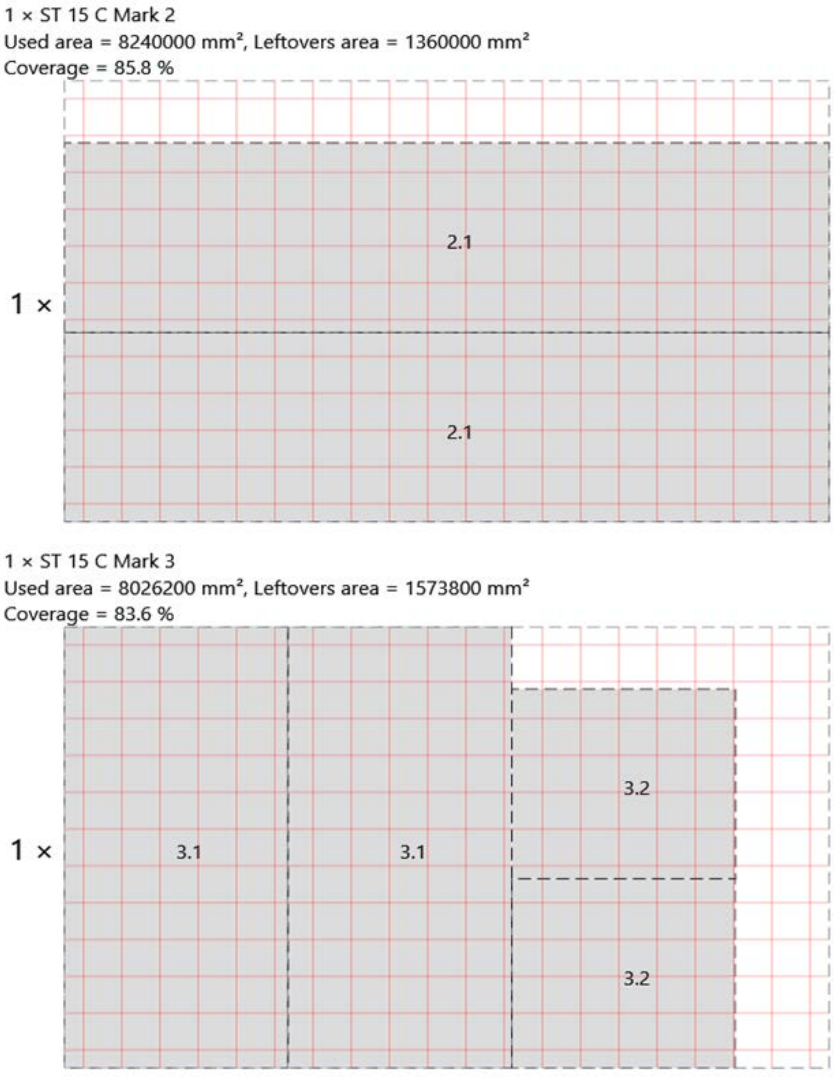


- **Reinforcement Schedule:** available for individual walls only, both **Bearing** and **Shear** ones. Includes only bars from the 3D model, in a format similar to the other three modules. If the wall is reinforced using fabrics *or* fabrics and bars, additional information will also be displayed on the sheet:



The schedule only displays the bars in the cage, and information related to the number and type of fabrics; the way they are cut is separately presented and can be saved as an external image.



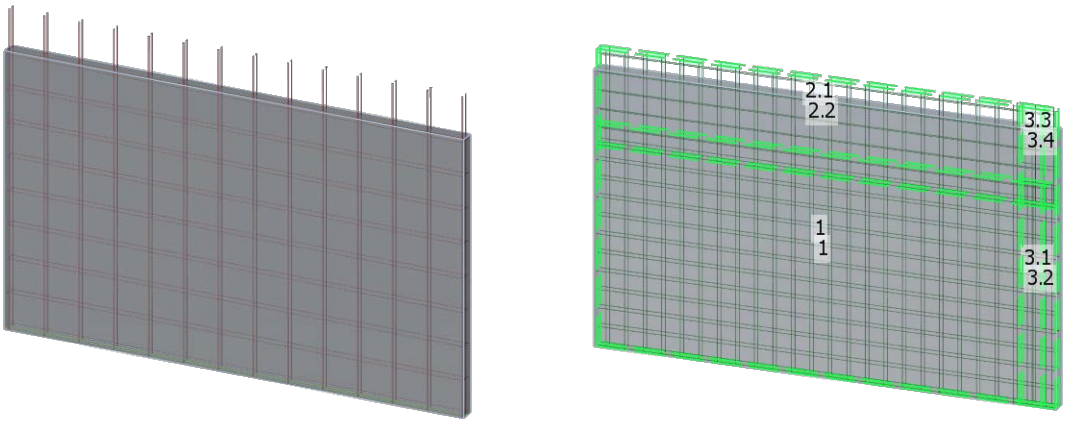


Reinforcement

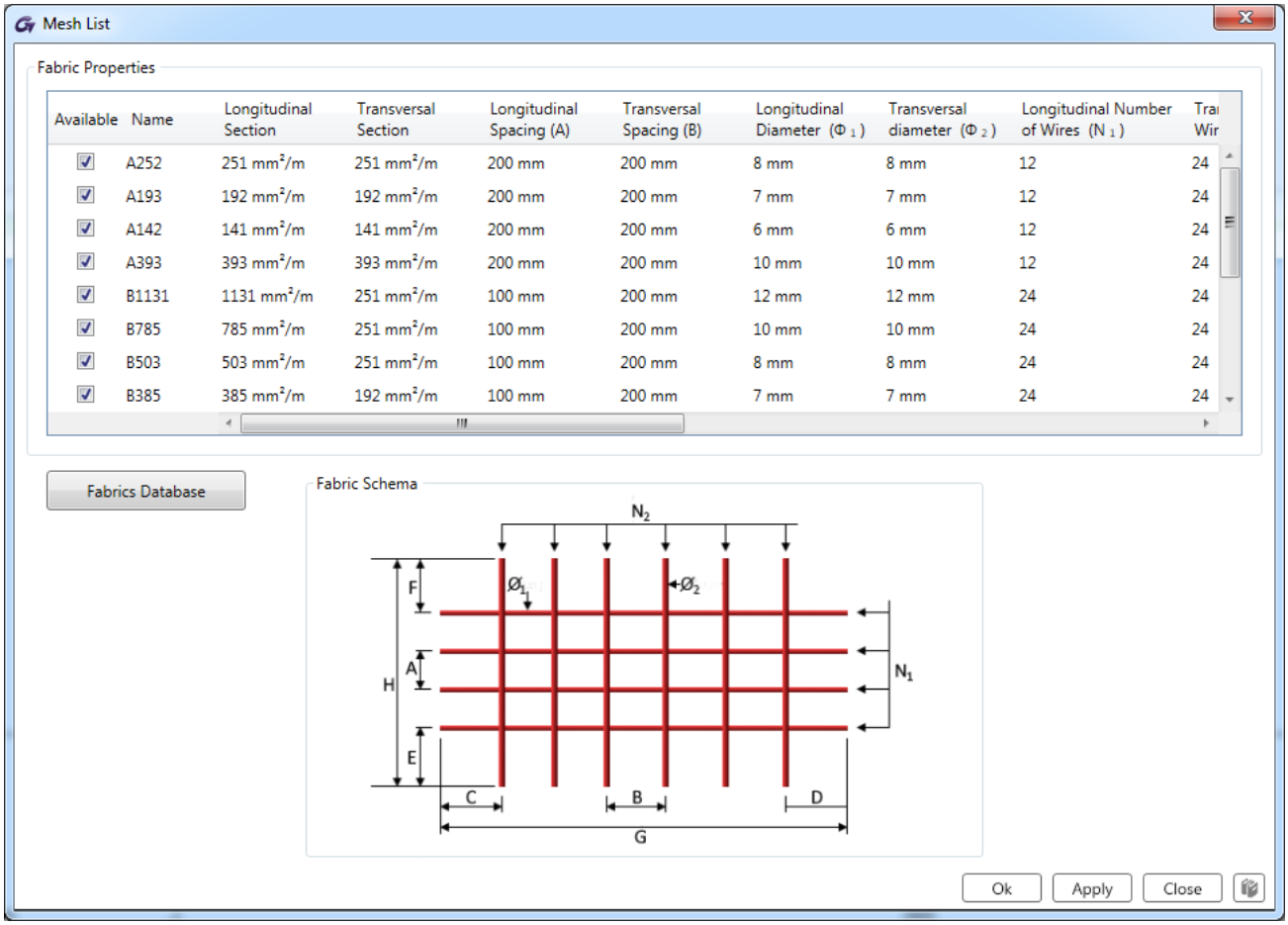
For the main reinforcement of the wall web, two reinforcement types are available:

- Separate horizontal and vertical rebar;
- Wire fabrics.

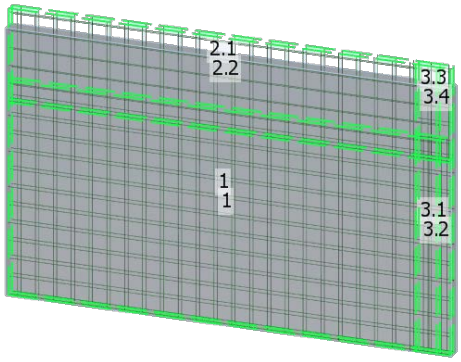
In both cases, the main reinforcement is placed symmetrically on both sides (front / back).

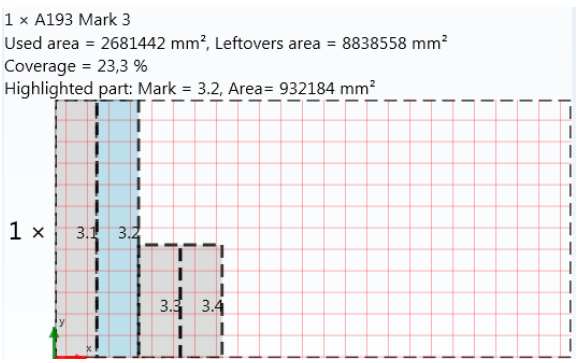


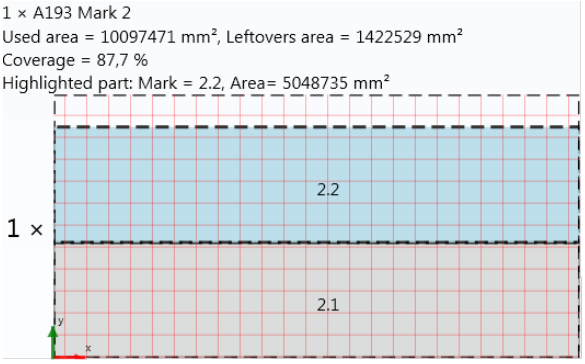
The Wall module offers a database of typical fabrics that can be also easily extended.



For wire fabrics, a special mechanism is implemented, aimed to optimize the distribution of fabrics and scraps reusing. By hovering the mouse cursor over the already-created fabrics, a special tooltip is displayed, containing details in both graphical and numerical form.

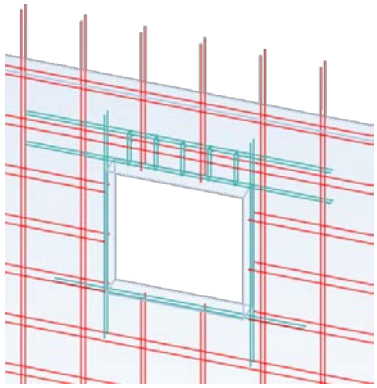




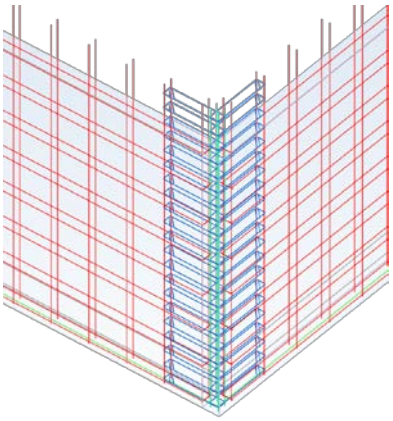


In addition to the main reinforcement, different kinds of additional reinforcement can be generated:

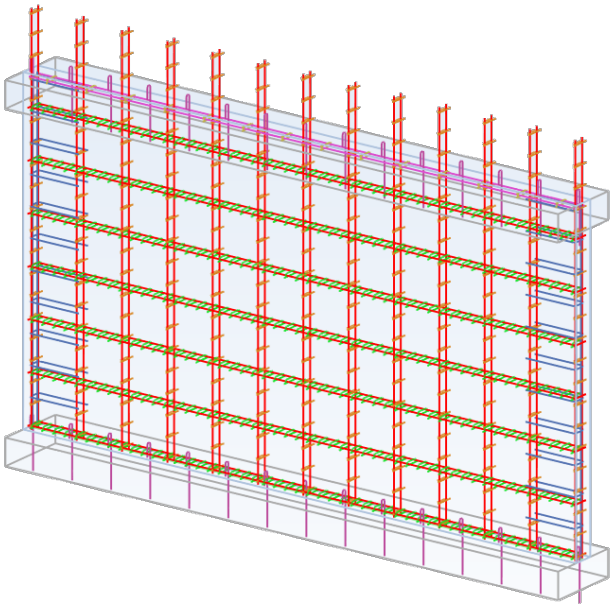
- Constructive reinforcement for openings: can be created if openings are defined. In addition, bars for the top lintel(s) can be calculated and created.



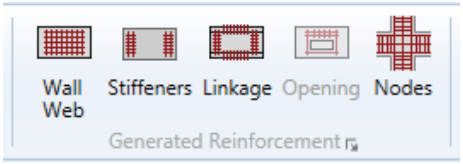
- Nodal bars: created for group of walls.

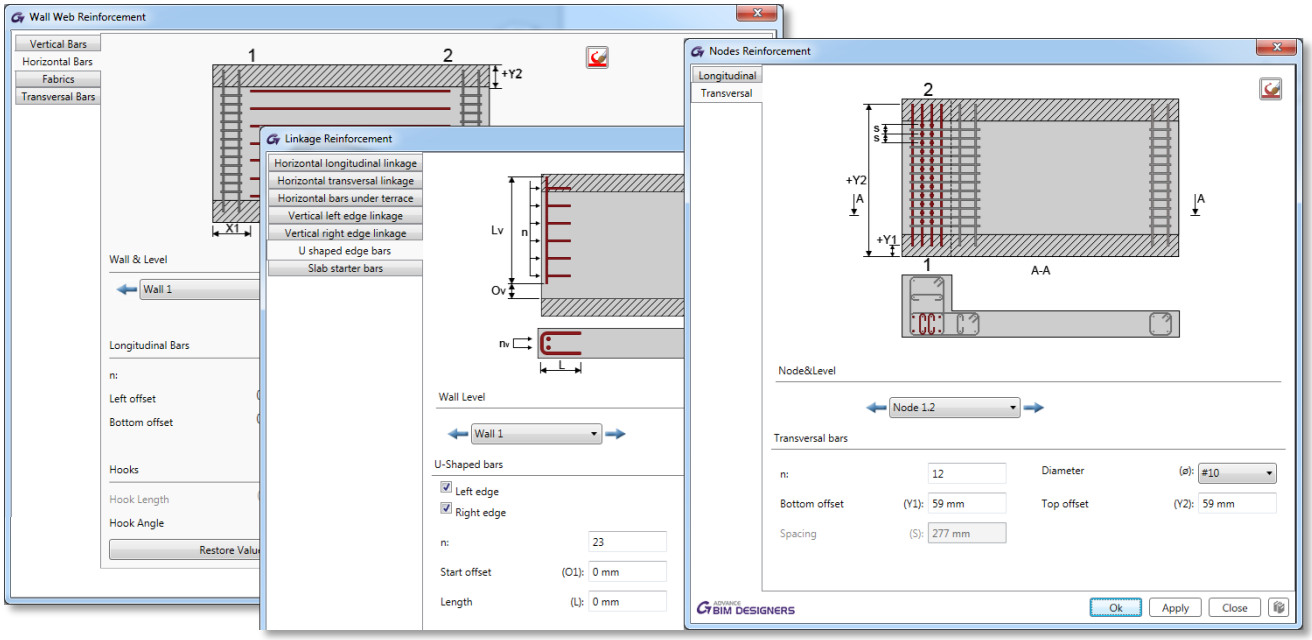


- Top and bottom starter bars;
- Edge U-shaped bars;
- Short horizontal links connecting main bars located in front and back layers;
- Linkage bars for connecting wall with slabs.



Advance BIM Designers Wall module offers a full range of options for editing / creation of reinforcement, using dialog windows. There are separate options for wall web reinforcement, stiffeners, linkage bars, opening reinforcement and nodes.

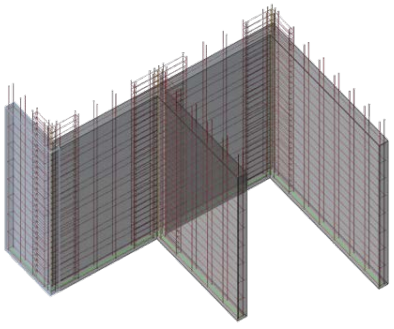


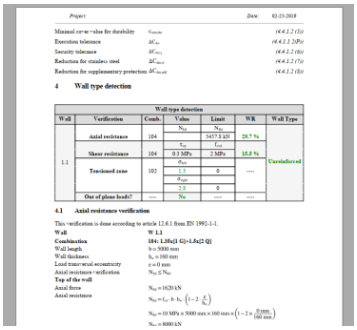


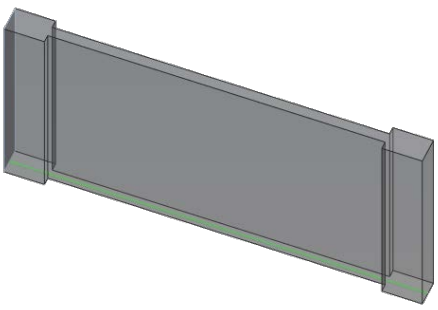
Limitations

The first version of the BIM Designers Wall module has a few limitations:

- No drawings for a group of walls;
- No detailed reports for calculations acc. to ACI and CSA codes;
- No boundary elements.







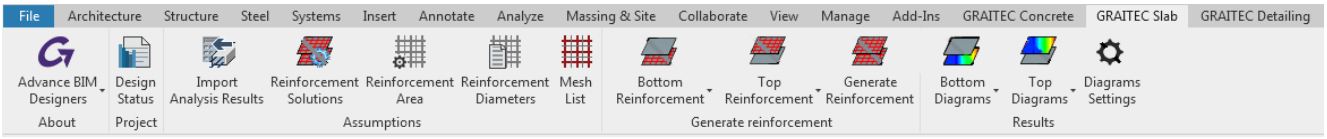
New RC Slab Module

Advance BIM Designers 2020 provides a first version of a new **Slab** module for the creation of reinforcement on structural slabs on Autodesk Revit®. The new module allows for full / semi-automatic reinforcement generation, using sets of reinforcement bars or wire fabrics.

The main usage scenario of the Slab module is to rely on the theoretical reinforcement area imported from Advance Design for creating the 3D rebar cage. Thanks to interactive tools showing the difference between the required reinforcement surface and the real reinforcement already proposed, the user has full control and is given the possibility to opt for a quick and effective reinforcement distribution.

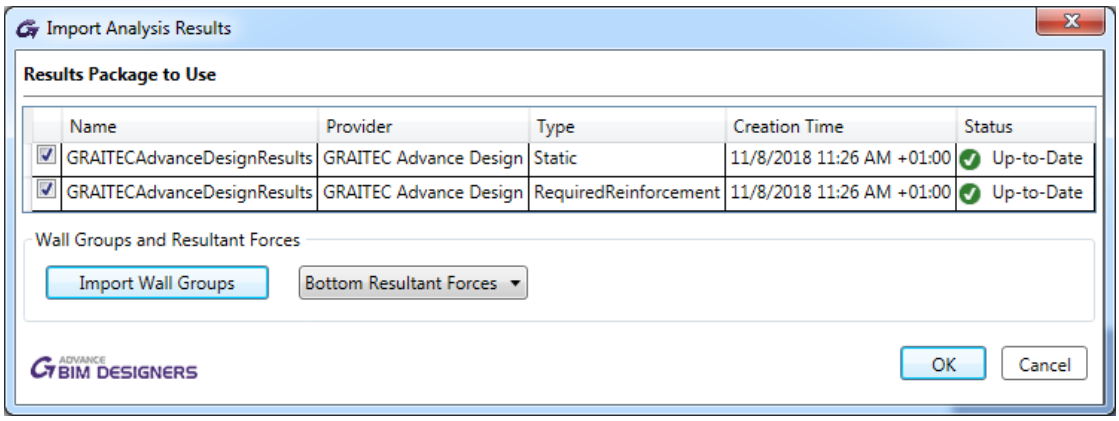
The module also enables reinforcement generation based on user input (detailing mode), without any information about the theoretical reinforcement area, using only minimal reinforcement areas.

All commands used to model the reinforcement in slabs using the new BIM Designers module are placed in a new GRAITEC Slab ribbon.



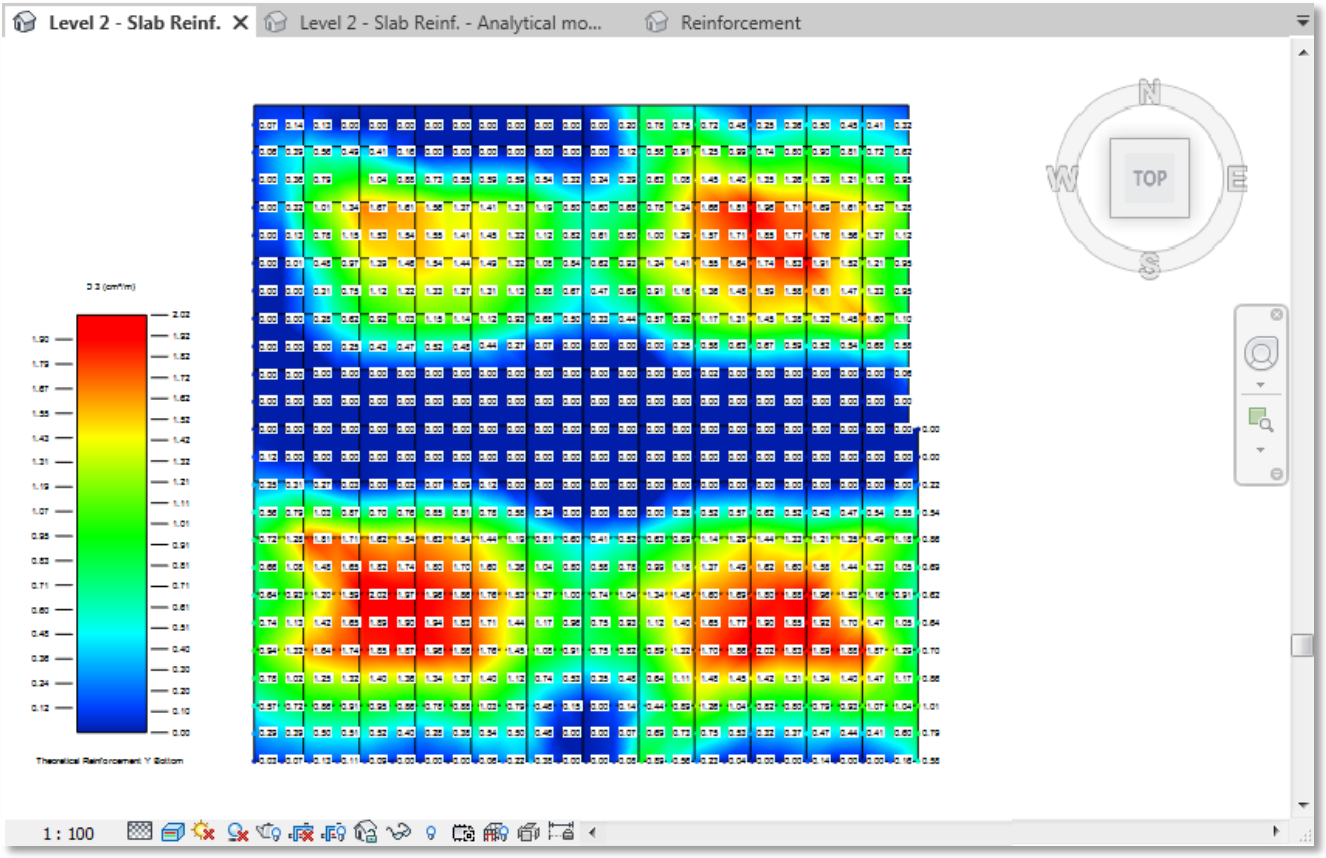
Required reinforcement area

The BIM Designers Slab module uses the required theoretical reinforcement area stored in the Revit® structural results package.

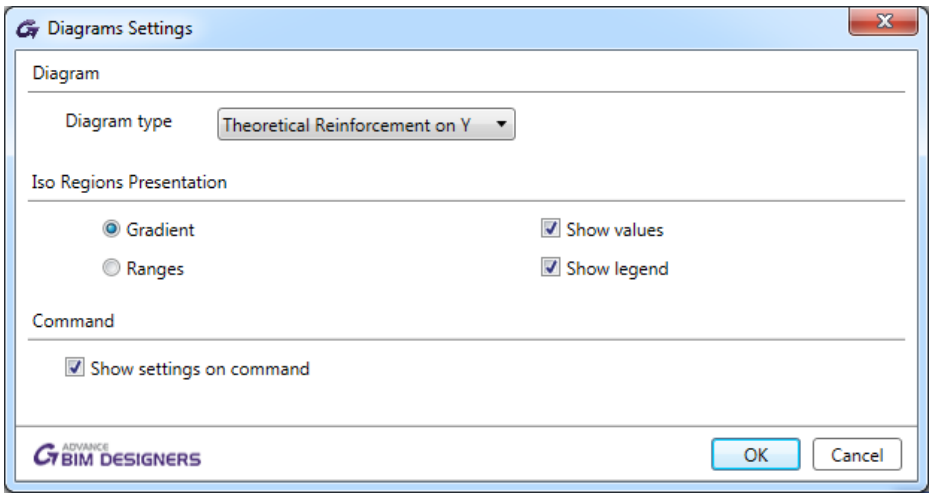


***Note**: The first version of the BIM Designers Slab module supports the theoretical reinforcement area imported from Advance Design only.*

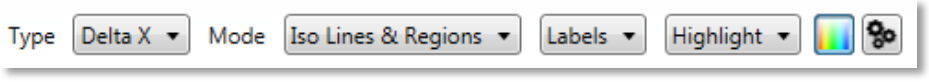
Using the **Bottom Diagrams** and **Top Diagrams** commands, it is possible to quickly display the imported reinforcement areas:

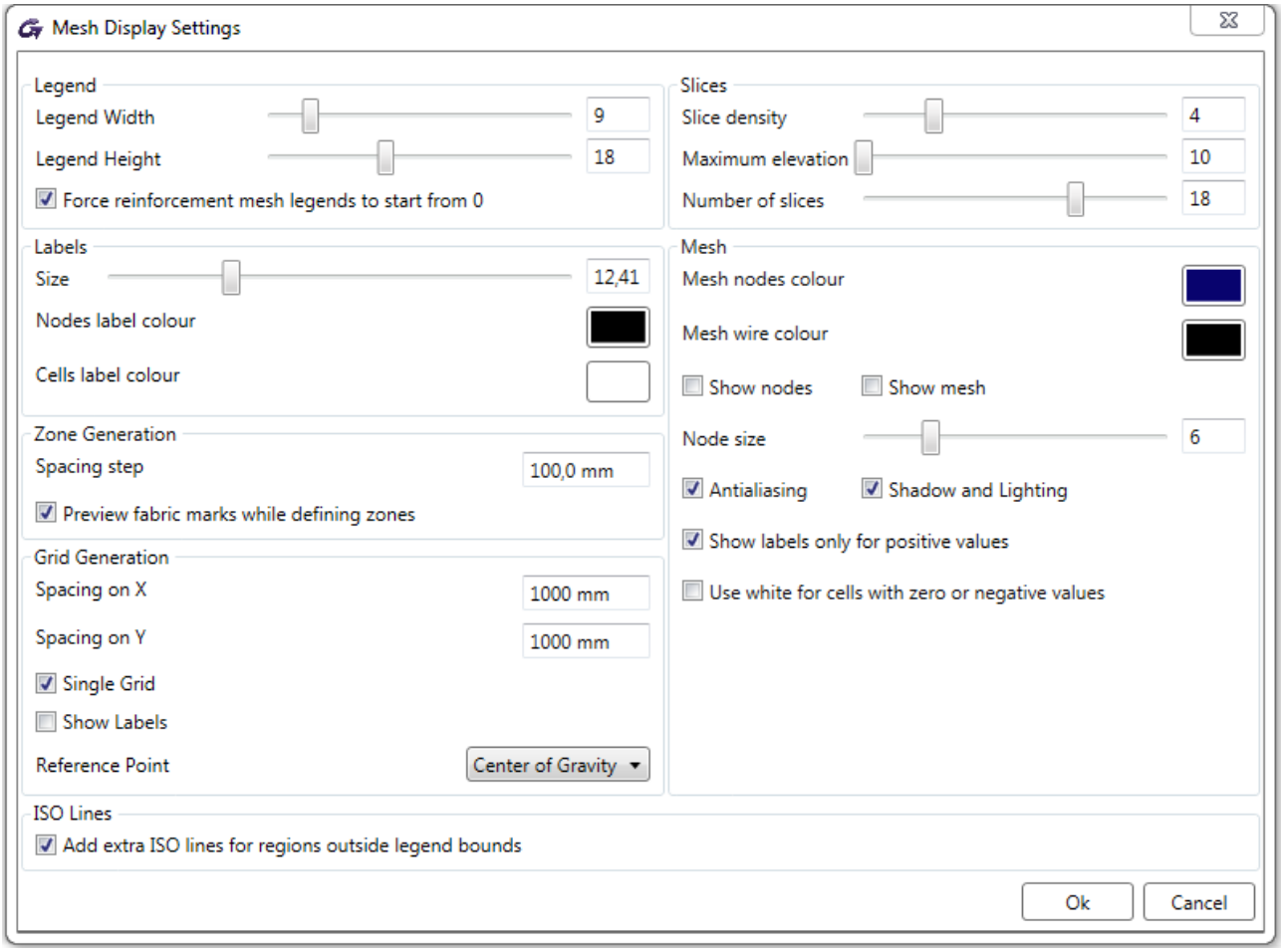


The basic settings for diagrams are available in a **Diagrams Settings** dialog or using Revit® Analysis Display Styles.

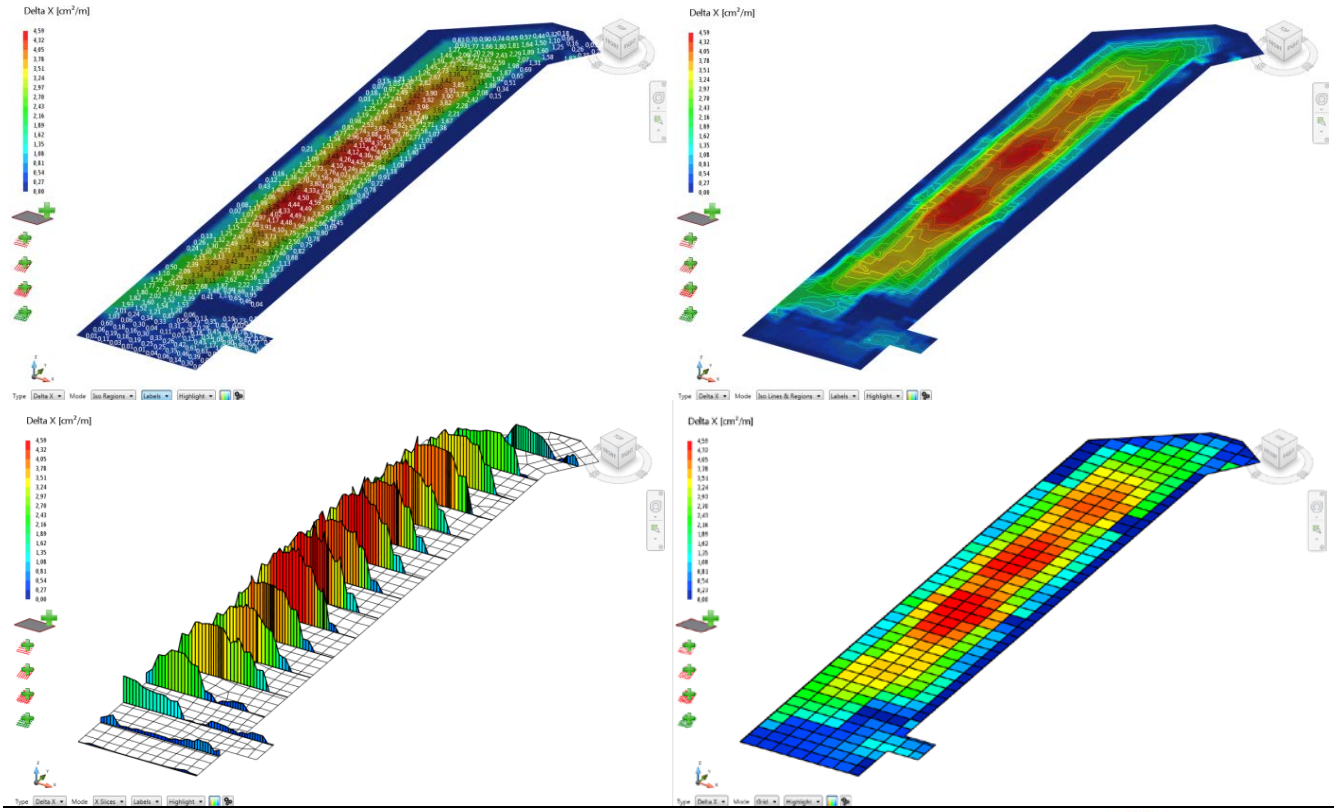


Imported reinforcement surfaces are also presented during the interactive reinforcement modeling. In this case, the data presentation is configured using both the commands located at the bottom of the Revit® viewport and the dedicated configuration dialog:





These settings enable the presentation of data in several modes that can be customized according to current needs.

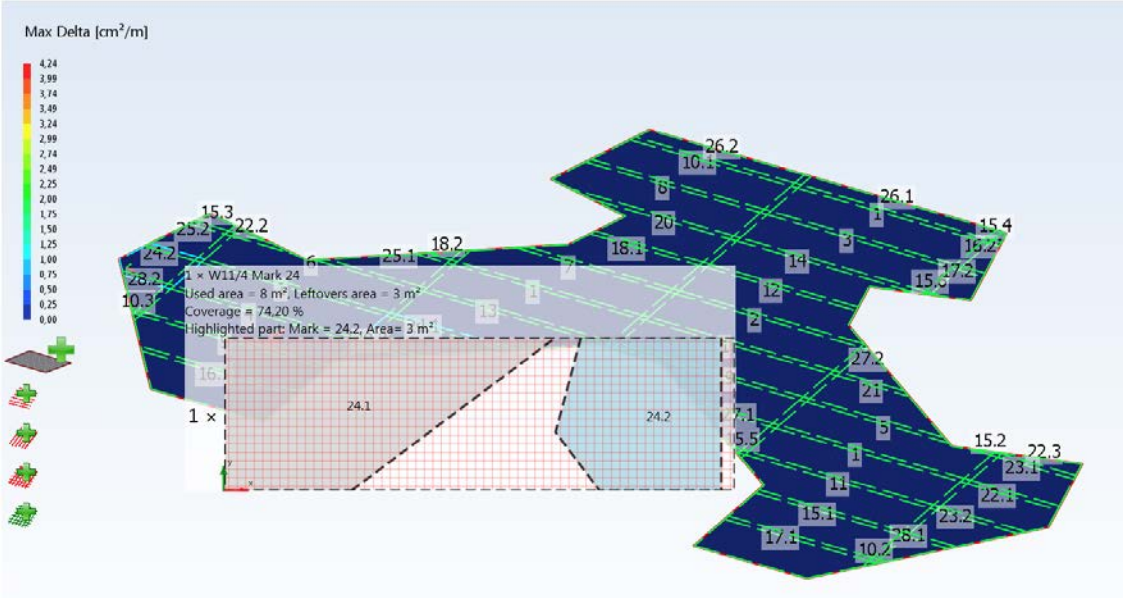


Reinforcement definition

There are two main possibilities to create the reinforcement cage using the Slab module:

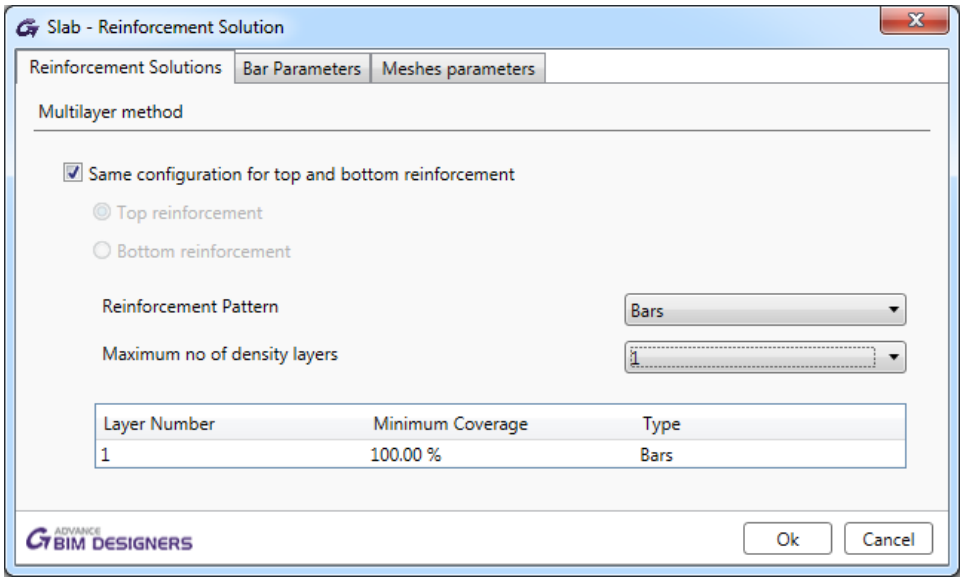
- Automatic reinforcement generation;
- Interactive reinforcement generation.

Both methods allow for creating reinforcement using rebars or wire fabrics. In the case of wire fabrics definition, an intelligent and unique repartition of wire fabrics with optimization of reusing scraps is implemented.



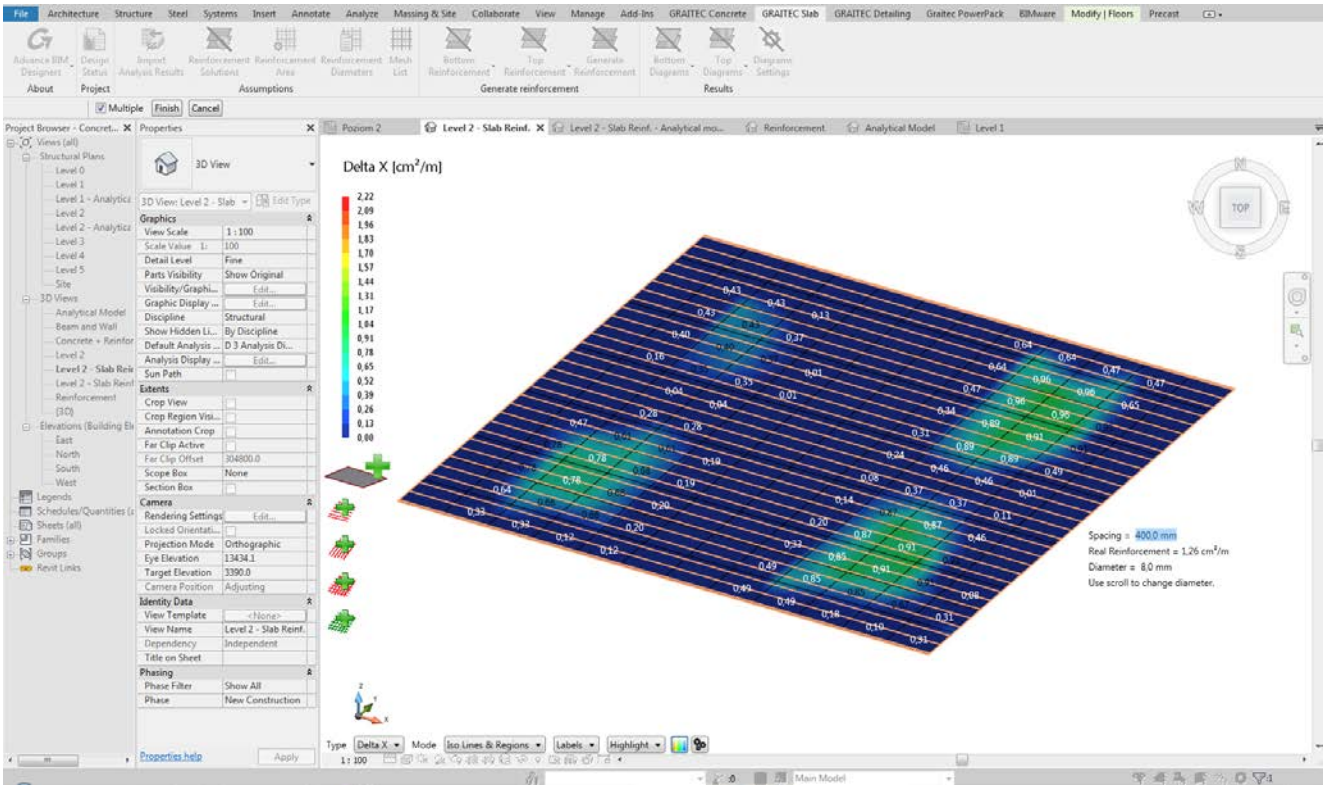
Automatic reinforcement generation

- Automatically creates top and bottom reinforcement on both perpendicular directions;
- Reinforcement is based on the required theoretical reinforcement area;
- Reinforcement is based on defined rules that enable different reinforcement strategies;
- Enables defining of reinforcement covering specified percentage of required reinforcement area;
- For well-defined parameters, itis enough to press one button: **Generate Reinforcement** (available on the GRAITEC Slab ribbon) in order to get full 2D reinforcement cage for a slab.



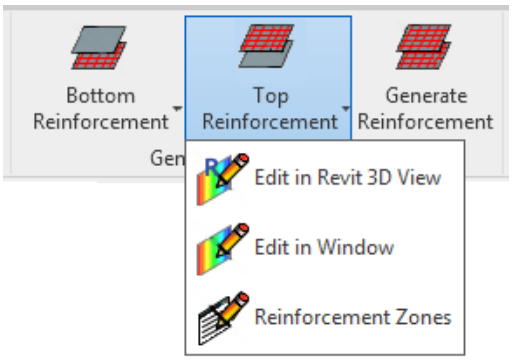
Interactive reinforcement generation

- Reinforcement is defined separately for top and bottom reinforcement;
- Reinforcement is based on the user input;
- It provides a real-time preview of the remaining required reinforcement area (as the difference between the required and entered area);
- Reinforcement is defined separately for top and bottom reinforcement.

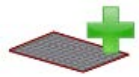


Interactive reinforcement generation

The interactive reinforcement generation can be run separately for top and for bottom reinforcement, using commands from the GRAITEC Slab ribbon. The interactive edit can be performed either in the Revit© 3D view or in a separate window: both ways offer ***identical*** functionalities, the only difference being the viewer type - the selection depends on the user's preferences.



The interactive editing of the reinforcement is done per slab, by selecting it in the Revit® viewport. The buttons on the left side of the view are used to select the reinforcement type:



Adds a new reinforcement layer – for cases when reinforcement is already defined on some areas and it is necessary to locally place additional reinforcement in the same direction;

Adds a new zone with bars along the main direction (X axis);

Adds a new zone with bars along the secondary direction (Y axis);

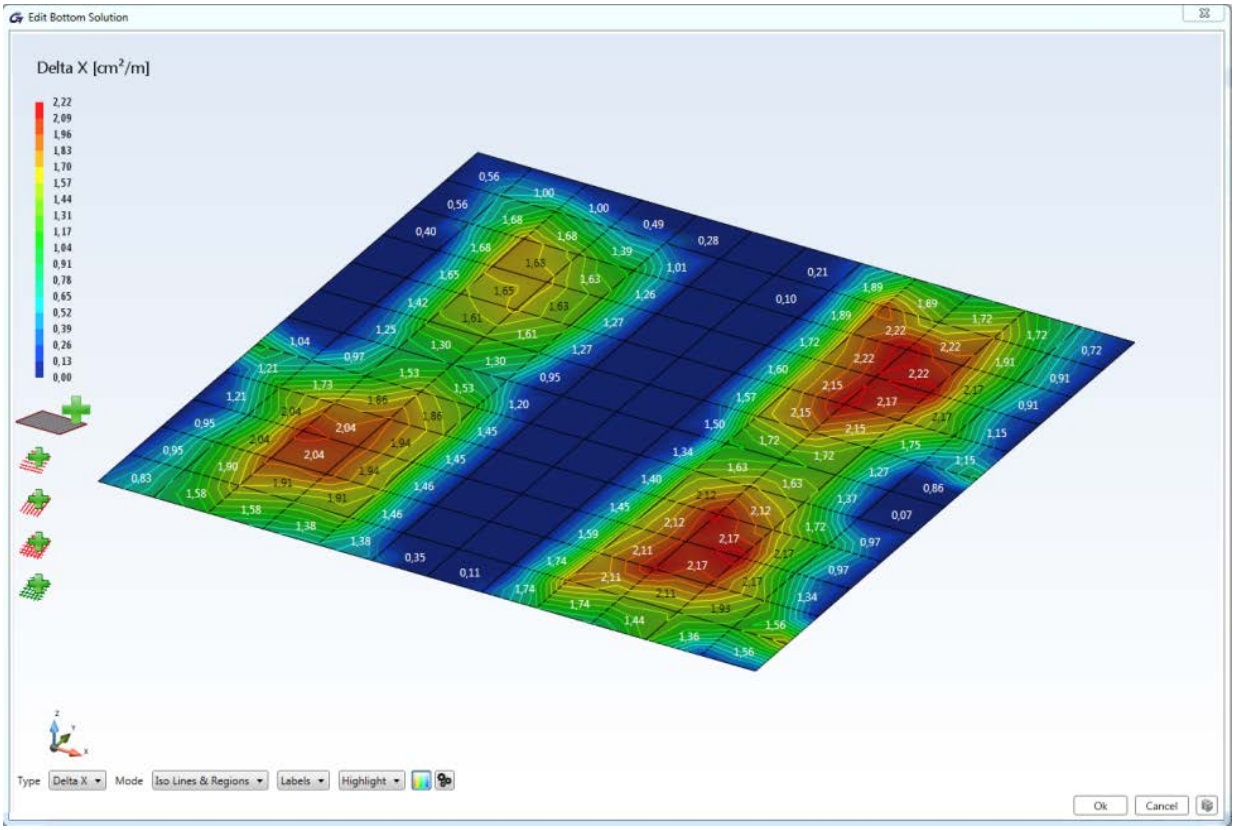
Adds a new zone with bars along both directions.

Adds a new zone with wire fabrics.

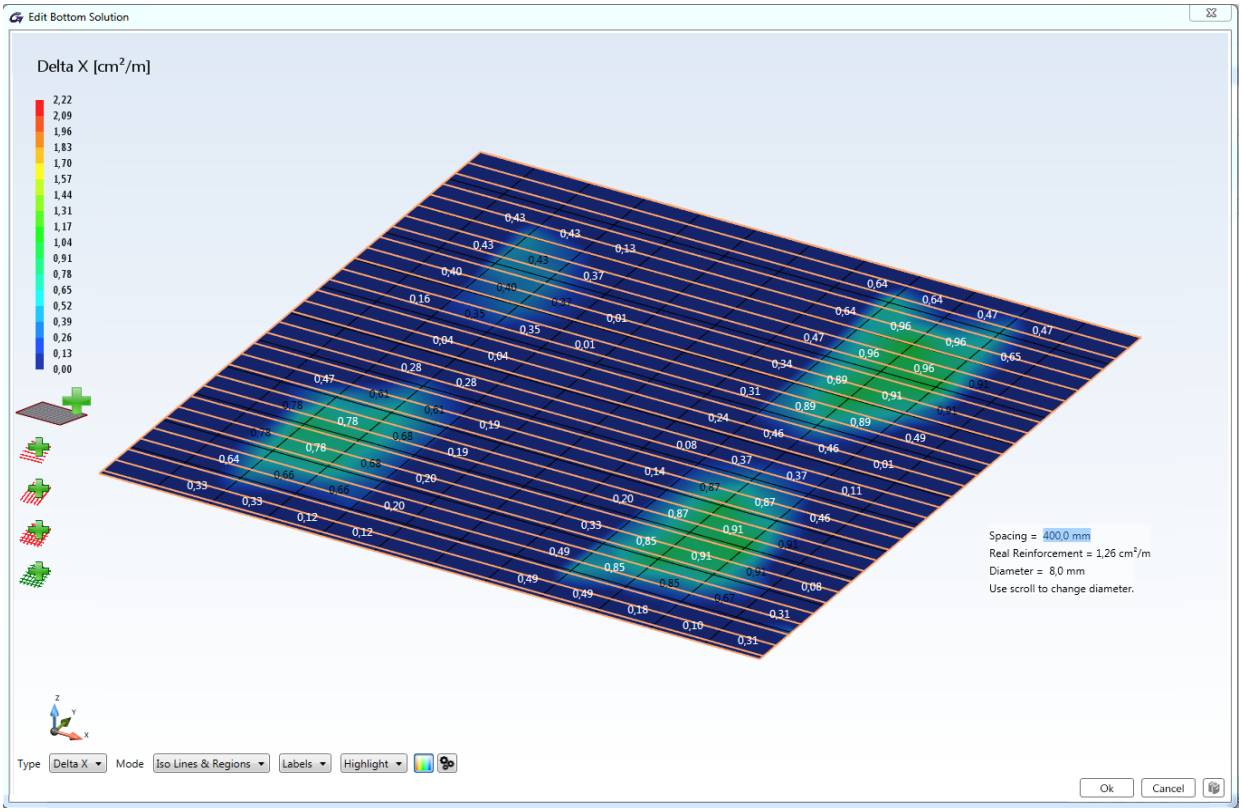
During the interactive editing, it is possible to present the value of the missing reinforcement (calculated as the difference between the required value at a given point and the value resulting from the entered reinforcement). Values are refreshed in real time, allowing the selection of diameters and bars spacing, or the wire fabric type.

Example:

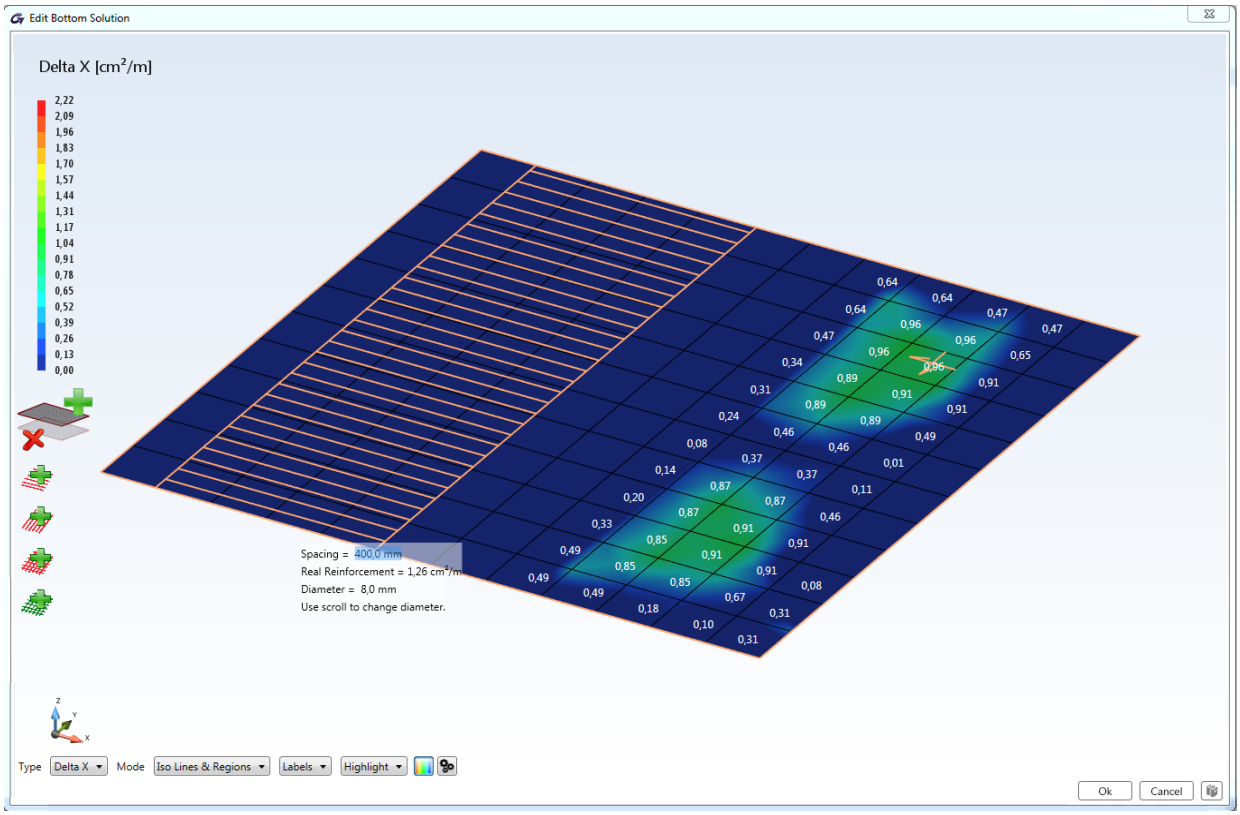
- Step 1 – resides in opening the interactive edit in a window with the required bottom reinforcement area on the X direction being visible.



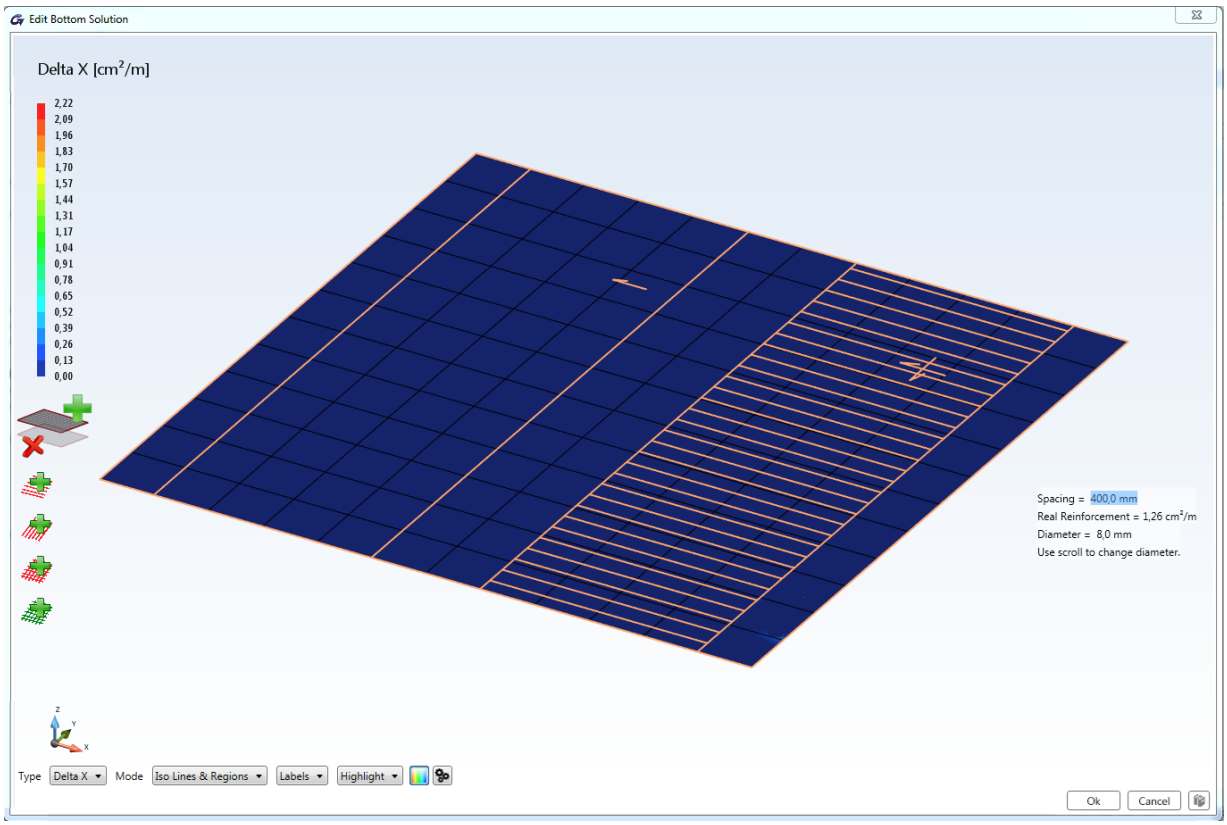
- Step 2 – supposes the creating one zone for whole slab (it's enough to press **Enter** to select the whole slab), then selects a diameter and the spacing of bars. The color map and values are changing during the selection process, showing the area of the missing reinforcement.



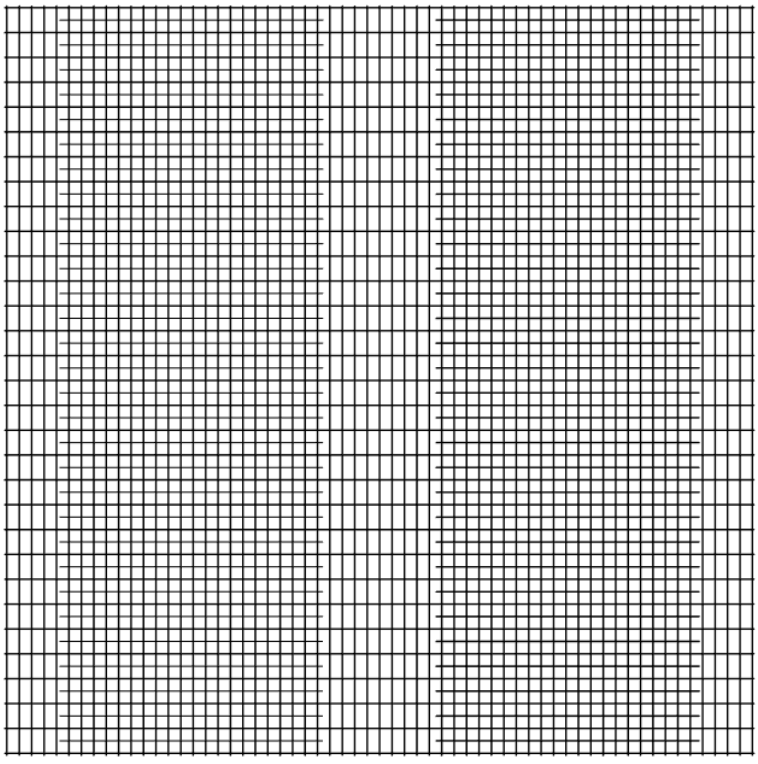
- Step 3 – as the selected reinforcement for the first zone is not fully covering the required area, the second layer is created where the additional zone is defined. As a result, on this particular zone, the required area is covered at 100%.



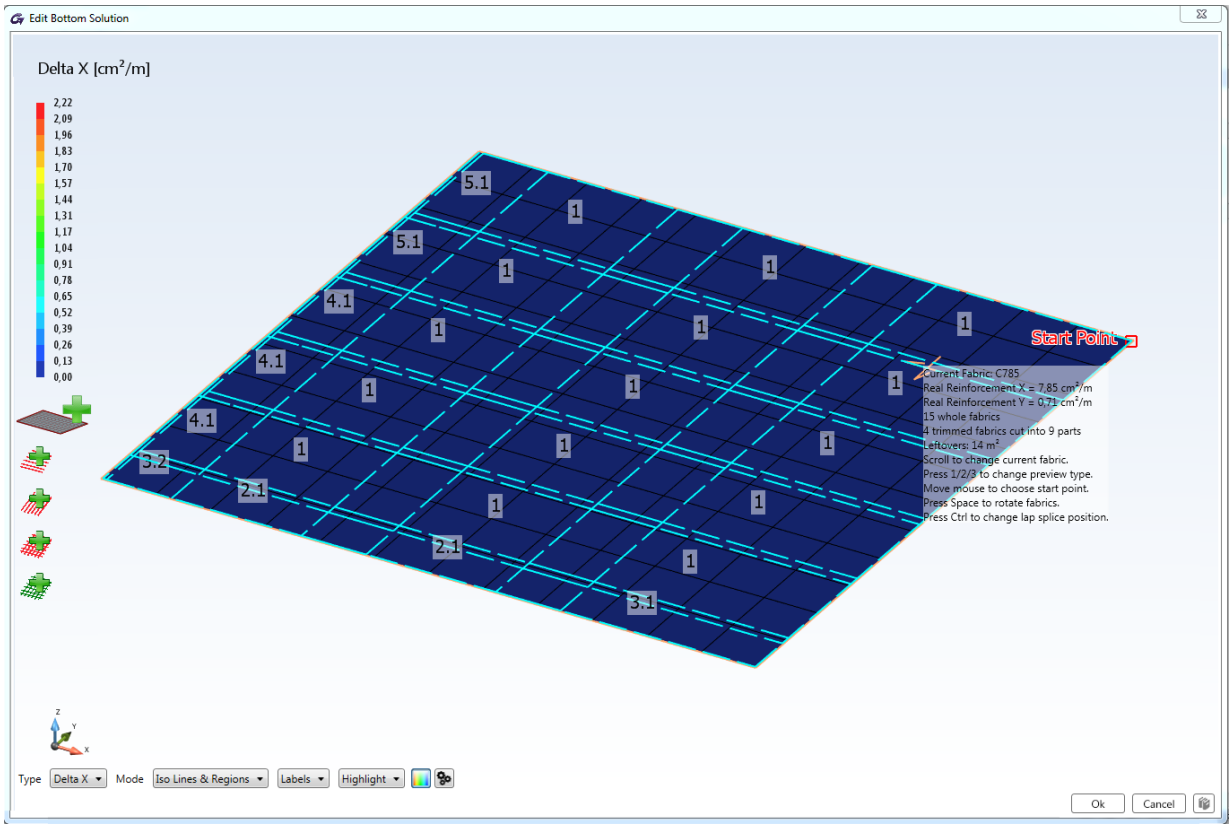
- Step 4 – by creating the next zone, the required theoretical reinforcement area is fully covered by the real reinforcement.



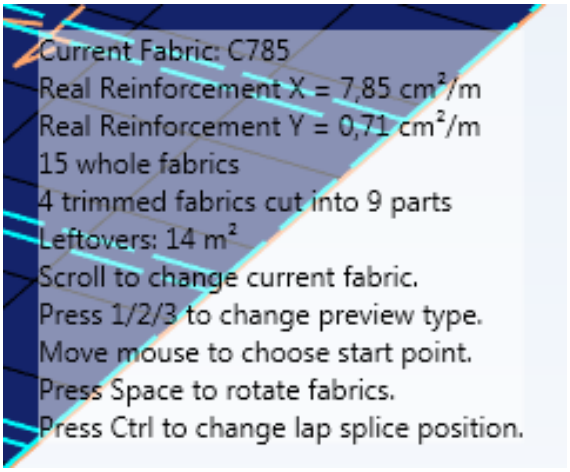
- Finally – by accepting the above definition and by defining the reinforcement in the perpendicular direction in a similar way, the bottom reinforcement is created on the Revit© model.



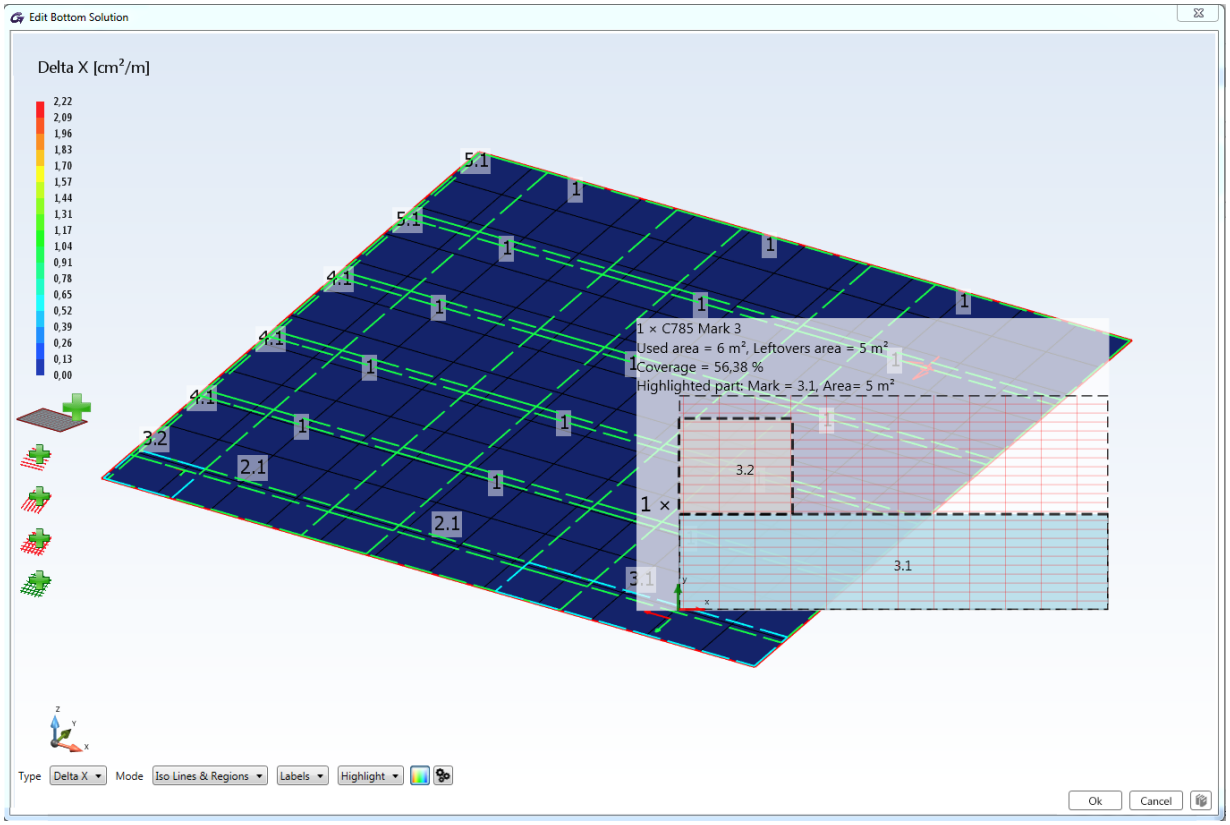
If, instead of bars, the wire fabrics are to be used, similar steps are performed. In this case, when the reinforcement zone is defined (it might be a whole slab), the appropriate type of wire fabric can be selected to cover the required reinforcement area.



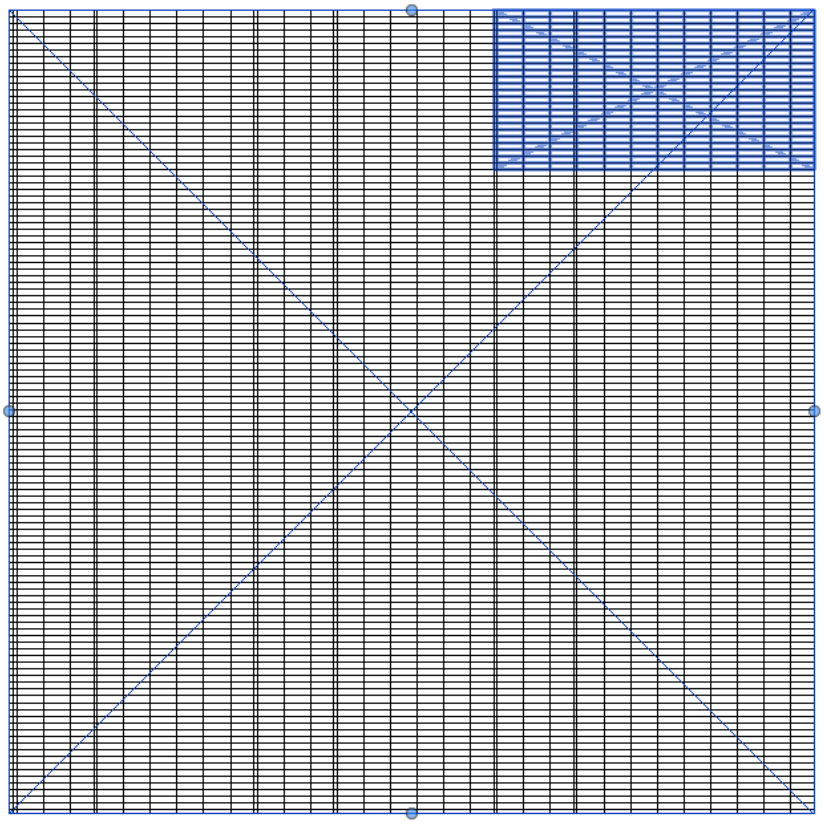
At the same time, it is possible to select the starting point for the fabrics layout – by moving the mouse cursor, the distribution of the fabrics is shown in real time, along with detailed information about it. Each subsequent layout presents a different way of dividing the fabrics, obtained from the optimization process, by reusing the cut-off parts.



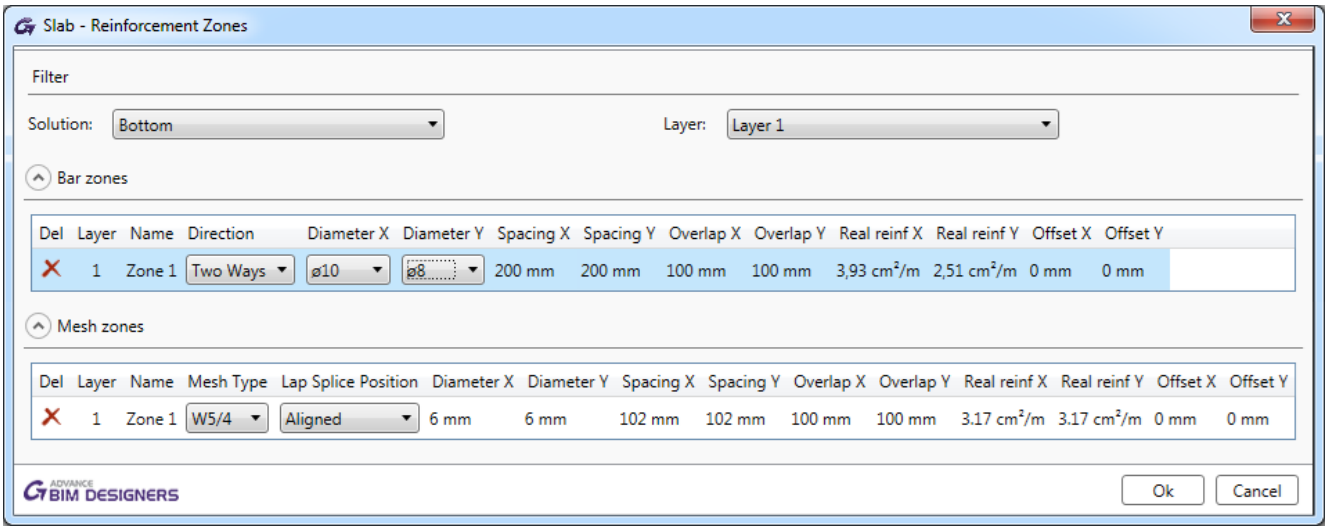
After accepting a proposed layout, it is possible to get information about the selected part (including the graphical preview of the cutting of wire fabric sheets).



Finally, appropriate wire fabric reinforcement is created on the Revit© model.



Regardless of the method used to generate the reinforcement, the information about the rebar or the fabrics can be checked with a special **Reinforcement Zones** window. Using this dialog, it is also possible to modify rebar diameters / fabric types for selected zone.



New Options & Improvements – Concrete Series

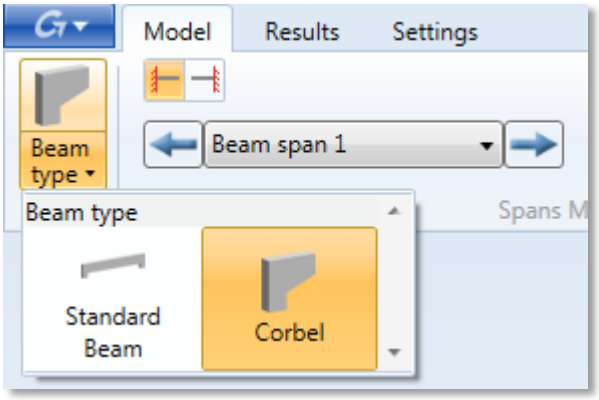
Advance BIM Designers 2020 brings many new options and improvements to the modules included in the **Reinforced Concrete Series** (Footing Designer, Beam Designer and Column Designer), running both in standalone platform and on top of Autodesk Revit®.

Corbel

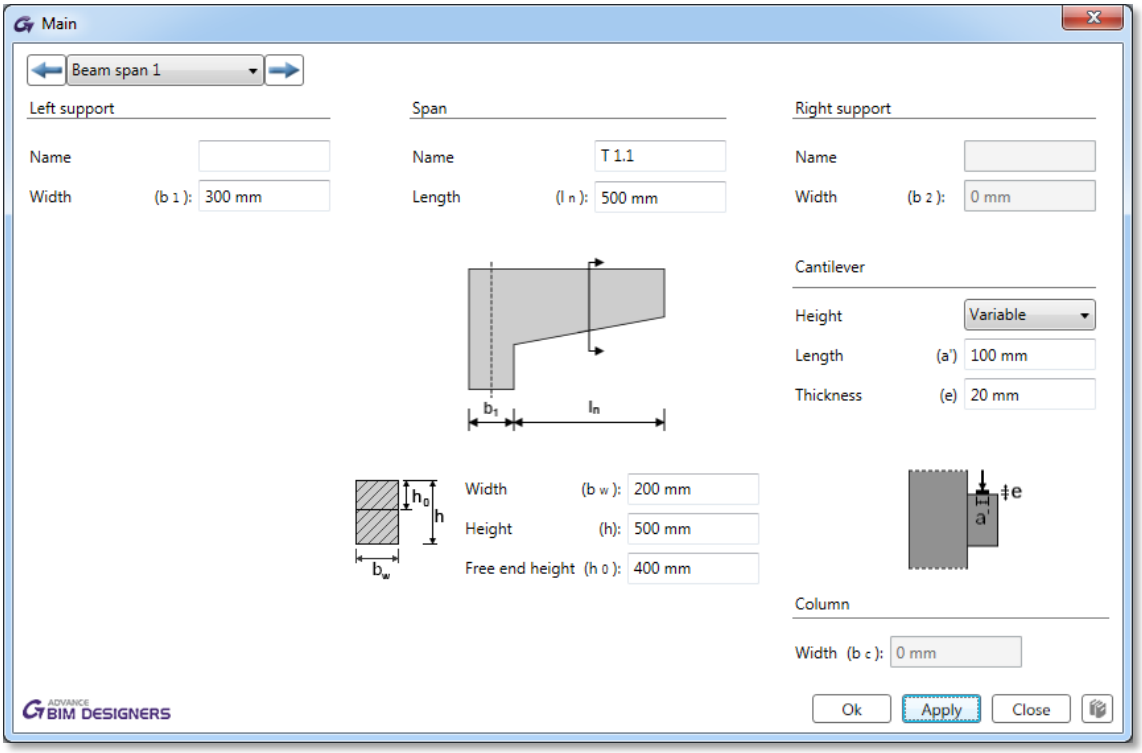
Main features & benefits:

- Design and reinforcement generation for a Corbel
- Constant or variable height

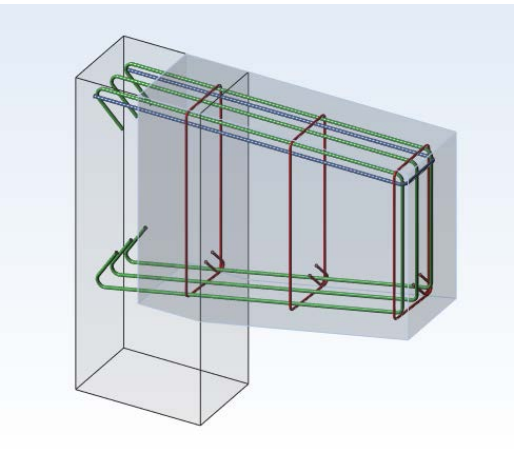
On the BIM Designers Beam module, a new beam geometry type is available: Corbel. It allows the designing of a corbel (short cantilever) according to the EN 1992-1-1 or ACI/CSA codes.

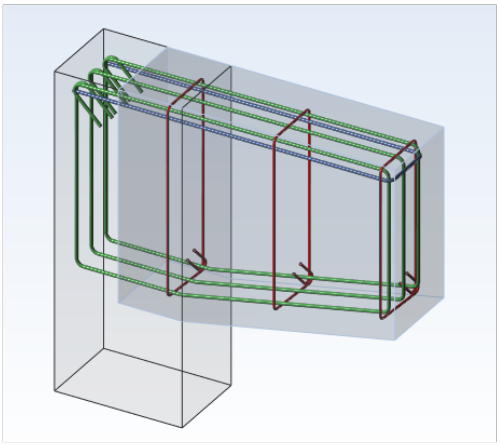


The span can be defined on one side of the support and can have either a fixed or a variable height. The definition of the geometric parameters is done in the **Main** window.



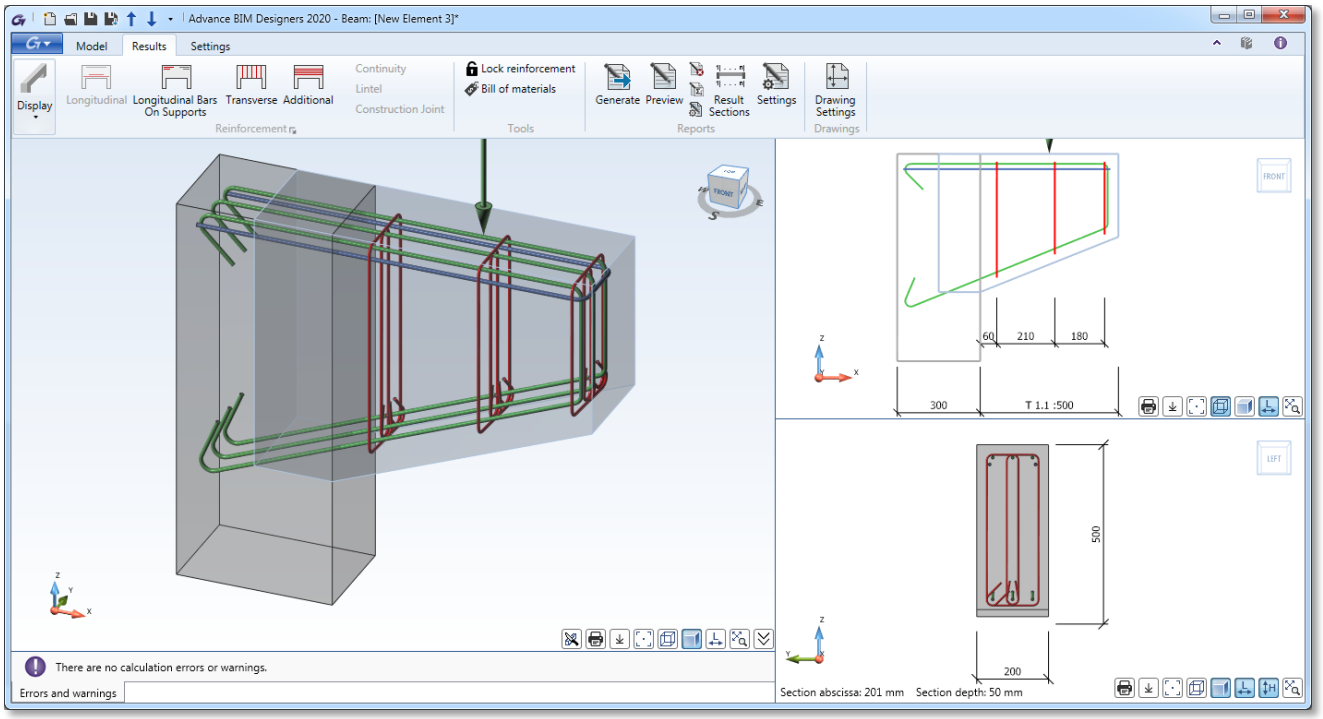
It is possible to set one of two types of main reinforcement shapes: either Open or Closed.





The selection is done by using the **Reinforcement Assumptions** dialog.

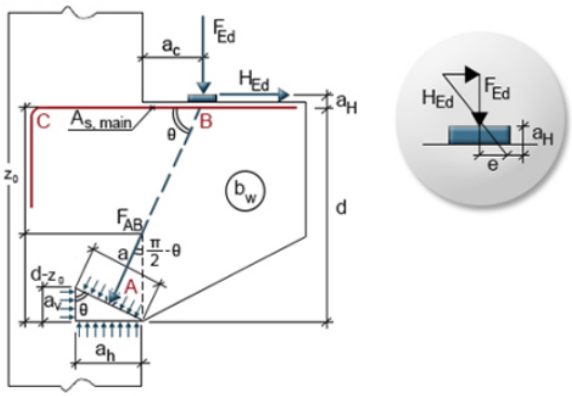
Similar to the standard beams, the result of the design is the 3D reinforcement cage of the short cantilever.



The short cantilever design calculations are based on the EN 1992-1-1 (article J.3), and according to the ACI / CSA codes.

10 Short cantilever calculation

The short cantilever design is done according to article J.3 from EN 1992-1-1.



10.1 Corbel verification

A corbel is a cantilever for which the following relation is satisfied:

$a_c < z_0$ (J.3 (1))

Span	**T 1.1**
Position of load (distance from load to support edge)	$a_c = 345$ mm
Distance from upper tensioned bars to strut "foot"	$z_0 = 0.9 \cdot d = 0.9 \times 475$ mm $= 428$ mm
	$a_c < z_0$: 345 mm < 428 mm
	Passed
	The cantilever is a corbel

10.2 Strut angle determination

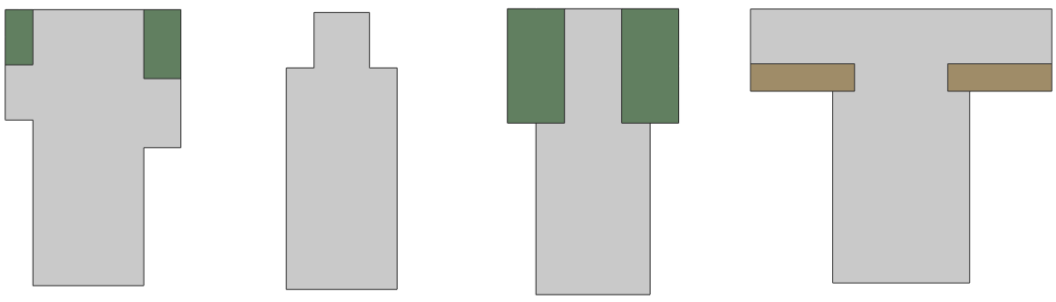
Span	**T 1.1**
Strut angle	$\tan\theta = \frac{a_h}{a_v} = \frac{10\text{ mm}}{8\text{ mm}} = 1.34$
Second degree equation for a_v determination	$a_v^2 - 2 \cdot d \cdot a_v + a_h \cdot (2 \cdot a_c + a_h + 2 \cdot e) = 0$
Vertical component of strut width	$a_v = 8$ mm
Horizontal component of strut width	$a_h = \frac{F_{Ed}}{\sigma_{Rdmax} \cdot b_w} = \frac{31.2\text{ kN}}{15\text{ MPa} \times 200\text{ mm}} = 10$ mm

New precast sections for beams

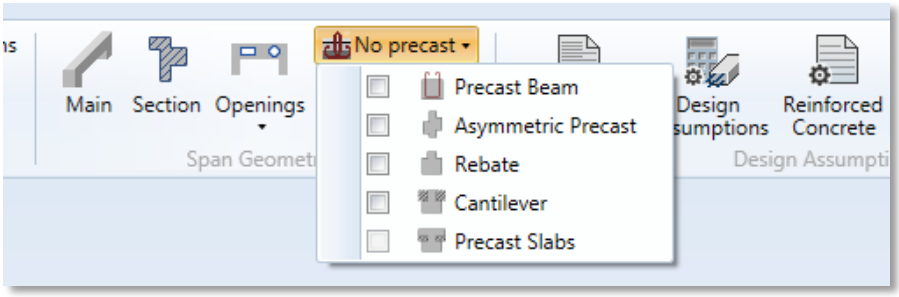
Main features & benefits:

- New section types typical for precast beams
- Detailed definition of reinforcement parameters

Advance BIM Designers 2020 provides four new section types for Precast beams: *Asymmetric*, *Rebate*, *Cantilever* and *Precast Slabs*. All new section types are fully supported in terms of geometry definition, verification, reinforcement and drawing generation.



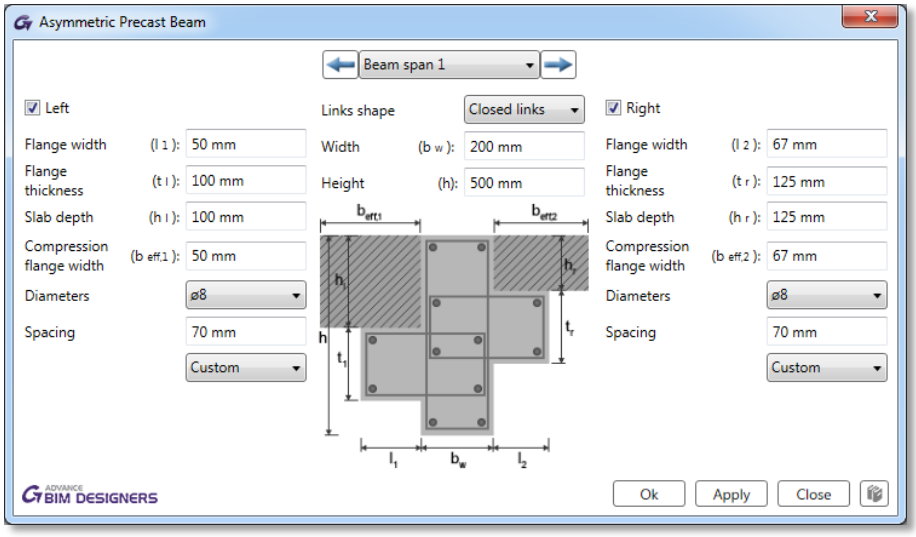
The selection of a precast section for a span is made by using the drop-down list available on the Ribbon (**Span Geometry** panel):



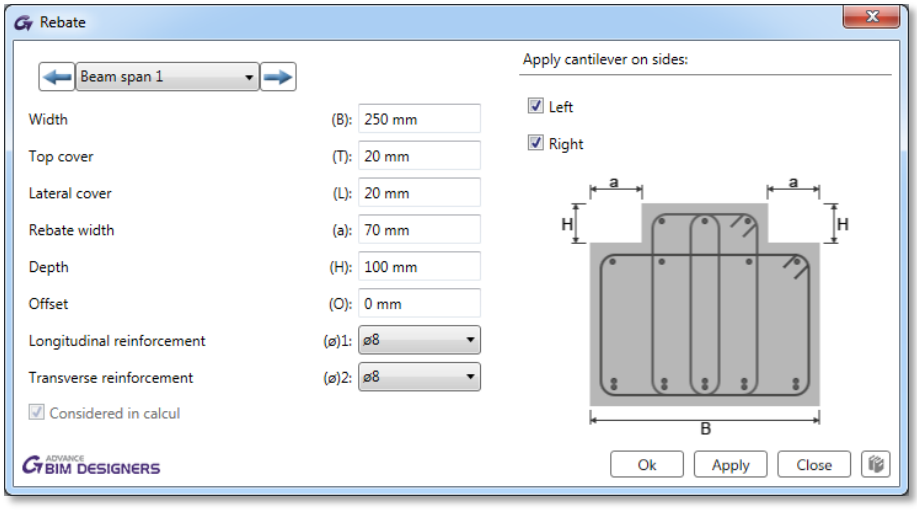
Selecting a checkbox on the list sets this section type for the active span, while pressing on the icon located next to the checkbox opens the dialog window for defining dedicated parameters. For a considered span, only one precast section type can be activated at once, except for the combination of the **Precast Beam** and Precast **Slab** on the same span. A selection of the **Precast Slabs** section type (the last one on the list) is available only for spans having a T section defined. Please note that the **Precast Beam** section type was already available in the previous version.

Each new type has a separate dialog for setting geometry and reinforcement parameters:

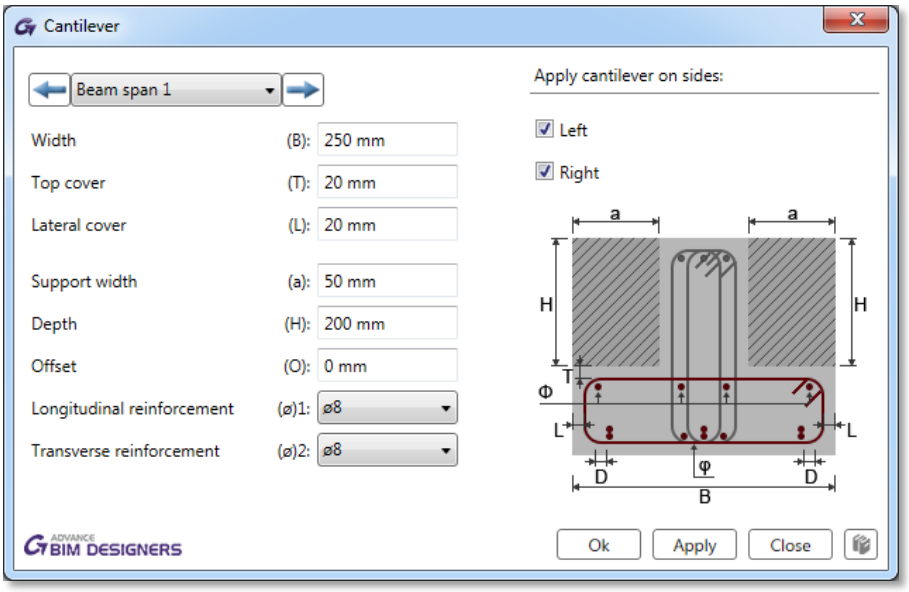
- Asymmetric Precast Beam:



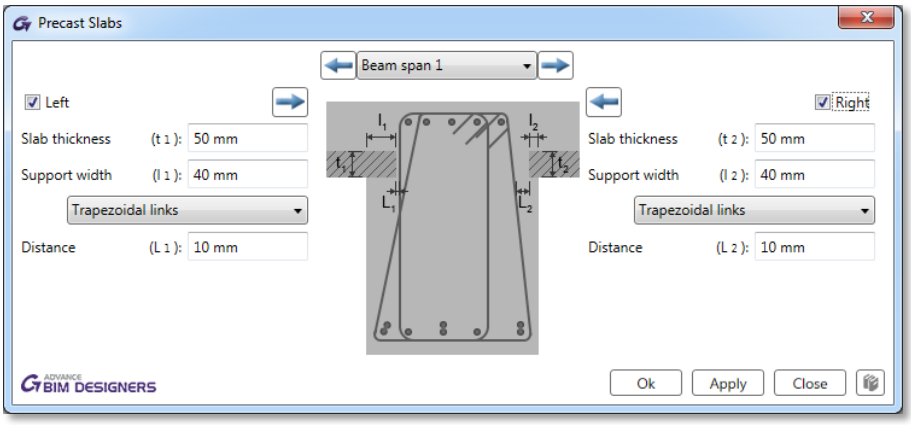
- Rebate:



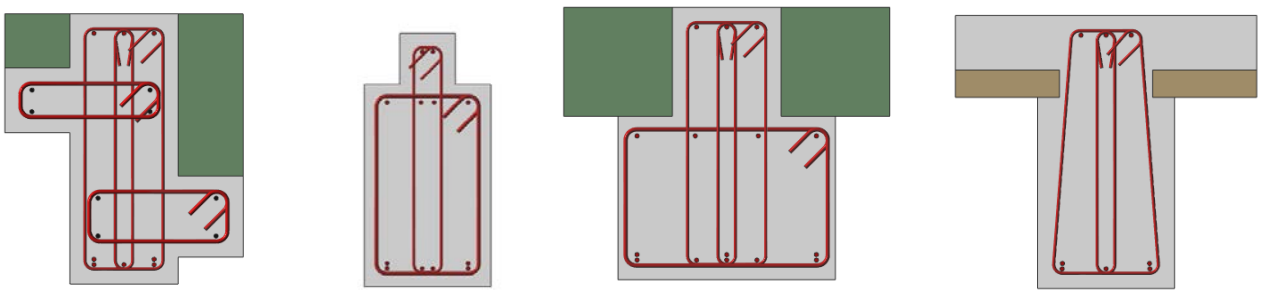
- Cantilever:



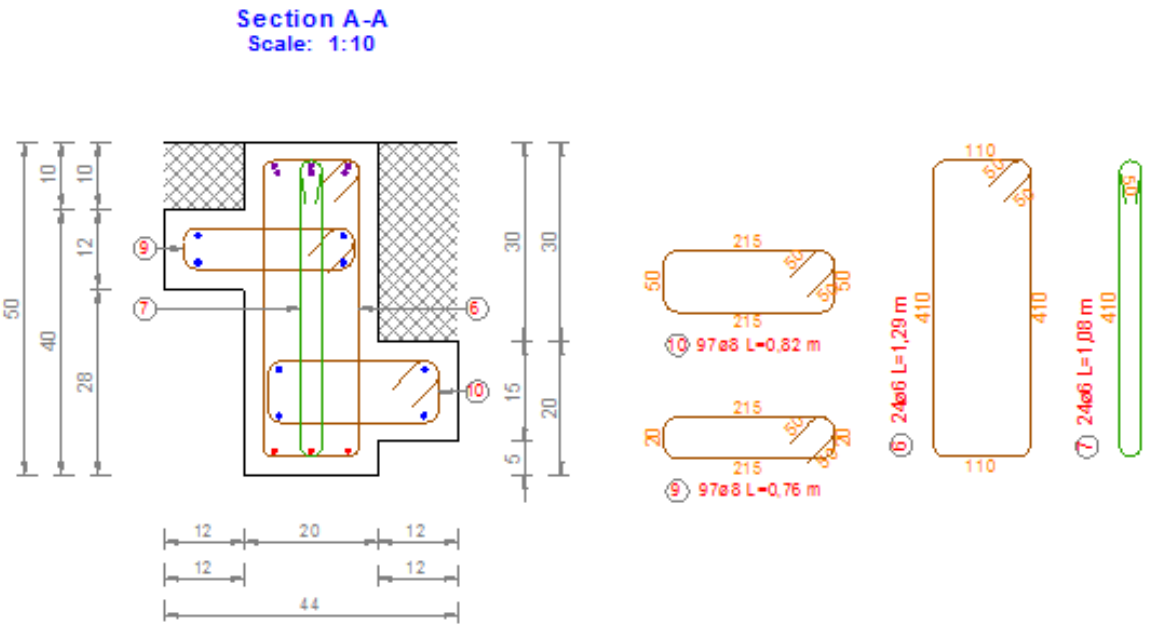
- Precast Slabs:



Examples of generated reinforcement for different configurations:



Similar to other section types, details of the design calculations are available in reports, while reinforcement details are presented in drawings:

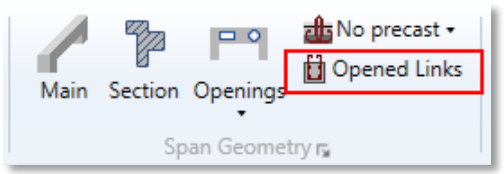


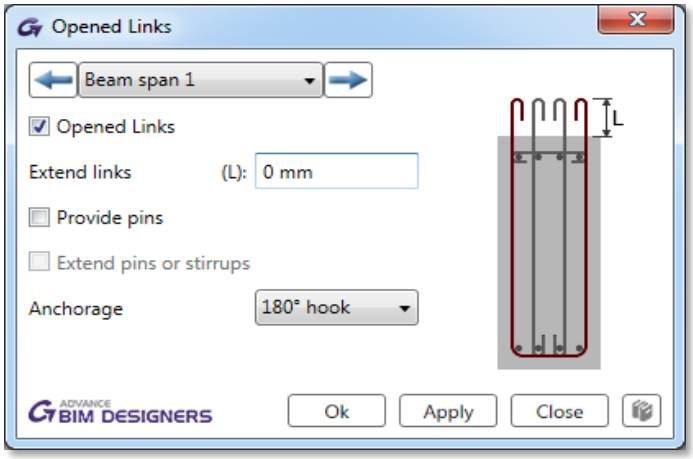
Opened links on beams

Main features & benefits:

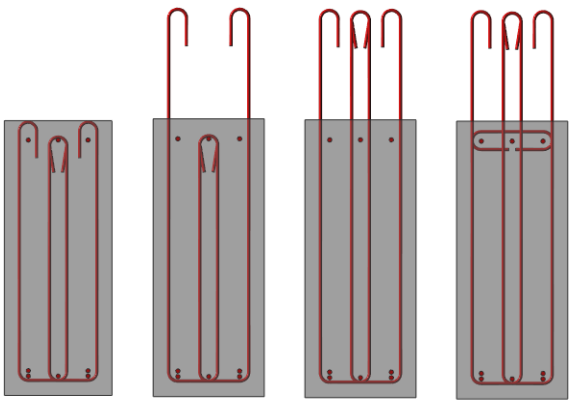
- Possibility to define opened links

The new version of the Beam module gives the possibility to define opened links separately for each span of the beam. The option is activated using the **Opened Links** dialog window:

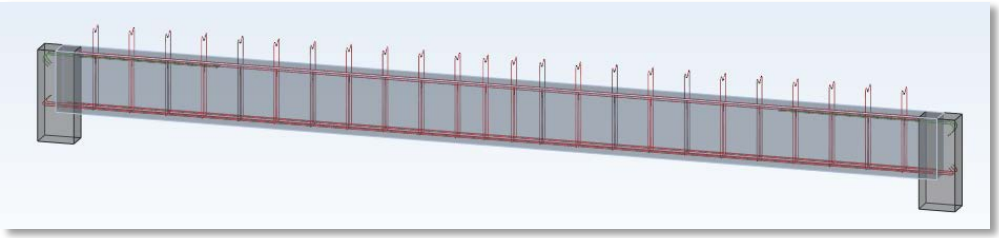




Depending on the parameter settings, transversal bars can be either defined with the maintaining of their heights or with extended arms above the top edge of beam. For the second case, it is also possible to extend pins or stirrups. It is also possible to provide horizontal pins closings at top opened stirrups.



Opened links are defined along the entire span.



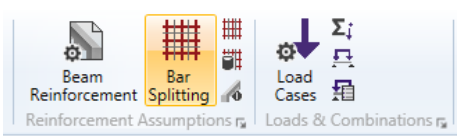
Automatic splitting of rebars in beams

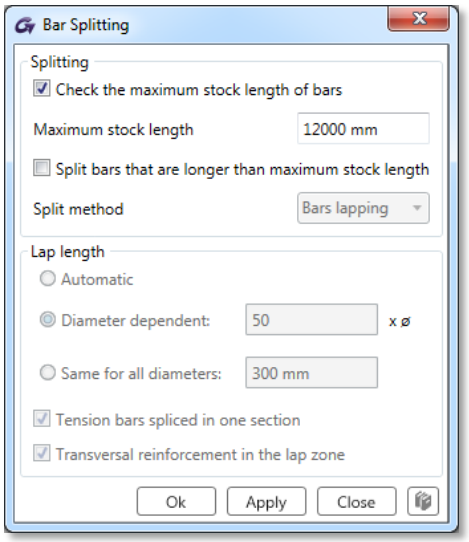
Main features & benefits:

- Possibility to verify the maximum length of bars
- Automatic splitting of bars that are too long
- Possibility to define lapping, welding or mechanical joining of divided rebars

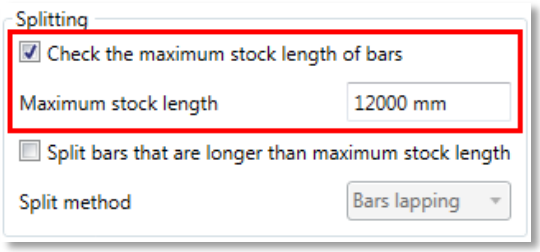
The new version offers the possibility to verify the maximum length of bars as well as the possibility for automatic splitting of bars that are too long. There are also three available methods for joining divided bars: by welding, by mechanical couplers and by the lapping of bars.

A new **Bar Splitting** window, available on the ribbon (on the **Reinforcement Assumption** panel), is used to activate and set parameters.

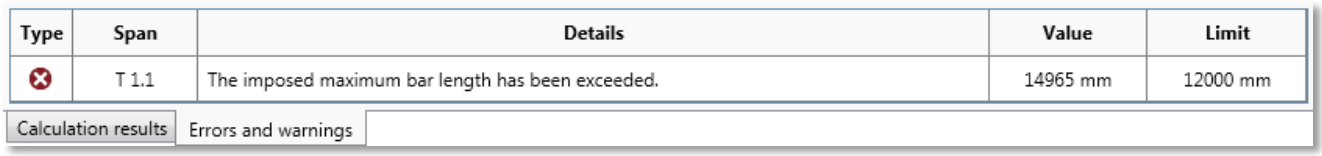




The verification of the maximum length of bars is activated by the “Check the maximum stock length of bars” option, while the value of this length can be set according to the needs.



If this length is exceeded, a relevant warning will be issued:



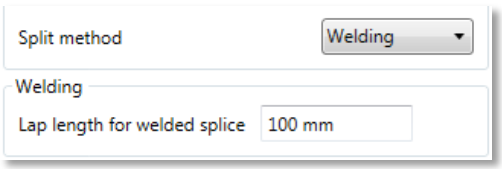
In this case, another solution is also possible - the automatic division of members that are too long. To do this, the “Split bars that are longer than maximum stock length” option must be activated.

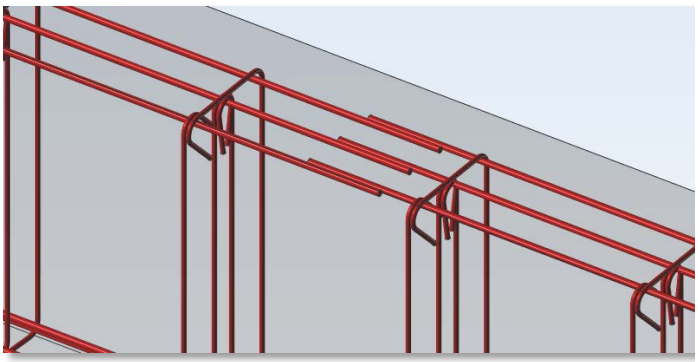
Three methods are available to maintain the continuity of divided members:

- joining rebars by welding
- joining rebars by using mechanical couplers
- lapping

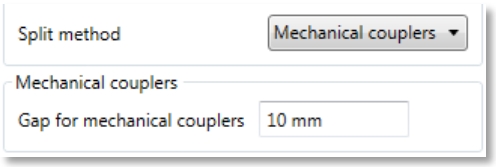
Additional parameters specific to each method are provided.

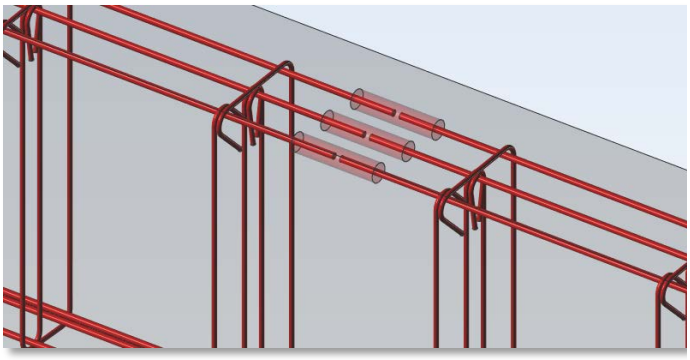
- **Welding:** Bars are lapped on a defined length and connected by welding.





- **Mechanical couplers:** Bars are offset by a defined gap length and are then mechanically connected using couplers.

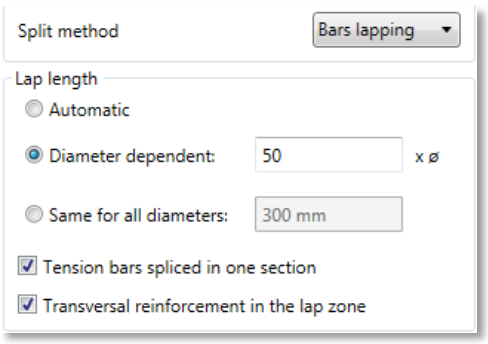


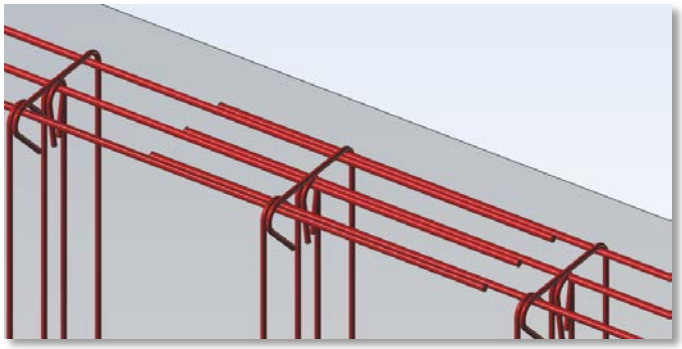


***Note**: Thanks to the possibility of defining a gap value and to the fact that mechanical couplers are presented in a symbolic way, the module does not limit the selection of the connectors manufacturer used in the project.*

- **Bars-lapping couplers**

  Bars are connected by lapping. The lap length value can be defined by using one of three methods:
  - automatically, according to the reinforcement code provisions;
  - as a multiplication of the diameter of divided rebar;
  - as a defined, unique value, regardless of rebar.



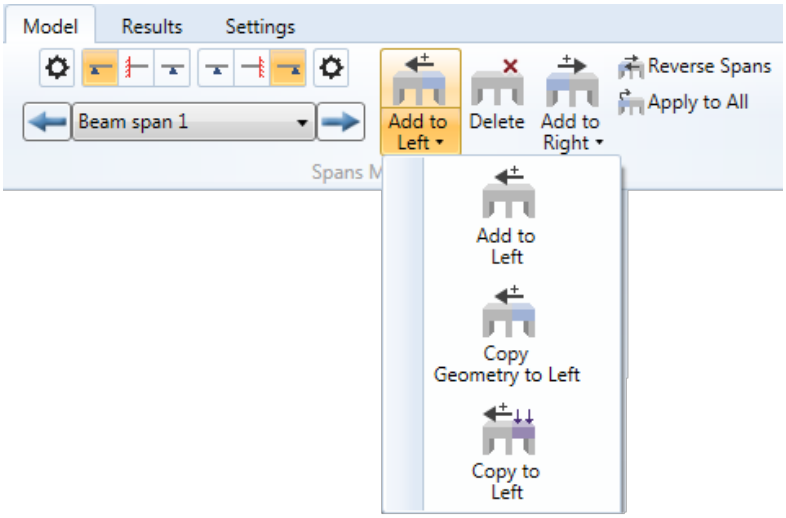


It is also possible to set additional options to avoid the splitting of all tension members in a single section and to define additional transverse bars at lap zone.

Additional method of copying a beam span

Main features & benefits:
- Faster definition of multi-span beams

A new **Copy Geometry** command is added to the ribbon to facilitate different scenarios for an easier defining of multi-span beams.

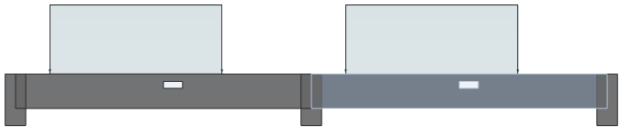


The following commands are now available for adding/copying a span:

- **Add** -> adds an empty span with default geometry;

- **Copy Geometry** -> copies the actual span geometry without loads;

- **Copy** -> copies the span geometry together with the loads.



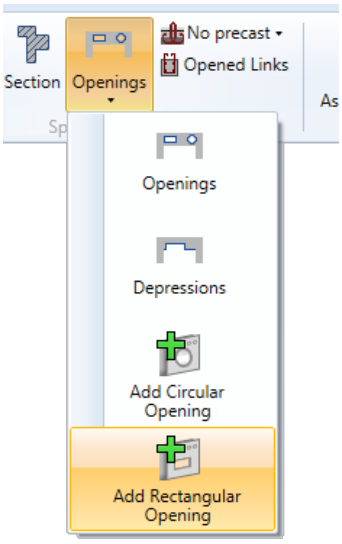
Graphical definition of openings in beams

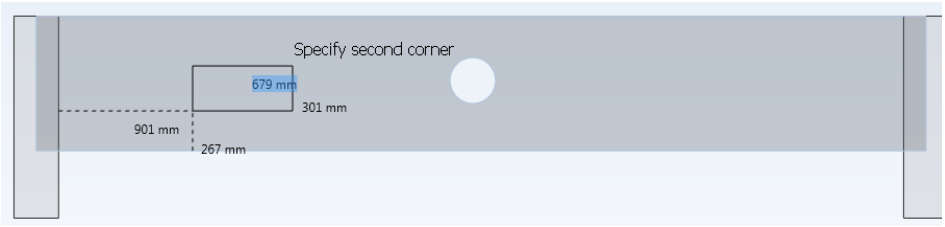
Main features & benefits:

- New, fast method of defining openings in beams

In addition to adding openings in spans by using the dialog box, it is now possible to define them graphically.

Two new commands available from ribbon are used for this purpose: **Add Circular Opening** and **Add Rectangular Opening**.





After selecting the command, one should indicate successively two corners of a rectangular opening or the center and radius of a circular opening. The values of appropriate distances (e.g. the position of the first point from the edges of the beam) are presented in real time and can be edited directly from the keyboard. When editing values, the transition from one coordinate to another is done by using the **TAB** key, while accepting the definition of a given point is done by using the **Enter** key. This enables precise and quick determination of the position of the points.

Graphically added openings are also available in the table in the **Openings** window. This allows for the editing and setting of additional parameters for the reinforcement of openings.

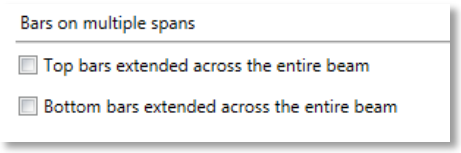
Longitudinal bars across the entire beam

Main features & benefits:
- Possibility of generating longitudinal bars as continuous over intermediate supports

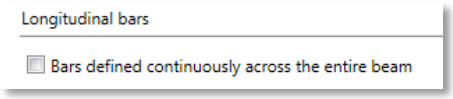
The new version of the BIM Designers beam module offers the possibility to define Longitudinal and Anti-crack bars continuously across the entire multi-span beam.

New options can be found in the corresponding tabs from the **Reinforcement Assumption** dialog:

- for Longitudinal reinforcement bars:

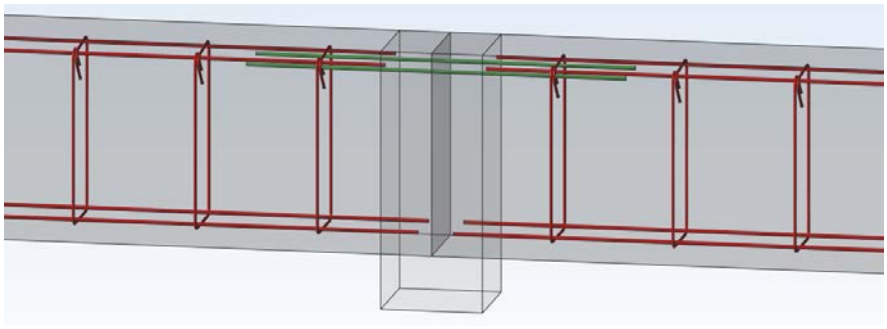


- and for Anti-crack bars:

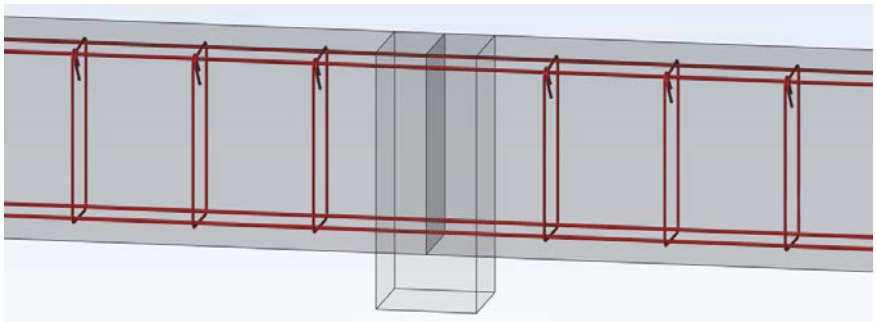


***Note**: These options are enabled based on a series of geometrical verification such as:*
- *the presence of multi-span beam(s);*
- *restrictions related to the geometry of the spans (height, offset, presence of depressions or openings, presence of a precast section).*

These new options determine whether longitudinal bars should be defined individually (separately) for each span or as common for more spans.



Top and bottom bars defined separately for each span



Top and bottom bars extended across the entire beam

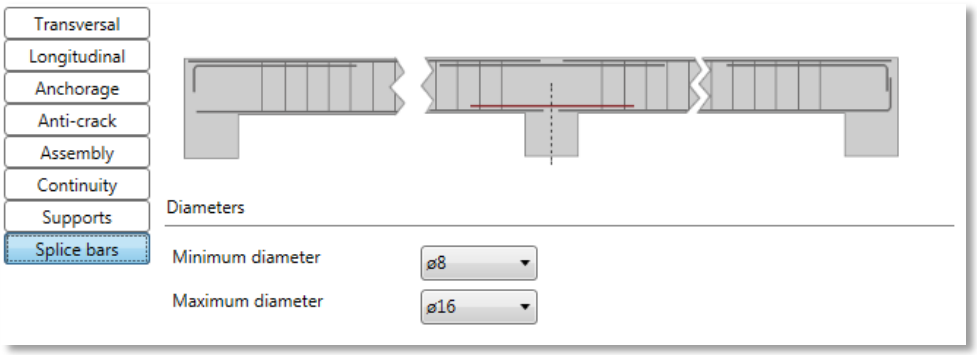
***Note**: Activating the option for top bars when the "Assembly" reinforcement is considered in calculation may lead to no additional top reinforcement being generated over the support. In this case, the top layers of the assembly bars are counted as provided reinforcement and so, the remaining requested over-top supports will not be not required.*

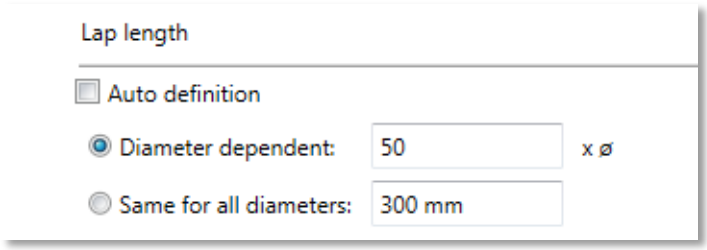
New methods for lap length definition for Splice bars on beams

Main features & benefits:

- Better control the value of the lap length for splice bars

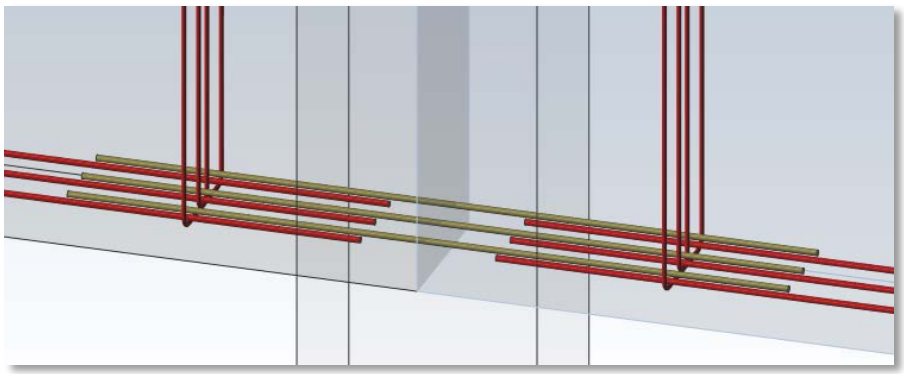
In the case of splice bars that ensure the continuity of the longitudinal reinforcement above the intermediate supports, the length of their overlap can be fully controlled by the new options available in the **Reinforcement Assumption** dialog on the **Splice bars** tab.





The "Auto definition" option causes the lap length to be determined automatically, according to the general code provisions. If it is unchecked, two other methods are available for determining of the lap length:

- by entering a multiplier of a diameter;
- by directly entering the lap length value.



Improvements to reports – extended table for deflections

Main features & benefits:

- More details for beam deflections results

The *Deflection verification* table in the Beams report, containing the results of the beam deflection analysis, has been extended. It now contains more information as well as intermediate results arranged into two separate tables.

2019

Deflection verification				
Span	L/d	Limit	Work Ratio	Status
1	15.90	77.73	20.46 %	Passed

The limit for L/d is calulated according EN 1992-1-1, 7.4.2, (7.16.a or 7.16.b).

2020

Intermediate values						
Span	d	ρ	ρ'	ρ_0	K	Correction
	(mm)	(‰)	(‰)	(‰)		
1	459	1.3	0	5	1.3	2.12
2	459	1.3	0	5	1.3	2.12

Deflection verification							
Span	$A_{req,tension}$	$A_{req,comp}$	$A_{prov,tension}$	$A_{prov,comp}$	Limit	L/d	WR
	(mm²)	(mm²)	(mm²)	(mm²)			
1	119	0	251	0	323,84	15,90	4.9 %
2	119	0	251	0	323,84	15,90	4.9 %

The limit for L/d is calculated according to EN 1992-1-1, 7.4.2, (7.16.a or 7.16.b).

Improvements to reports – compact summary tables

Main features & benefits:

- Shorter and clearer Summary tables

Report tables with a summary of the results for each chapter have been revised to show only results for decisive cross sections for the given condition. This makes these tables shorter and clearer, as only relevant results are presented.

2019

Crack width verification									
Span - Section	Abscissa	Section	$w_{k,top}$	$w_{k,bot}$	$S_{r,max}$	$\varepsilon_{sm} - \varepsilon_c$	$w_{k,max}$	w_{lim}	WR
	(mm)	position	(mm)	(mm)	(mm)	(‰)	(mm)	(mm)	
1 - Right support	7000	Top	0.042	0.013	299	0.14	0.042	0.400	10.54 %
1 - MInf	3500	Bottom	0.000	0.095	202	0.47	0.095	0.400	23.87 %
1 - VMax	7000	Bottom	0.042	0.013	245	0.05	0.042	0.400	10.54 %
1 - wk Max	3500	Bottom	0.000	0.095	202	0.47	0.095	0.400	23.87 %
1 - Max Concrete Stress	3500	Bottom	0.000	0.095	202	0.47	0.095	0.400	23.87 %
1 - Max Steel Stress	3500	Bottom	0.000	0.095	202	0.47	0.095	0.400	23.87 %
1 - Max Deflection	0	Top	0.042	0.013	299	0.14	0.042	0.400	10.54 %

2020

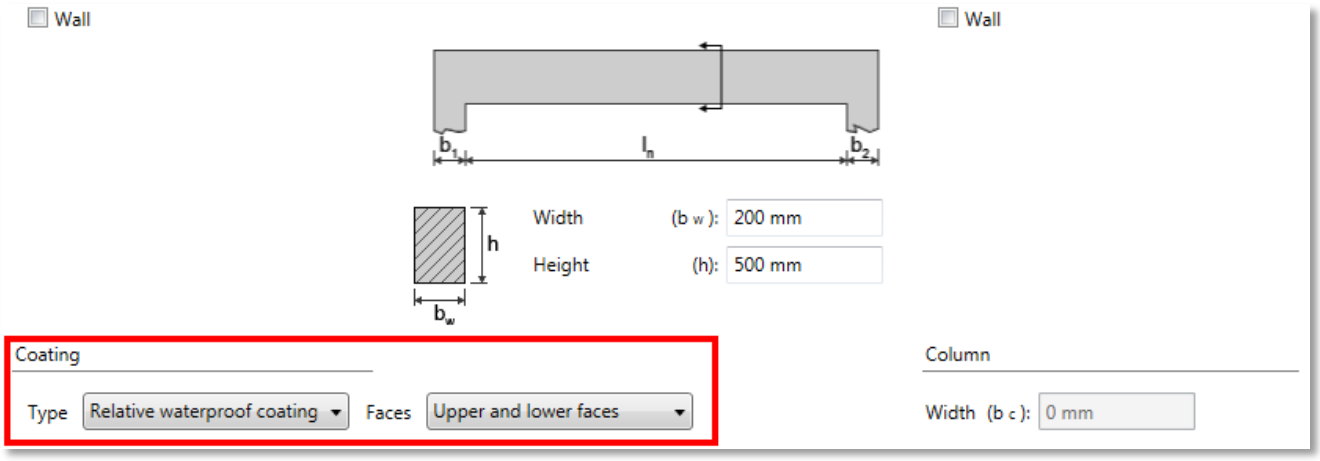
Crack width verification									
Span - Section	Abscissa	Section	$w_{k,top}$	$w_{k,bot}$	$S_{r,max}$	$\varepsilon_{sm} - \varepsilon_c$	$w_{k,max}$	w_{lim}	WR
	(mm)	Position	(mm)	(mm)	(mm)	(‰)	(mm)	(mm)	
1 - wk Max	7000	Top	0.16	0	272	0.6	0.16	0.4	39 %
2 - wk Max	0	Top	0.16	0	272	0.6	0.16	0.4	39 %

Improvements to calculation of waterproofing in beams (French NA to EC2)

Main features & benefits:

- Better consideration of waterproofing for beams

A set of improvements is introduced to verifications related to the waterproofing in beams (available if the French National Appendix to Eurocode 2 is selected).



These improvements include:

- better management of water loads, like avoiding situations where one span is unloaded while the adjacent span is loaded;
- improvements on reinforcement generation, when loads are acting upwards;
- improvements on stress verification.

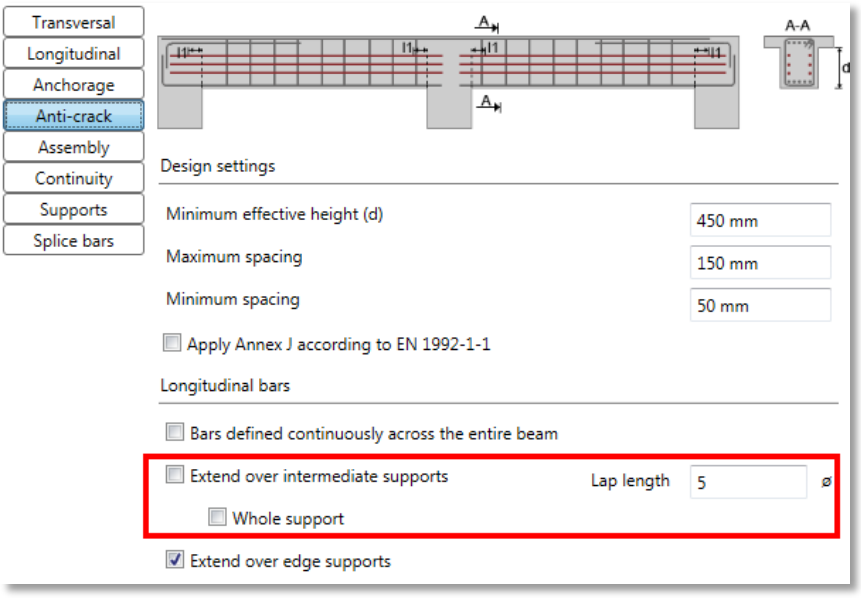
In addition, a new **Auto** option for the bar diameter used in waterproof calculation is added. This new option is available on the **Longitudinal** tab in the **Reinforcement Assumptions** window. It allows for the final (real) diameter of the reinforcement to be considered when verifying the stresses for waterproofing, by performing the second iteration of calculations.

Additional options for defining anti-crack bars over supports' edges

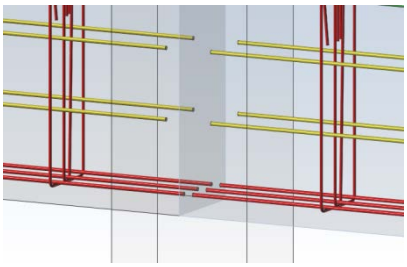
Main features & benefits:

- Greater control over the positioning of the anti-crack bars at supports.

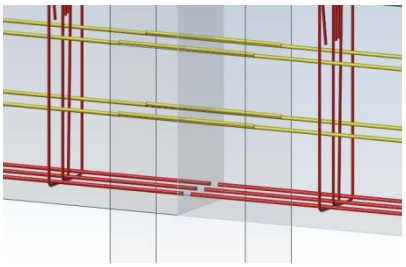
For anti-crack bars in beams, new additional options related to the lapping length over intermediate supports are added. The new options can be found on the **Anti-crack** tab of the **Reinforcement Assumptions** window.



- **Extend over intermediate supports** – gives the possibility to define the lap length as the multiplication of the bar diameter.



- **Whole support** - extends anti-crack bars over intermediate support edges, so that their lap length becomes the width of the support.



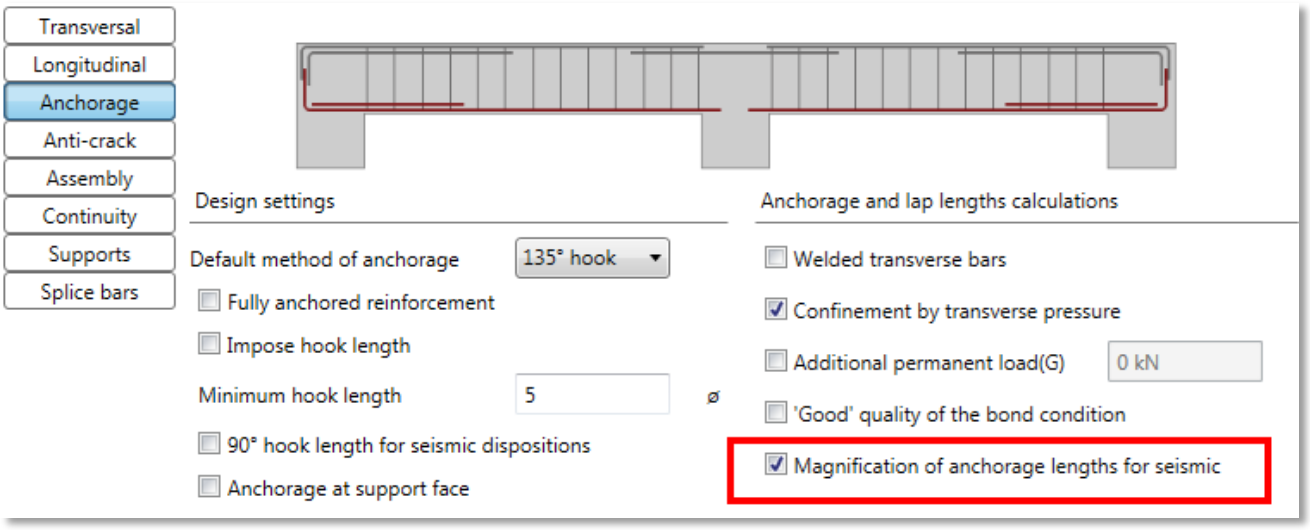
New parameter for magnification of anchorage lengths in beams (EC 8)

Main features & benefits:

- Considering an additional standard condition for anchorage lengths under seismic conditions

On the beam module, a new option **Magnification of anchorage lengths for seismic** is added to the **Anchorage** tab on the **Reinforcement Assumptions** dialog. This option is available only when the "Seismic dispositions" option (available on the **Design Assumptions** dialog for Eurocode) is activated.

If the "Magnification of anchorage lengths for seismic" option is activated, the anchorage lengths will be increased to become 50% longer than those specified in EN 1992-1-1, according to EN 1998-1 provisions.

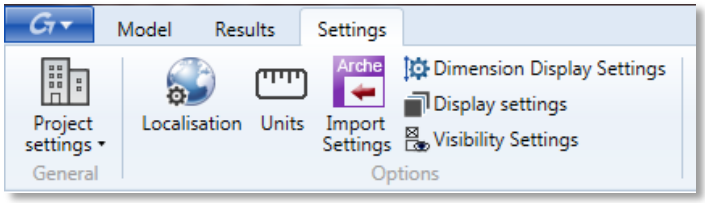


New tab on the Ribbon

Main features & benefits:

- Easier search for commands

To distinguish the range of operations available on ribbons, a new **Settings** ribbon tab has been added. It contains commands used to configure the project and the program itself.

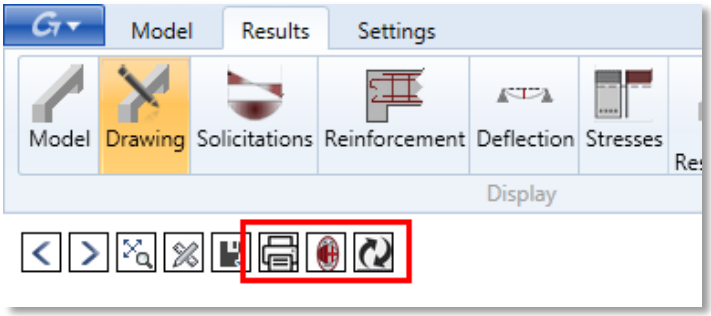


New quick commands on the Drawing view

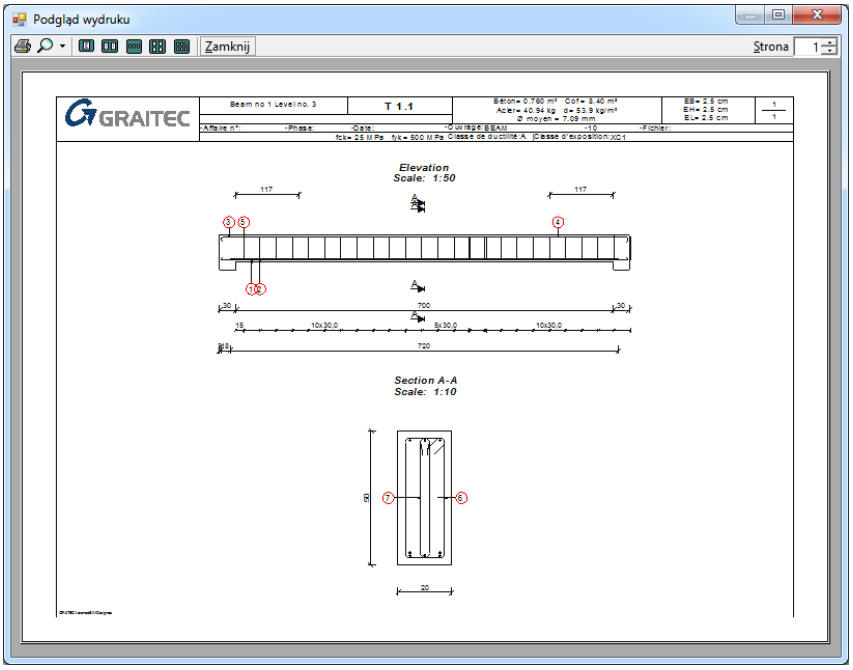
Main features & benefits:

- Faster printing of drawings

To facilitate the preparation and printing of drawings, new commands have been added to the list of quick commands visible in the **Drawing** window:



- **Print preview** - opens a dialog for the preview of the drawing, ready for printing.

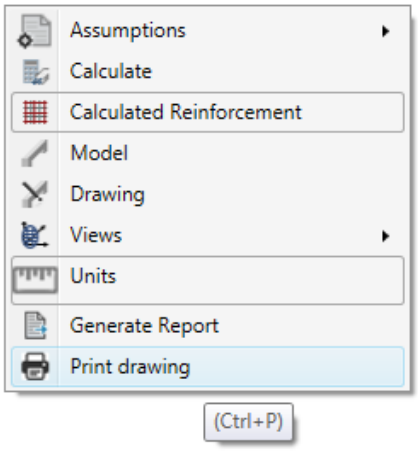


- **Regenerate drawing** - enables the regeneration of the drawing after making changes that do not cause automatic regeneration (e.g. after changing the name of the element).

- **Print all spans** – available only on the Beam module, enables direct printing of drawings for all spans of the multi-span beam.

- **Print meshes** - available only for the wall module, enables the possibility to save an image containing the way in which the fabrics are cut and reused.

In addition, it is now possible to print direct drawings, without the print preview, by using the <CTRL+P> keyboard shortcut or the "**Print drawing"** command from the context menu.



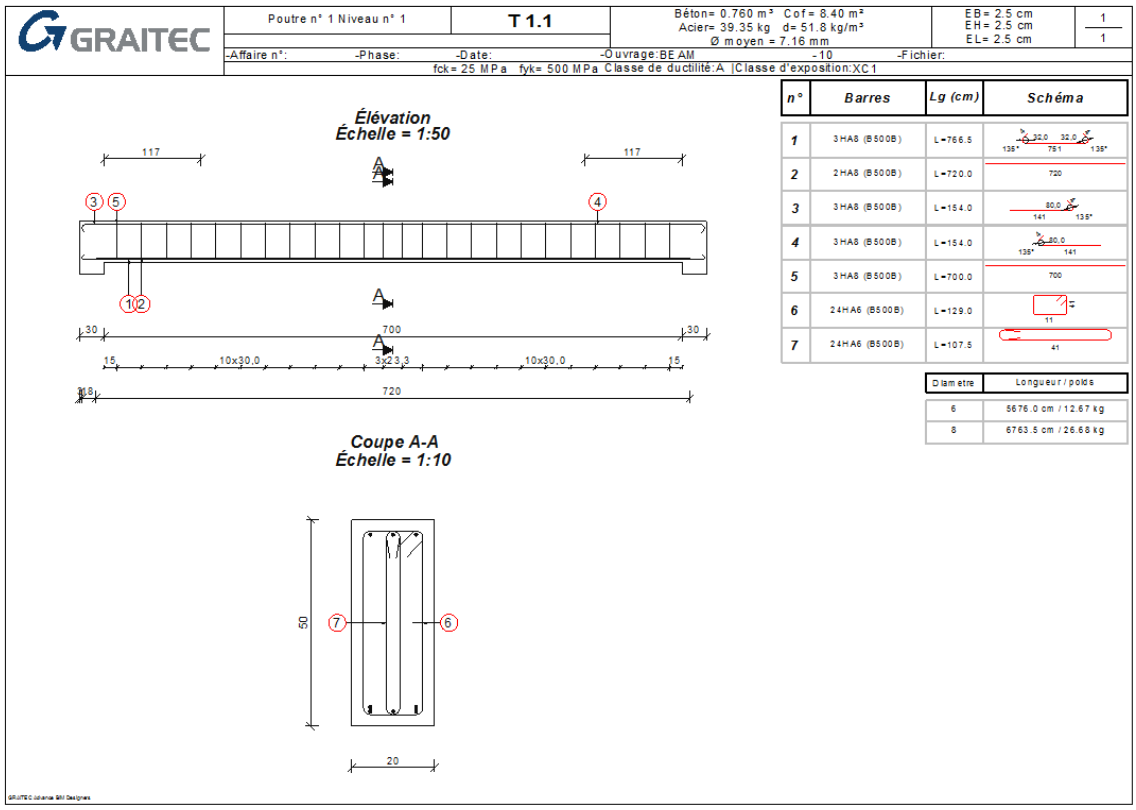
Updated drawing templates

Main features & benefits:

- Improving the appearance of drawings

Drawing templates for reinforced concrete elements have been improved to speed up the generation of drawings and make it easier for users to modify the templates.

In addition, the default templates used in the drawings for French localization were customized according to the users' suggestions. Changes are mainly related to Drawing styles (including new colors and fonts) and to the content of title blocks.

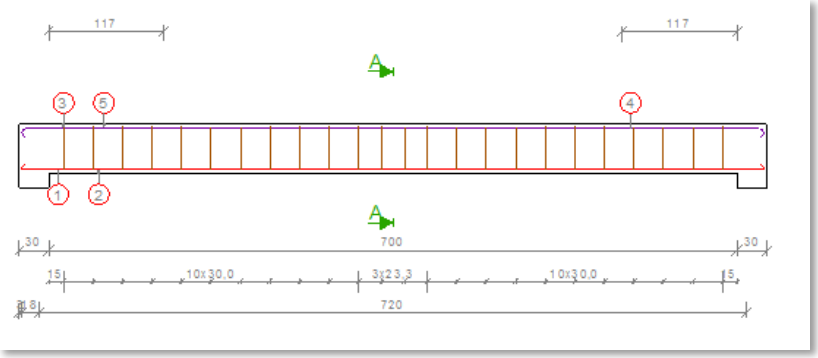


Drawing Styles available for two units

Main features & benefits:

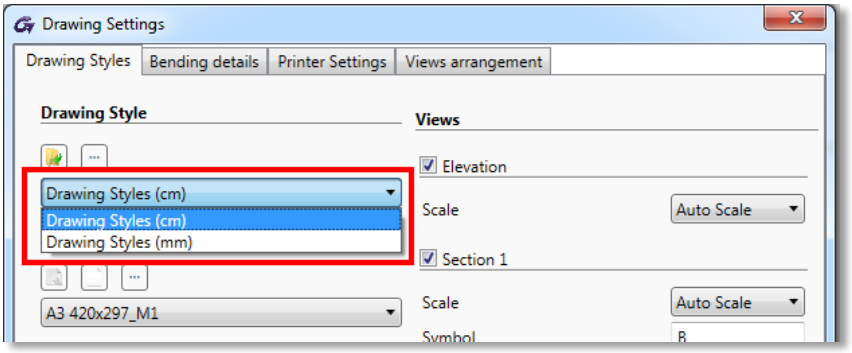
- Quick selection of units for geometrical dimensions on drawings

Unlike other types of values visible on the generated drawings, for which units can be set in the program settings, **units for geometric dimensions** of elements depend on the “Drawing Style” template .dwg file.



As the default “Drawing Style” template used **centimeters** for geometric dimensions, it was necessary to edit the template file using CAD software to set **millimeters** as the measuring unit.

To avoid the need for manual editing of the templates by users, two versions of templates were created, one for ***cm*** and one for ***mm***. The selection of a template is available on the **Drawing Setting** dialog by using the “Drawing Style” list:

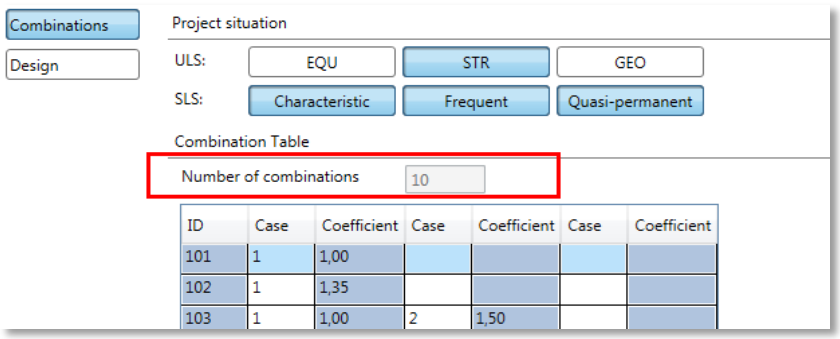


Number of generated load combinations

Main features & benefits:

- Easier control of the combination

On the “Load combination” table, there is a new field available for showing the number of generated load combinations. It can be used to quickly evaluate the correctness of defined load cases and combinations.

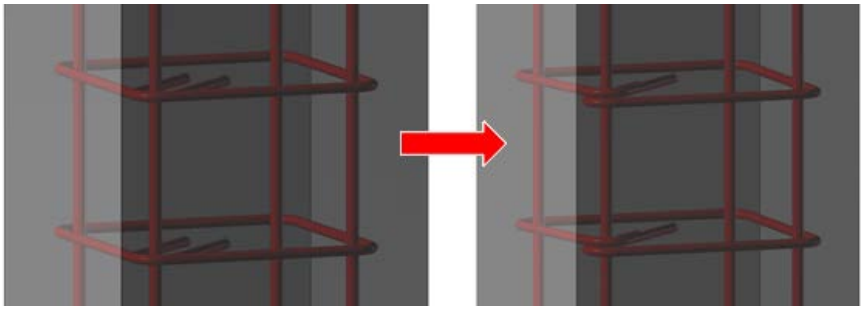


Improved display of closed bars

Main features & benefits:

- Appearance of stirrups in accordance with the real shape

On 3D views showing generated reinforcement, bars that are closed (such as stirrups) are now presented in their actual position, as closed on different layers.

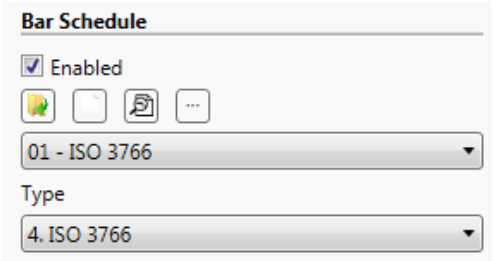


Update of the bar schedule according to ISO 3766

Main features & benefits:

- Reinforcement table generation according to the ISO standard

The rebar schedule generated on drawings using the ISO 3766 template has been updated to conform to the ISO3 3766 Table 6 template.



Included changes:

- New “Member” column - for the identification of the structural member in which the bar is located;
- New “End hook” column - for displaying hook type code, separate for both ends:
  - 0 for hook angle 0;
  - 1 for hook angle 90;
  - 2 for hook angle between 90 and 180;
  - 3 for hook angle 180;
  - -1 for any other value.
- New “h” column - for the length of the hook. If both hook lengths are equal, “h” takes the value of the start hook, otherwise * is displayed.

Member	Bar mark	Type of steel	Bar Diameter mm	Length of each bar (Method A) (mm)	Number of members	Number of bars in each member	Total number	Total Length (mm)	Shape code	End Hook		Bending dimensions							Index
												a	b	c	d	e	R	h	
T	1	B500B	8	7760	1	3	3	23280	21	1	1	120	7550	120			16	99	
T	2	B500B	8	7200	1	2	2	14400	00	0	0	7200					16	0	
T	3	B500B	8	1895	1	3	3	5685	11	0	1	1800	110				16	*	
T	4	B500B	8	1895	1	3	3	5685	11	1	0	1800	110				16	*	
T	5	B500B	8	7000	1	3	3	21000	00	0	0	7000					16	0	
T	6	B500B	6	1370	1	24	24	32880	51	2	2	450	150	115	115		12	98	
T	7	B500B	6	1155	1	24	24	27720	33	0	0	450	30	115			12	0	

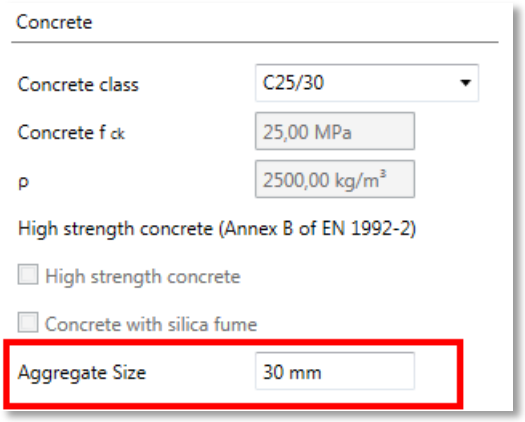
Aggregate Size definition available on all RC modules

Main features & benefits:

- Better control over concrete parameters for all modules

The **Aggregate Size** value, accessible for editing in the **Reinforced Concrete** dialog, is now available for all RC modules (it was previously available only for the Beam module).

The maximum size of the aggregate is used to calculate the clear distance between individual parallel bars (or horizontal layers of parallel bars) in accordance with point 8.2(2) of EN 1992-1-1.

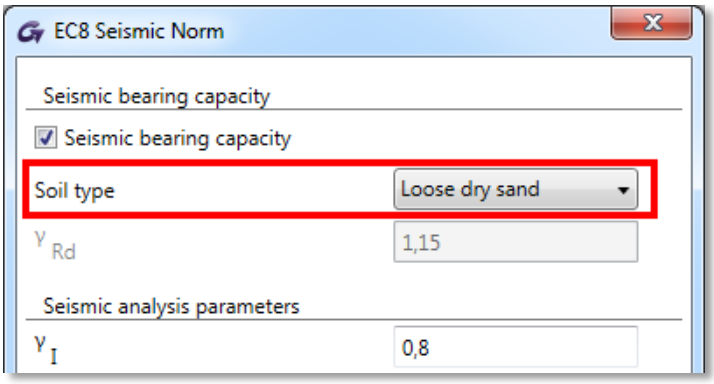


List for easy selection of the partial factor for the seismic bearing check

Main features & benefits:

- Fast definition of the partial factor for seismic bearing check

To facilitate the defining of the Model Partial Factor (γ_{Rd}) which is used for seismic bearing capacity calculations, a new selection is added to the **EC8 Seismic** parameters dialog on the Footing module. It contains a list of soil types according to EN1998-5.



Selected other improvements

Advance BIM Designers 2020 contains many smaller improvements and corrections, which are listed here below.

Automatic activation of undrained calculations in case of water definition

In the Footing module, when the water level is activated during the definition of the soil profile, the analysis for undrained conditions is automatically activated.

Structural class reduction

A new functionality for reducing structural class is available in the concrete cover definition window. The structural class can be reduced according to the Table 4.3N from EN1992-1-1, based on the Exposure class and Concrete resistance. Lower structural class allows for using a smaller concrete cover.

Improvements to reports and drawings of the Footing module

A set of small improvement has been brought to reports and drawings of the Footing module, including (among others): hiding the cross-section symbol on a plan view (if the related section is not generated), correction of displaying bar hooks for bending details, correction on reports, to a few formulas as well as updating selected references to codes.

Corrected values of soil parameters on soil databases

Values of soil modules (Young, Odometrical and Menard) have been revised for a default soil database and are now using unified and correct units. Previous values were, in many cases, too big, and this leaded to settlement values being overestimated.

Additional formulas for minimal longitudinal reinforcement for Seismic Dispositions

On the detailed report of the Beam module, formulas related to calculation of the minimum reinforcement area of longitudinal reinforcement have been extended by a criterion due to seismic conditions (when activated).

New hotkeys for the Beam module

On the Beam module, two new keyboard shortcut are added: <Alt+Z>, for opening the **Reinforcement Assumptions** dialog and <Alt+X>, for opening the **Drawing Settings** dialog.

New options & Improvements – Revit® environment

With the Advance BIM Designers 2020 version, the modeling capabilities of reinforcement in Autodesk Revit® have been significantly increased. In addition to the possibilities of reinforcement generation in slabs, described earlier in this document, a number of novelties have been introduced, including the reinforcement generation in walls, the reinforcement generation in continuous foundations and a new tool for splitting bars.

Compliancy with Revit® 2019 and Revit® 2020

Advance BIM Designers 2020 is compliant with both Autodesk Revit® 2019 and Autodesk Revit® 2020.

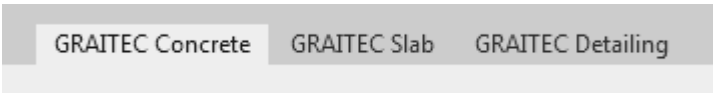
Modifications on the Ribbon

Main features & benefits:

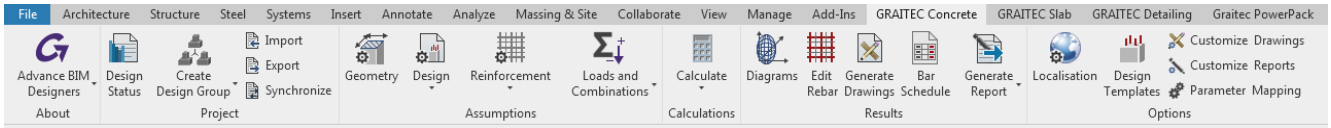
- Easier search for commands

To make it easier to find commands typical for different GRAITEC BIM Designers package configurations, changes have been made to the distribution of commands available on BIM Designers ribbons.

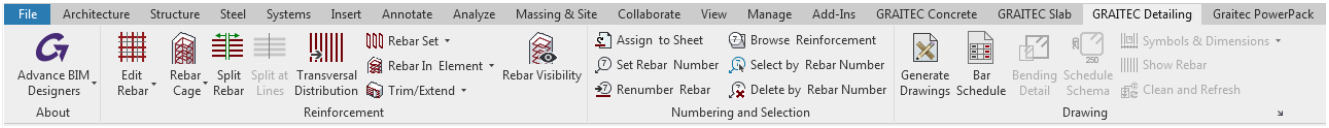
Three ribbons are now available:



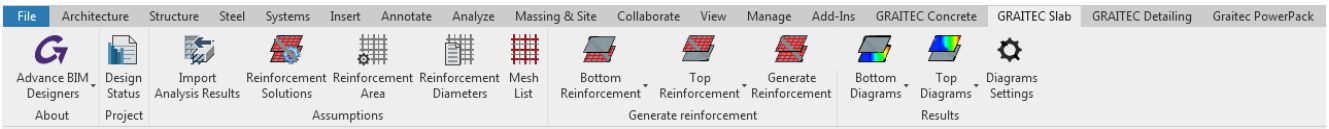
On the **GRAITEC Concrete** ribbon, users can find commands for designing rebar cages according to international design codes, as available in the *Rebar Designing and Detailing* package.



On the **GRAITEC Detailing** ribbon, users can find commands for creating parametric 3D rebar cages, for automating the creation of rebar views, 2D rebar bending details and lists with bending schedules, as available in the *Rebar Detailing* package.



On the **GRAITEC Slab** ribbon, users can find commands for reinforcement generation on slabs.



Rebar splitting

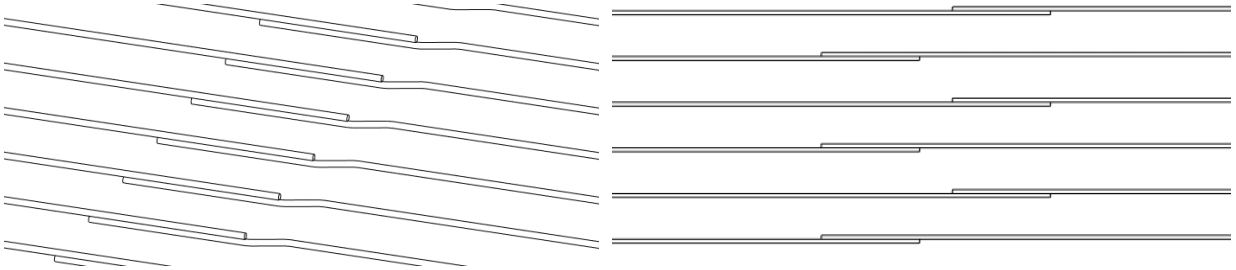
Main features & benefits:

- Automatic splitting bars that are too long
- Possibility of connecting divided bars by lapping, mechanical couplers or with cranked bars
- Full control thanks to the real-time preview and possibility for editing values
- Automatic and manual mode

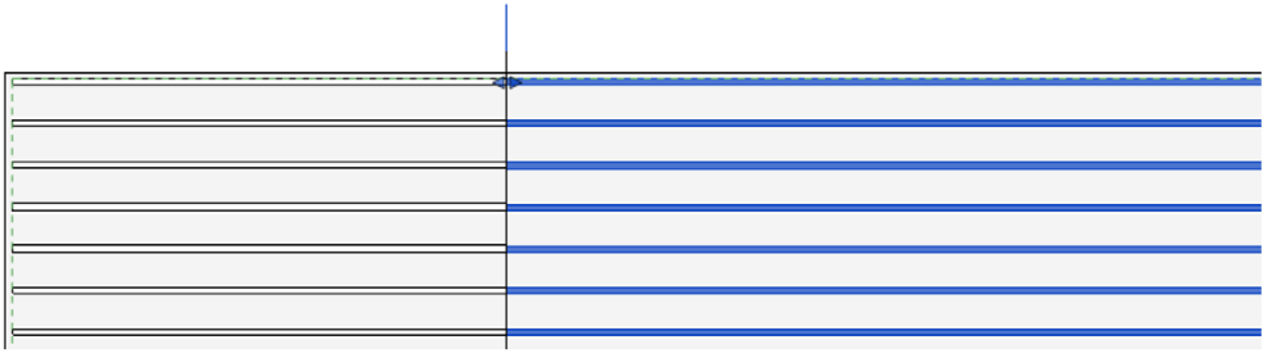
A new Split rebar functionality allows for dividing existing reinforcement bars with the use of multiple possible rules, including maintaining the continuity of the divided bars.

There are two new commands available allowing two modes of splitting:

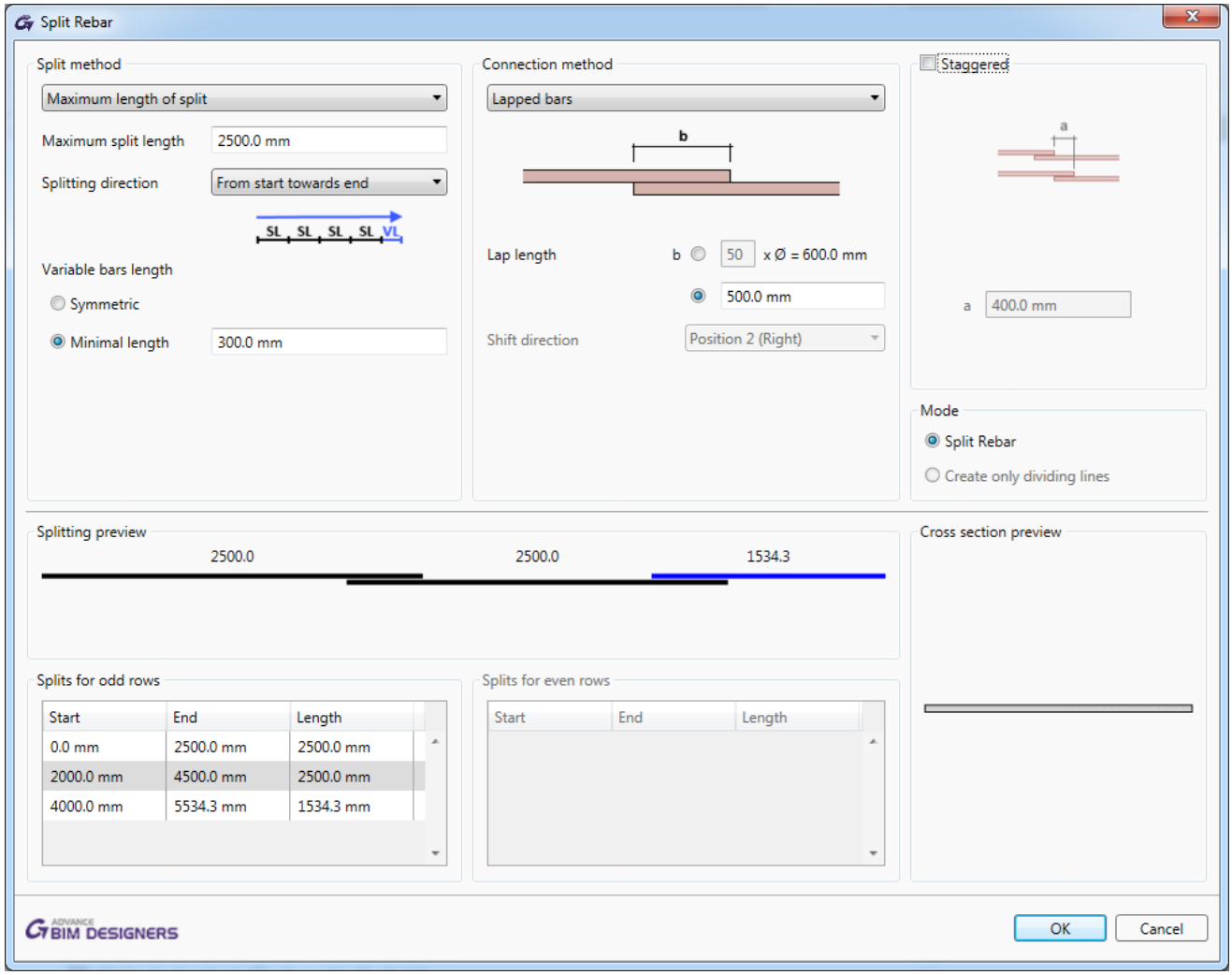
- **Split Rebar** – it is an automatic mode for splicing straight bars (with/without hooks) defined as single or in a set (including regular and varying length set type), respecting a set of rules and different connection methods.



- **Split at Line** – it is a manual mode available only on 2D view that divides rebars (single or in a set) by using earlier defined lines.



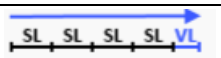
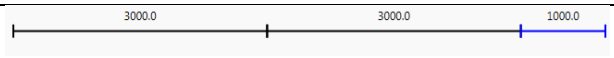
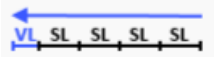
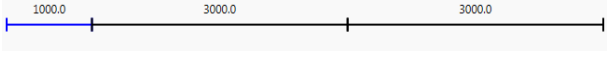
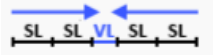
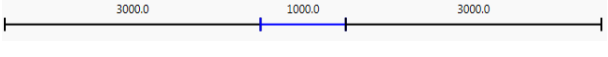
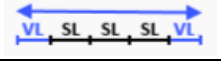
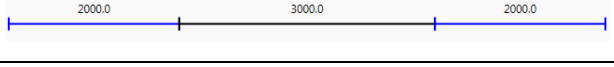
The **Split Rebar** commands opens a configuration dialog that contains settings for selecting either a splitting method or a connection method; the preview is based on real geometry and offers the possibility to edit the lengths of divided bars.



There are three available methods of splitting rebars:

- **Exact number of splits** – bars are divided into a number of segments entered by the user, having the same length;
- **Exact length of split** - bars are divided into segments, having the same length as entered value. For this method, bars are always lapped;
- **Maximum length of split** - bars are divided considering the maximum (stock) length.

The last method has two additional functionalities: the first functionality comprises the selection of the direction of the splitting:

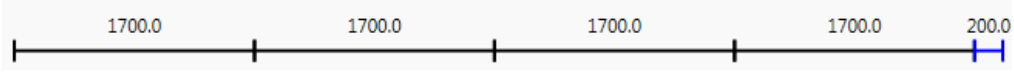
From start to end		
From end to start		
From ends to center		
From center to ends		

The second functionality is the selection of a method for managing the variable (remaining) length:

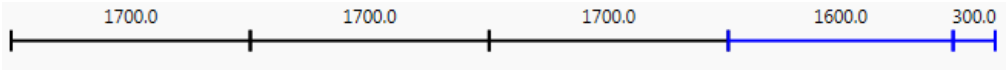
- **Minimal length** – it is used to avoid creating bars that are too short. If a remaining length is smaller than the entered value, it will be lengthened, while the adjacent bar will be shortened.
- **Symmetry** – it is used to avoid creating too many bars having different lengths, by setting the same length for the bars adjacent to the bar with the remaining length.

Examples:

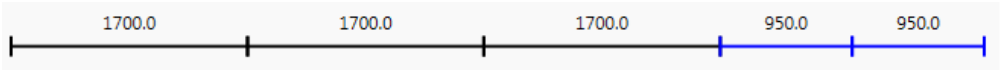
- The minimal length is smaller than the entered minimum:



- The minimal length is bigger than the entered minimum:

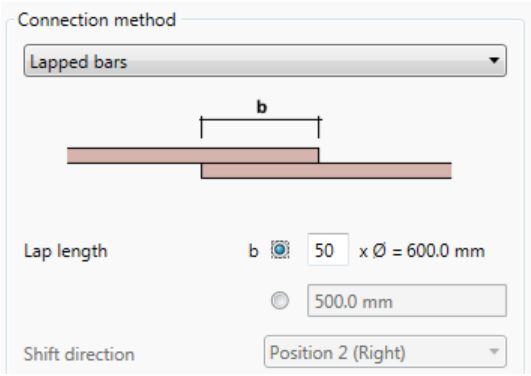


- The two last parts have the same length

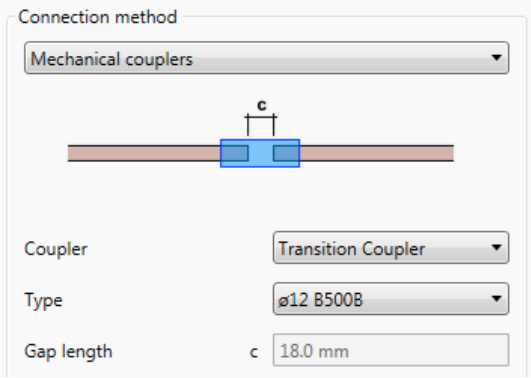


Four types of connection divided bars are available:

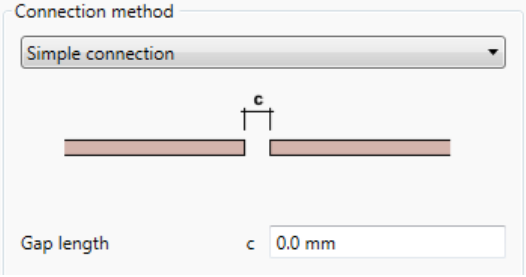
- **Lapped bars** – bars are connected by lapping. The lap length value can be defined either directly or as a multiplier of a bar diameter.



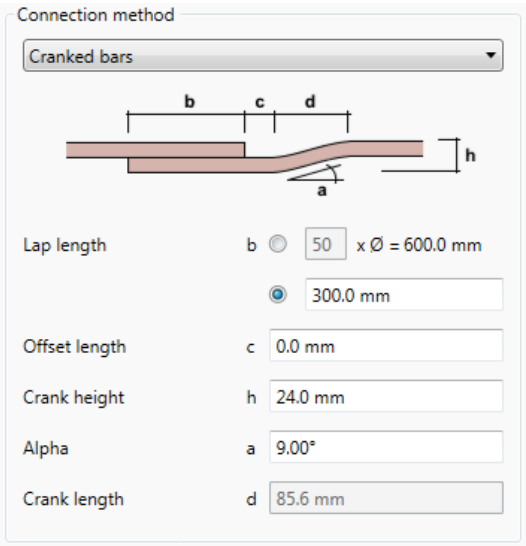
- **Mechanical couplers** – bars are connected using mechanical couplers. It supports the using of couplers already existing in a project as well as the creation of default ones.

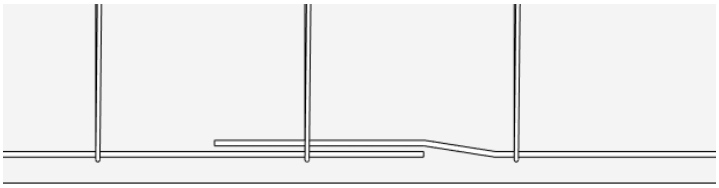


- **Simple connection** – bars are divided in line, with the optional gap between them.



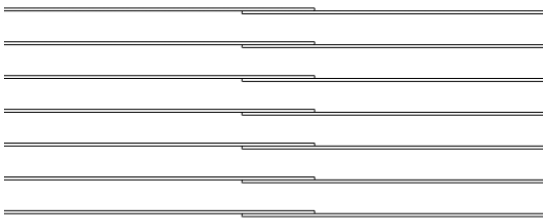
- **Cranked bars** – it is a method similar to the Lapping bars, but one of bars is bended in order to maintain the collinearity. It is suitable for defining the lap length value as well as for setting of geometry parameters.

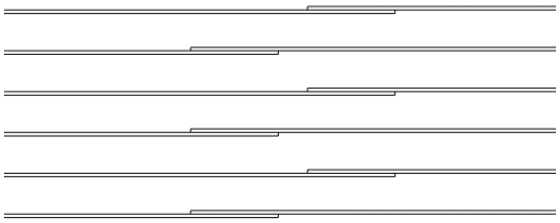




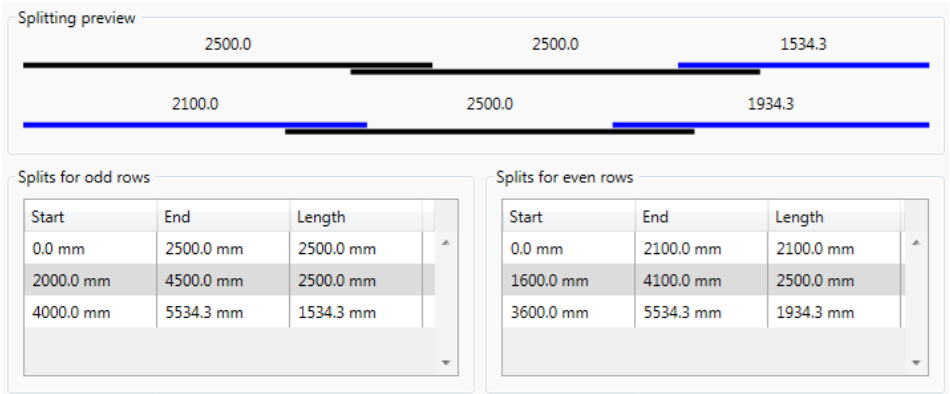
Cranked bars defined on beam

For the cases of dividing all rebar in set, if one line is not wanted, there is the possibility for defining staggered bars, when bars in even and odd lines are shifted by an entered value:



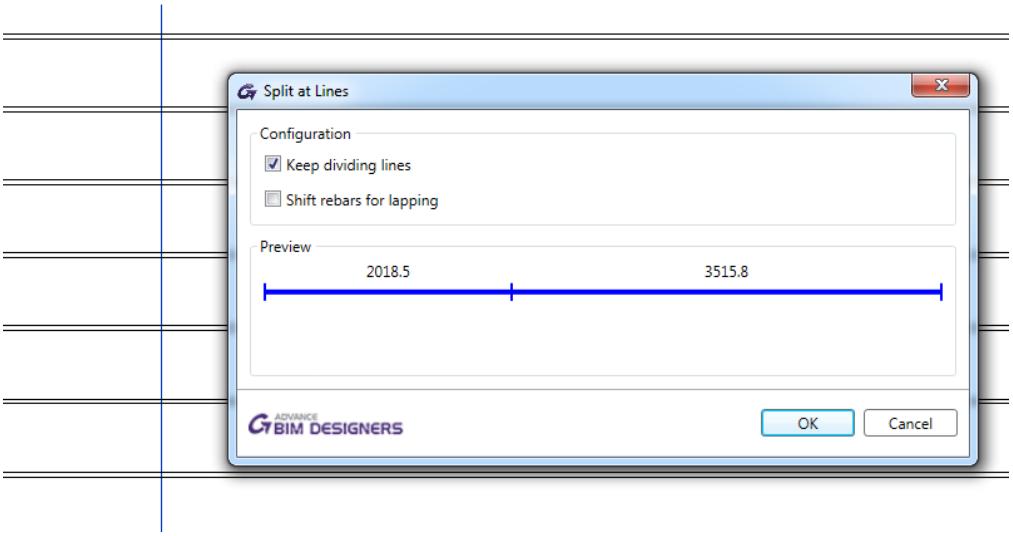


To have full control over the lengths of divided bars, a live preview is displayed on the window, whilst all values can be edited using grid tables.

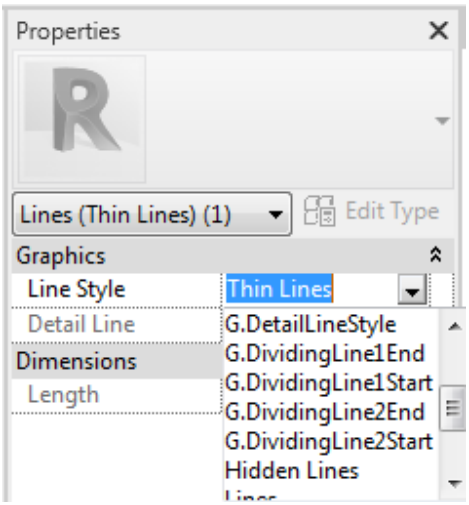


The “Split Rebar” option gives the possibility for either automatic splitting (available on 2D and 3D views) or for only the generating the dividing lines (available on 2D views). Dividing lines and can be manually adjusted and used as input lines for Split at Lines command.

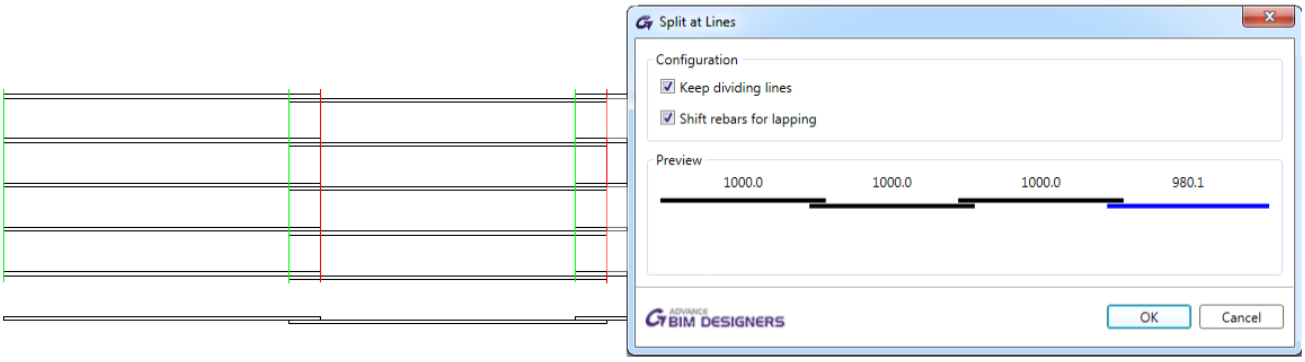
The “Split at Line” command can be used on 2D views and is based on Model or Detail lines.



Using detail lines gives additional advantages, as such lines can have special styles assigned, which allow defining if the start or end for bars is indicated.



By using different combinations, it is possible to get either simple splitting or lapping, or even to defy staggered lapping, when even and odd lines of bars are split using different lines.

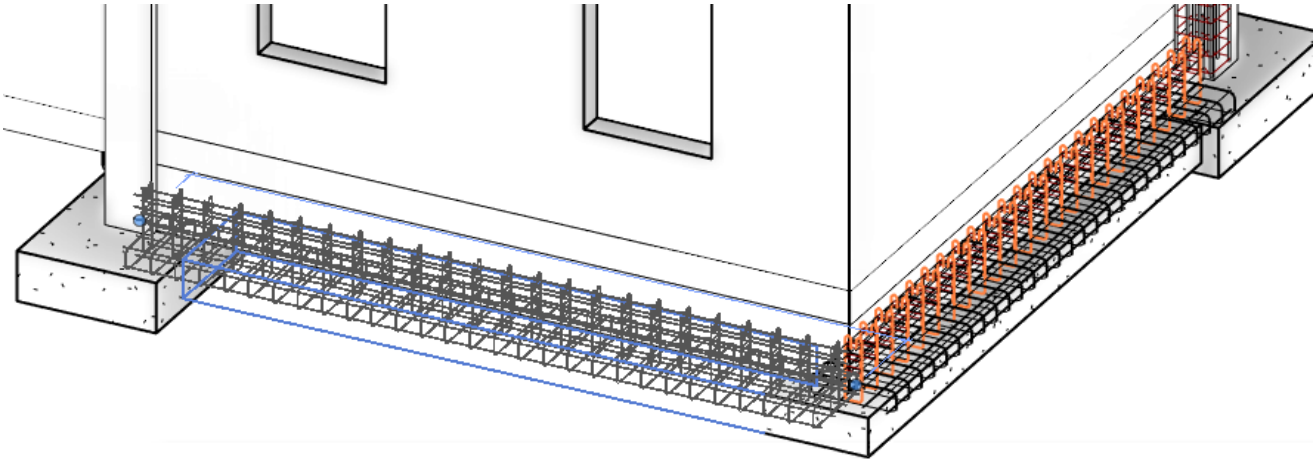


Continuous footing

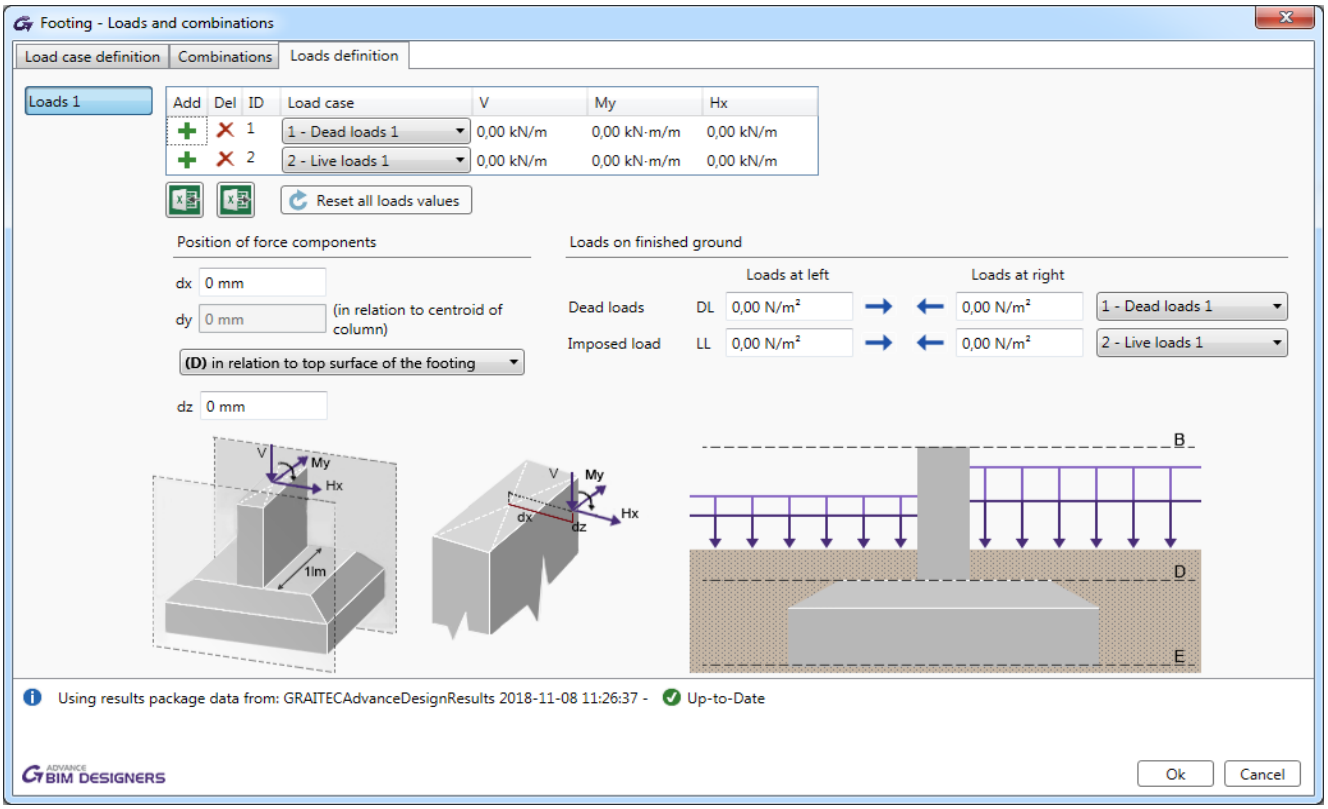
Main features & benefits:

- Designing and detailing of structural foundations hosted by walls
- A full range of settings for automatic generation of the reinforcement

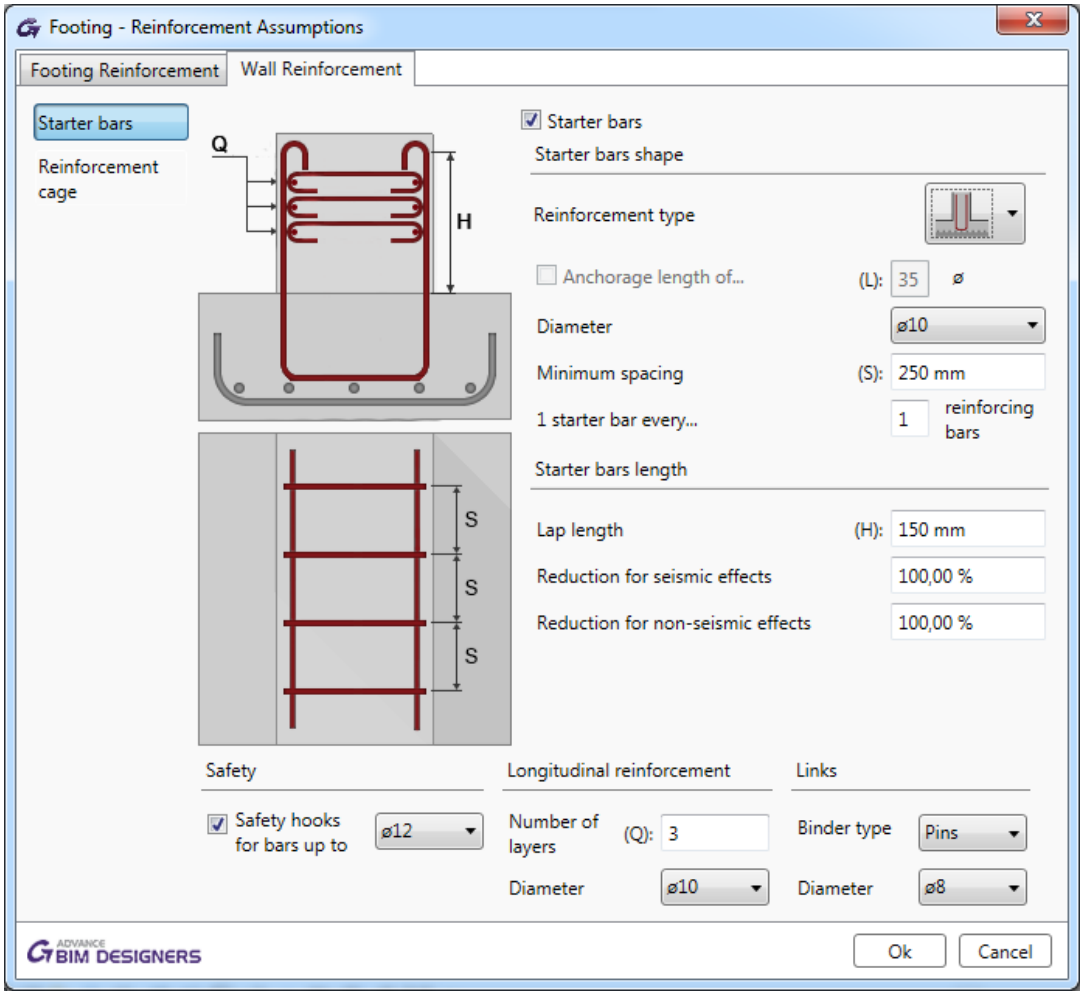
The Advance BIM Designers 2020 version introduces the possibility of creating the reinforcement on continuous foundation (structural foundations hosted by walls) in Autodesk Revit®. Both creating modes are available: calculation and reinforcement generation, according to code rules with the Design & Detailing mode or modeling rebars using the Detailing mode.



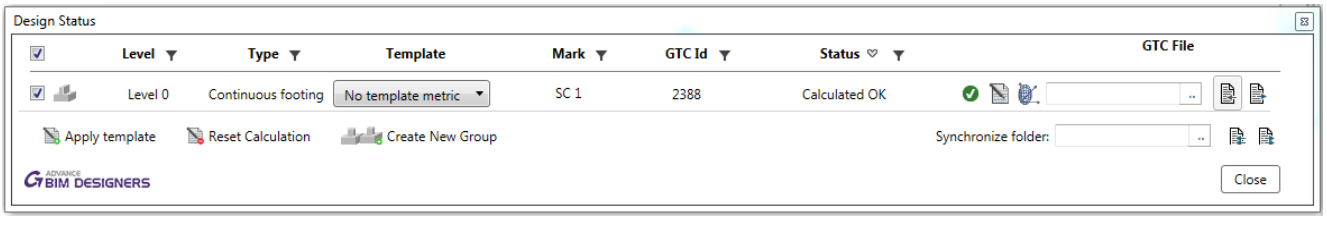
For Design & Detailing mode, similar to the one for footings, it is possible to define a set of required parameters including loads, ground soil profile, design and detailing settings.

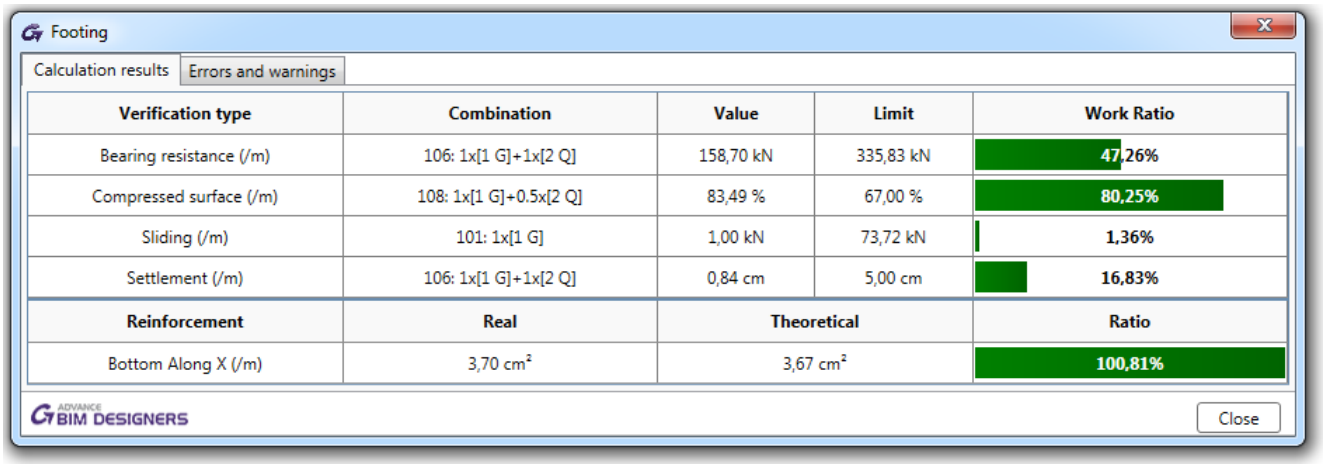


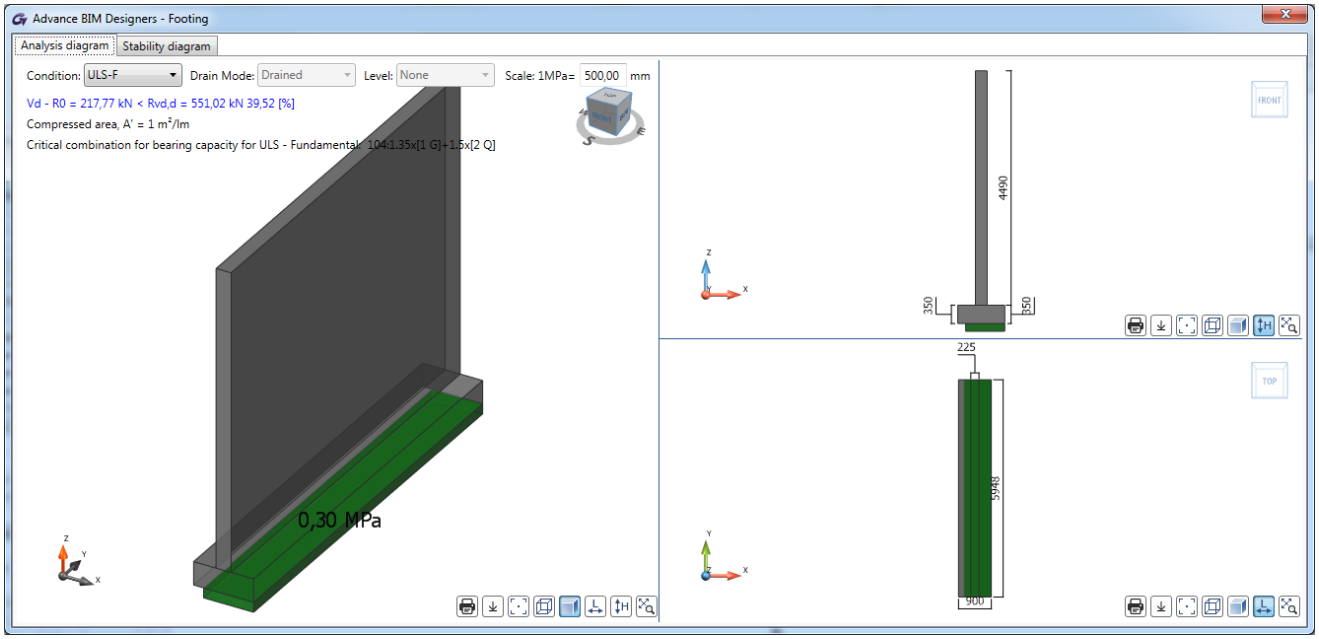
Reinforcement Settings covers a full range of parameters related to longitudinal or transversal reinforcement in the footing part as well as in starter bars, or related to a reinforcement cage in a wall.



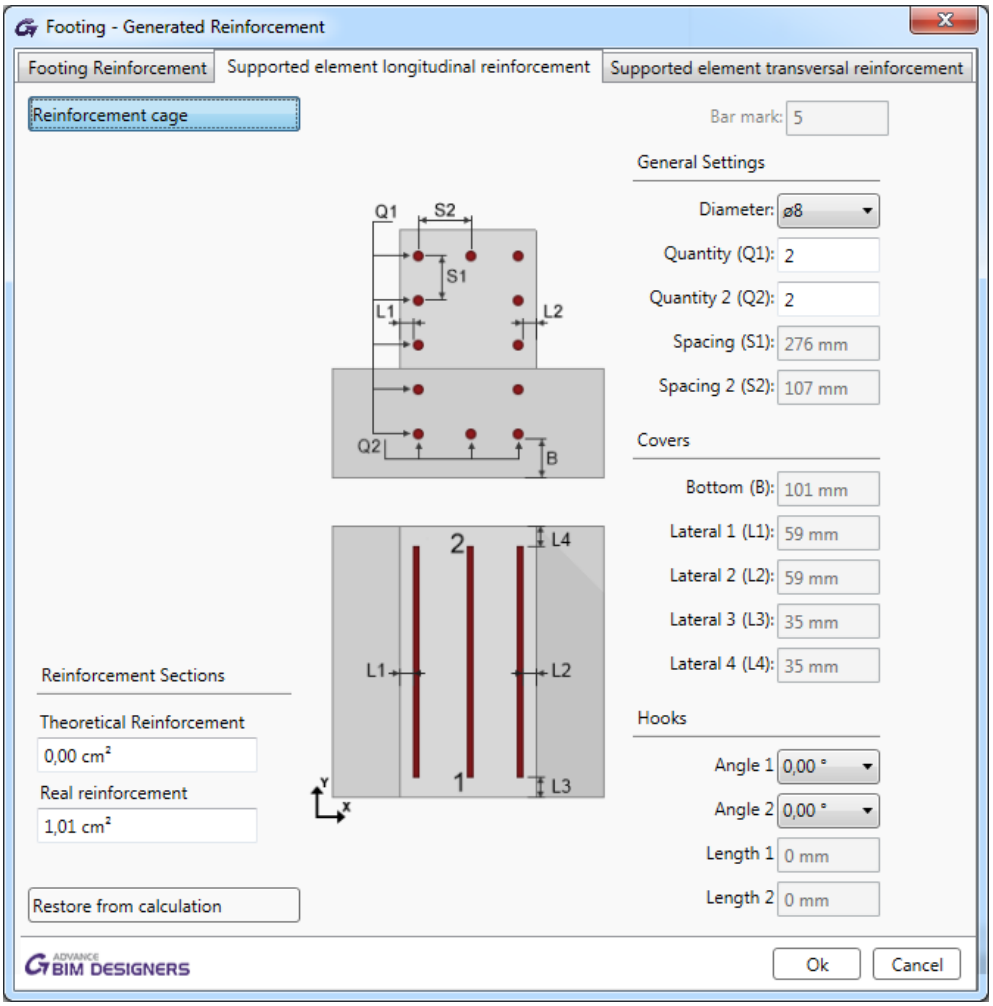
A wide range of results is available for designed continuous footings, including verification summary, diagrams and detailed calculation reports.



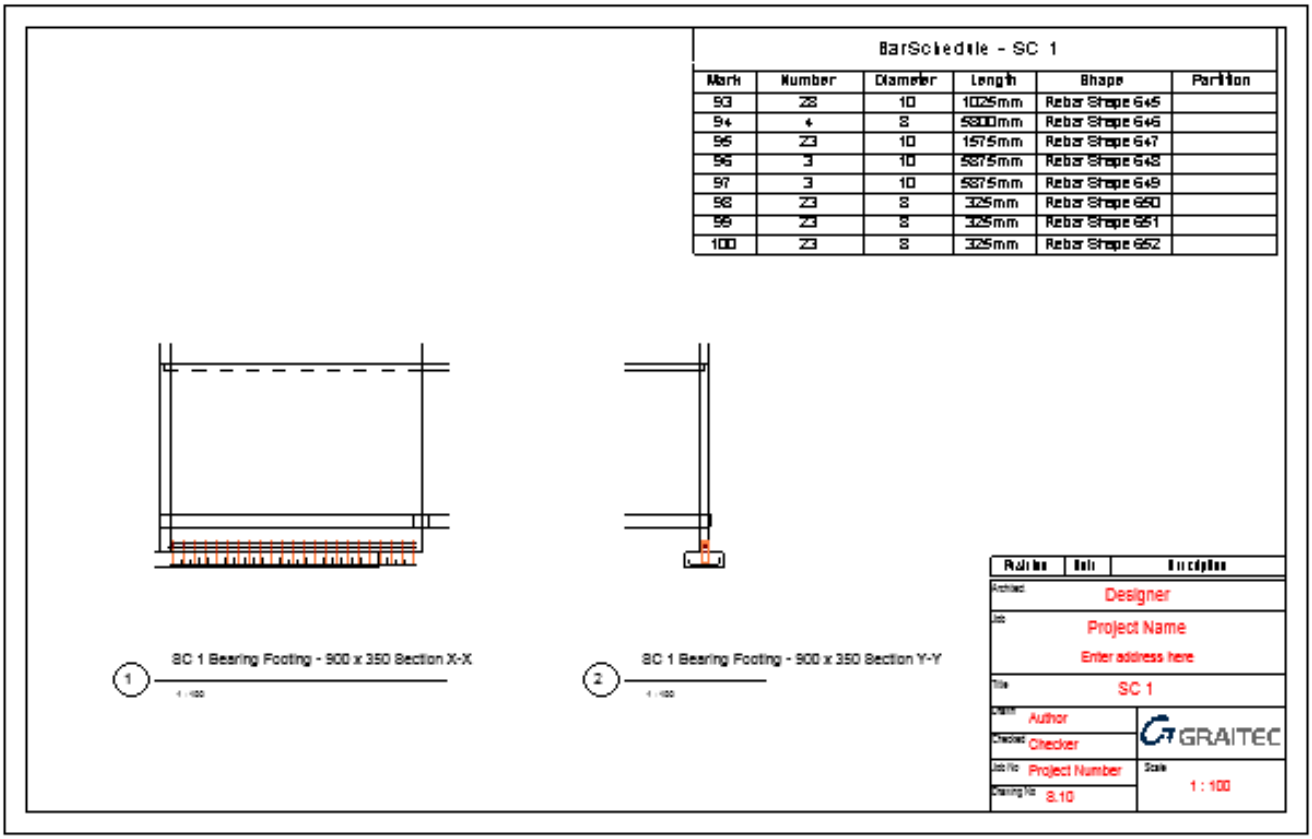




A set of new dialogs windows is available to automatically generate new reinforcement in the Detailing mode or to edit an existing one created during the design process. The different kind of reinforcement typical for continuous footings is available, including top and bottom bars in the footing and longitudinal and transversal bars in the supported element (wall).



Similar to beams, columns and footings under columns, reinforcement drawings for continuous foundations can be generated automatically, according to the drawing templates.

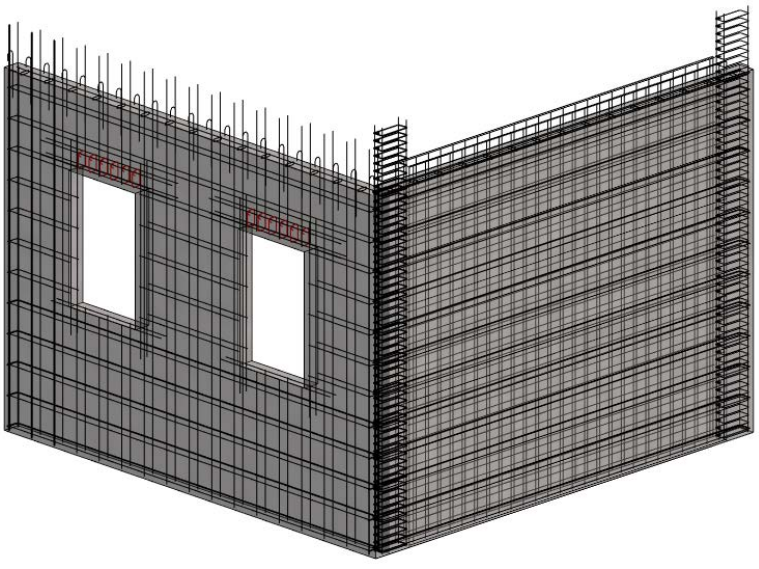


Walls

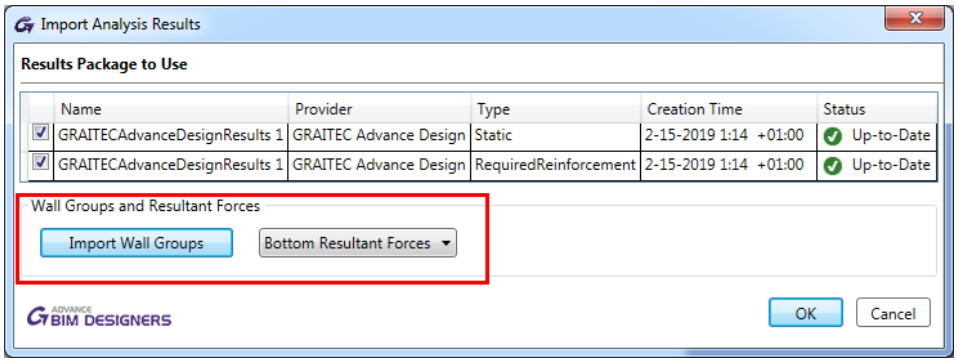
Main features & benefits:

- Designing and detailing of structural walls
- A full range of settings for automatic generation of the reinforcement

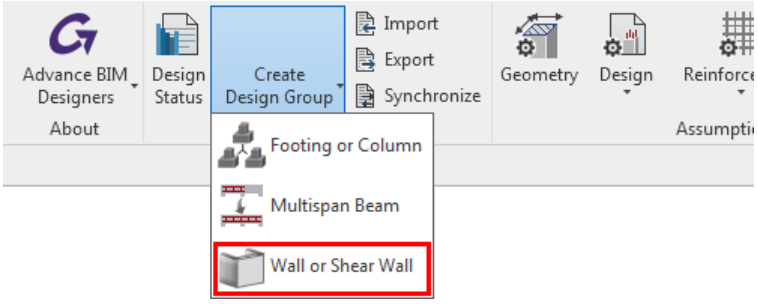
The Advance BIM Designers 2020 version introduces the possibility of creating the reinforcement on concrete walls in Autodesk Revit®. Both creating modes are available: calculation and reinforcement generation according to code rules using the Design & Detailing mode, or modeling rebars using the Detailing mode.



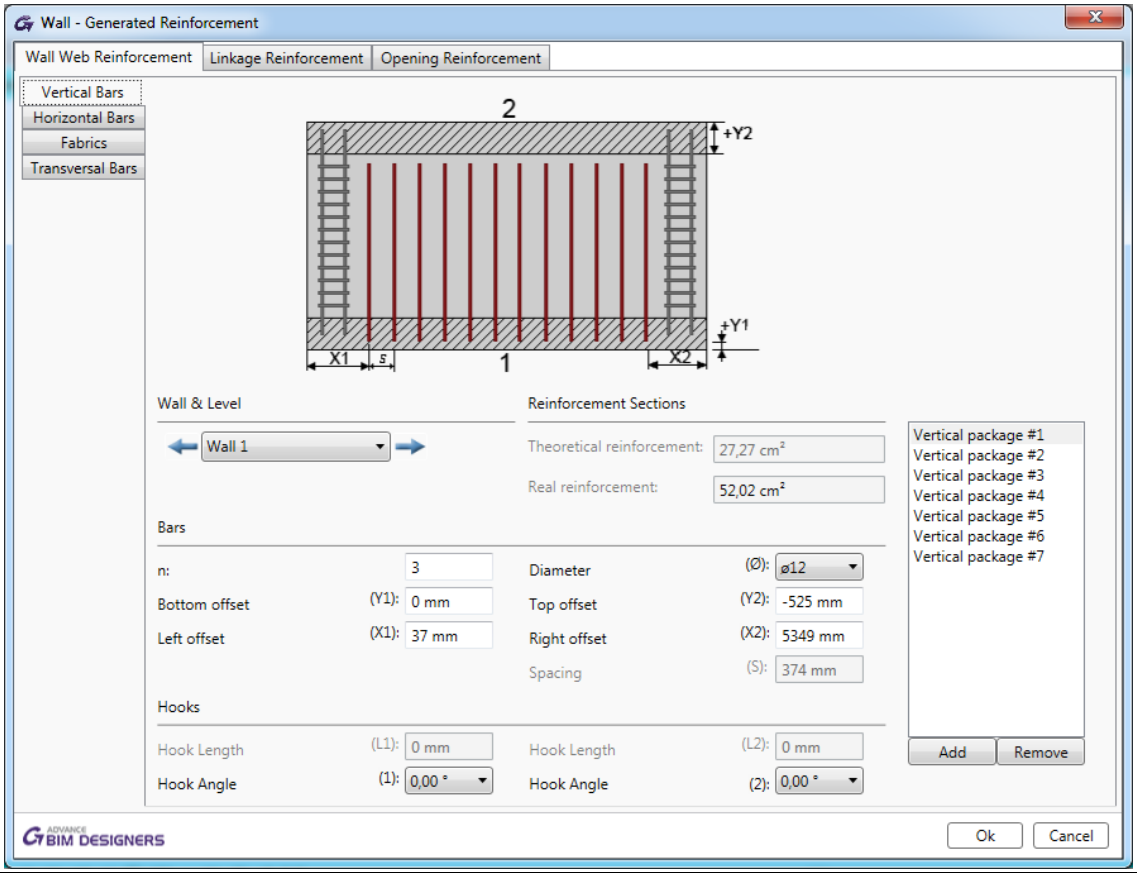
For the Design & Detailing mode, similar to the one used for beams/columns/foundations, it is possible to either enter load values or to use results obtained from FEM calculations in Advance Design. For the second case, results contain resultant forces, calculated on both the top and bottom of the wall, therefore during the import it is necessary to select the desired package.

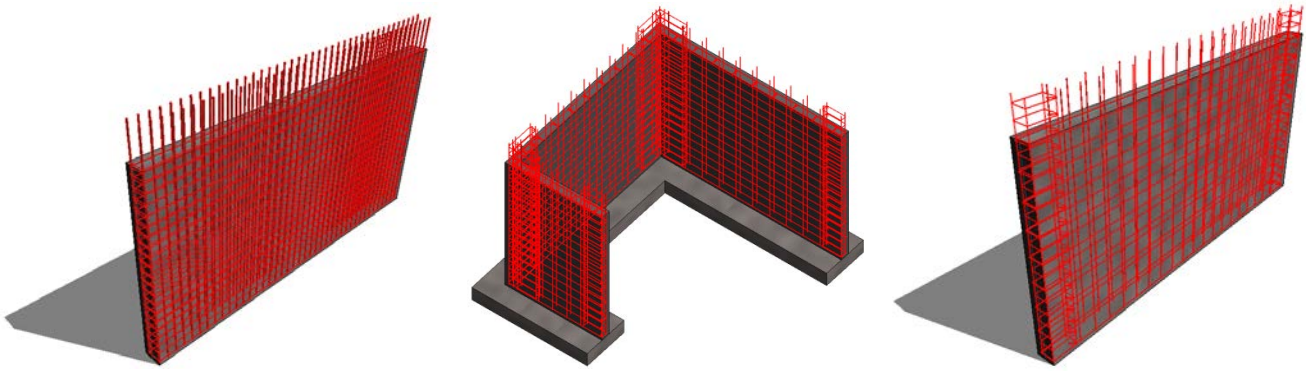


The calculation of wall groups, whose definition can be imported from Advance Design, or defined at Revit® level, is also supported.



The BIM Designers Wall module offers a full range of options for editing / creating reinforcement, using dialog windows, which assures a significant speeding of the modelling process.

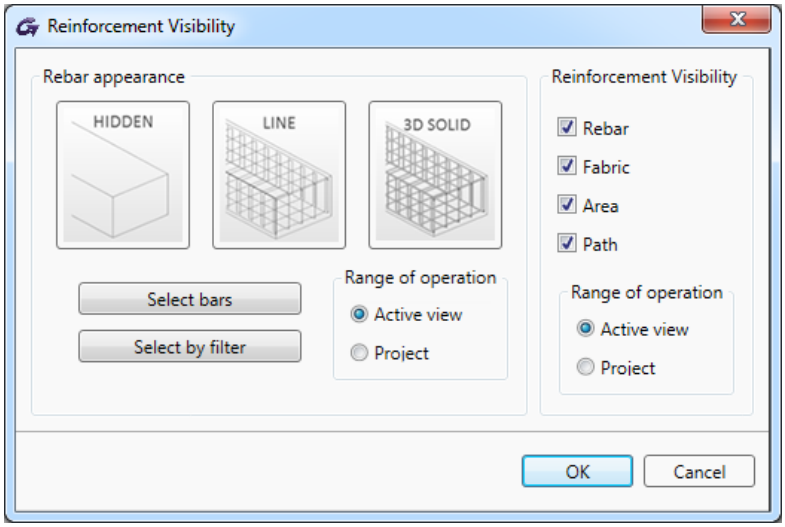




***Note**: For more details related to the Wall module capabilities, please check the related chapter in this document.*

Improvements to the Rebar visibility

A small improvement has been brought to the dialog window of the “Rebar visibility” command, by removing buttons for selecting the Level of Detail and by rearranging the content. Selecting any visibility option on the dialog does not automatically change the current level of details, ***except*** when selecting the *3D solid* rebar appearance type, which applies the Fine level of detail.



Welcome to Advance BIM Designers 2020 STEEL SERIES

GRAITEC is very pleased to present the latest version of the Advance BIM Designers – Steel Series 2020, part of the Graitec Advance suite.

The GRAITEC Advance BIM Designers Suite is a collection of advanced apps for automating structural design to-detail BIM workflows and produce technical documentation.

Version 2020 is bringing new features and more flexibility, offering new innovative modules and truly improving the BIM workflow for the concrete and steel industries.

Advance BIM Designers 2020 brings many new features and improvements to the Steel Connection Designer and Stairs and Railings modules.

The 2020 version introduces a completely **new GUI** for both Steel Connections module and Stairs and Railings module.

In addition to the new look, the 2020 version of the Steel Series arrives with a new connection, HSS Bracing, and new design methods for stairs.

Steel Connections Designer

The Steel Connections Designer 2020 comes with a new GUI, a new connection and many enhancements of the existing connections.

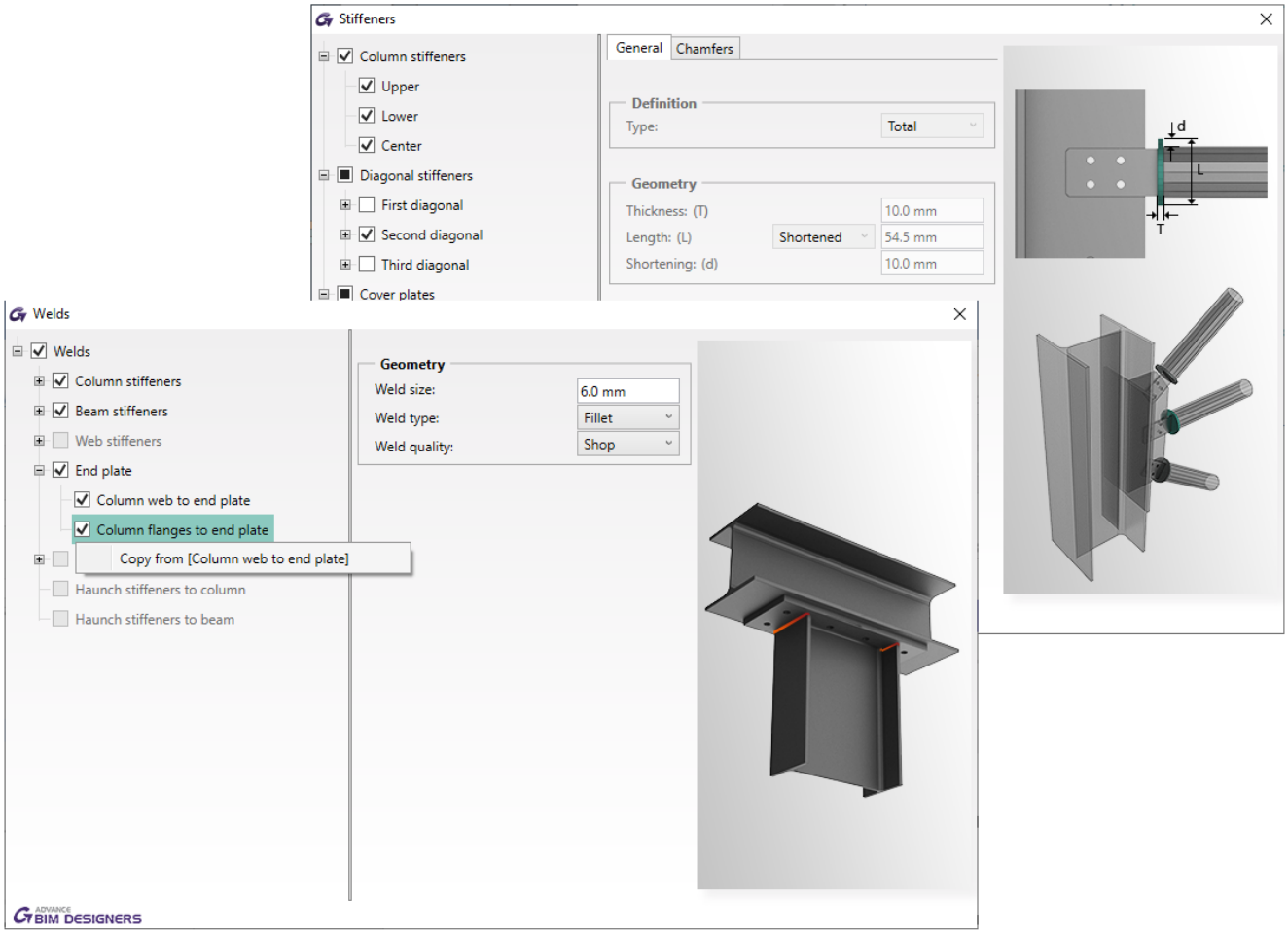
Novelties

New GUI

The user interface is a critical part of any software product. To increase the chances of success when creating user interfaces, most designers follow interface design principles.

The new GUI of Steel Connections Designer 2020 proposes to:

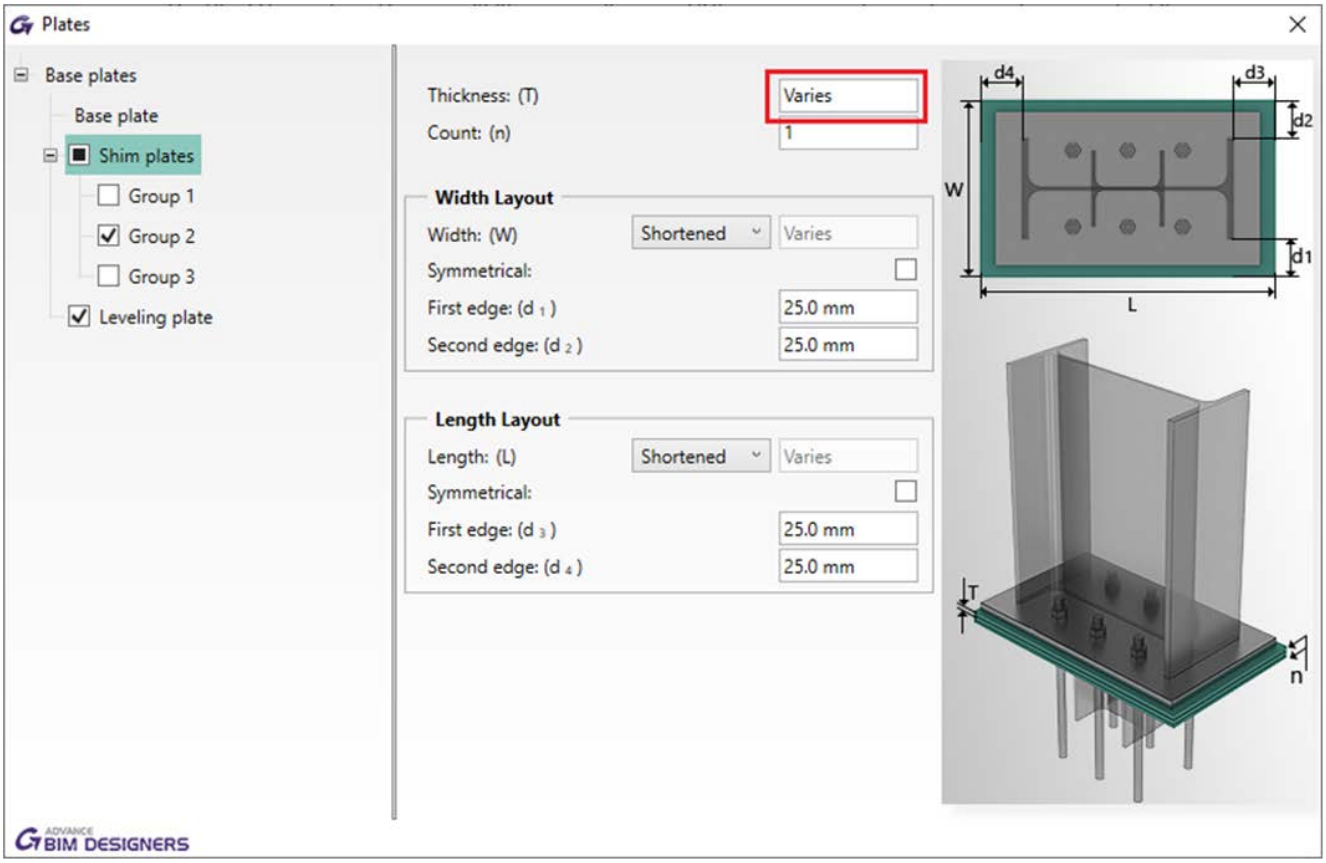
- Place the user in control of the interface by creating an easy-to-navigate interface;
- Make the user more comfortable to interact with the module by eliminate all elements that are not helping;
- Reduce the cognitive load by following conventional patterns and reducing the number of actions required to complete the task.



The GUI was recreated as the classic Tree-View navigation control, used to group and display a hierarchical list of items, but it has been enhanced with some additional “magical powers”:

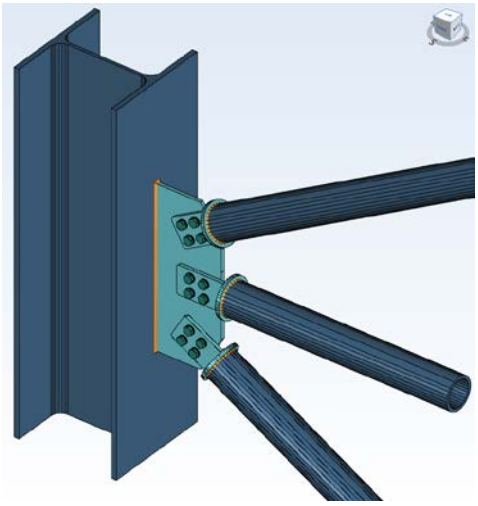
- Propagation of parameter state between all the child items of a parent item and all the parent items of the tree family;

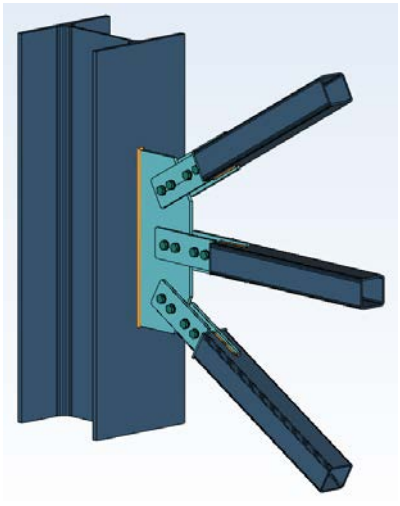
- Self-expanding/collapsing mechanism at each parent level, function of the parameter state of its child item.



New Connections – HSS Bracing

The **HSS Bracing** joint connects bracing members with hollow sections, circular or square. The number of bracing members can vary from one to three.



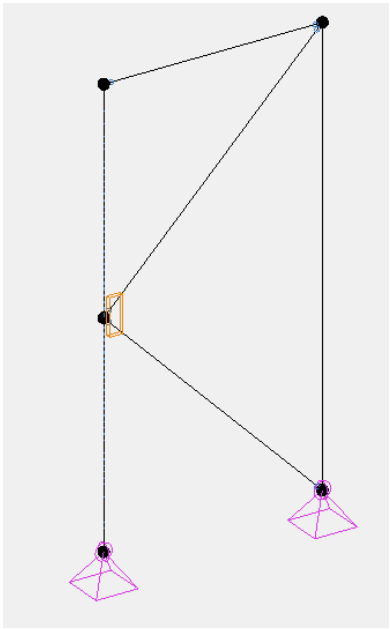


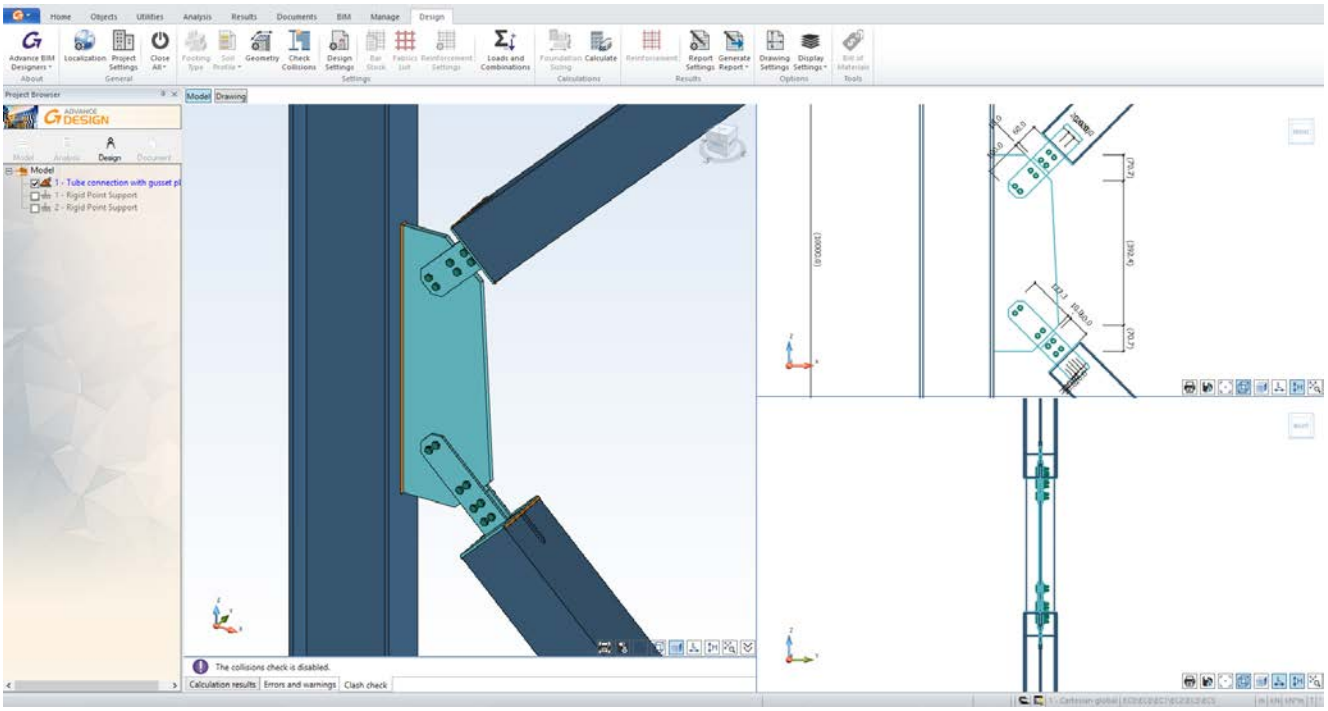
The joint is designed according to Eurocode 3 and multiple verifications are made, such as:

- Verification of welds between main member and gusset;
- Verification of gusset subjected to combined axial and bending;

- Verification of welded assemblies (gusset + sandwich / tab plates);
- Knife plate verification (depending on joint configuration – user must configure a knife plate);
- Local shear verification of HSS wall;
- Verification of welds between tab plate/sandwich plate and cover plate;
- Verification of welds between cover plate and diagonal.

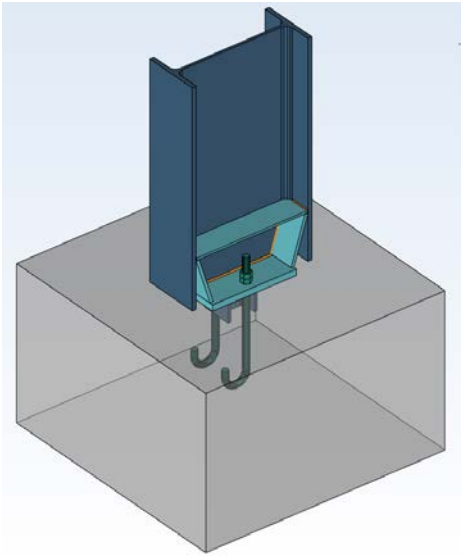
The new HSS Bracing joint is also linked with Advance Design, as are all BIM Designers Steel Connections joints.





New option – Reduced Base Plate connection

The Base Plate connection can now have a different configuration: Base plate with sloped or vertical stiffeners.



Starting with version 2020, the base plate size can be smaller than the column size, which allows users to preserve a pinned connection for the columns with big sections.

It is used, for example, for column sections bigger than 300 mm – the accepted limit for a pinned connection.

The sloped stiffeners are transferring the vertical efforts from the column's flanges to the reduced base plate.

Improvements

New verifications for Clip Angle, Splice, Triple Gusset – welded connections

The following verifications for welded parts were added:

- Verification of welds between members and plates;
- Verification of gusset subjected to combined axial and bend

5 Column - gusset connection verification

5.1 Gusset axial and bending verification

Check relation:

$$\frac{N_{Ed}}{N_{Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \leq 1$$ EN1993-1-1 6.2.1 (6.2)

$$N_{Rd} = \frac{A \cdot f_y}{\gamma_{M0}} = \frac{3653.6\ mm^2 \times 235.00\ MPa}{1.00} = 858.60\ kN$$

$$M_{y,Rd} = \frac{W_y \cdot f_y}{\gamma_{M0}} = \frac{222.48\ cm^3 \times 235.00\ MPa}{1.00} = 52.28\ kN{\cdot}m$$

$$M_{z,Rd} = \frac{W_z \cdot f_y}{\gamma_{M0}} = \frac{6.09\ cm^3 \times 235.00\ MPa}{1.00} = 1.43\ kN{\cdot}m$$

Check relation becomes:

$$\frac{25.13\ kN}{858.60\ kN} + \frac{2.92\ kN{\cdot}m}{52.28\ kN{\cdot}m} + \frac{1.14\ kN{\cdot}m}{1.43\ kN{\cdot}m} = 0.88 \leq 1.0$$

Work Ratio: 88.05 % **Passed**

- Verification of welded assemblies (ex: gusset + diagonal, splice plates + beam)

5.2 Weld verification for column - gusset connection

Weld group connecting gusset plate and flange of main member

a) Weld Dimension Conditions

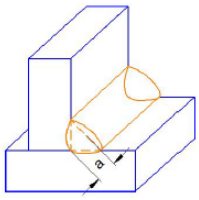
In this chapter, conditions for minimum throat thickness and minimum weld length are verified.

• Minimum throat thickness verification

$a \geq 3mm$ EN 1993-1-8, 4.5.2 (2)

• Minimum weld seam length verification

$l_{eff} \geq \max(6 \times a; 30mm)$ EN 1993-1-8, 4.5.1 (2)



Both conditions are verified in the table below.

Weld no.	a (mm)	Minimum a (mm)	Min. throat thickness verification	Leff (mm)	Leff limit (mm)	Minimum Length verification	Weld seam status
1	4.0	3.0	Passed	365.4	30.0	Passed	Ok
2	4.0	3.0	Passed	365.4	30.0	Passed	Ok

Next, only weld seams with "Ok" status will be considered.

- Tension yielding and compression yielding are also available for welded clip angle, welded diagonals on gusset or on new HSS bracing.

Project: *Date:* 04-23-2019

5.2.2 Tension verifications

5.2.2.1 Tension Yielding Verification

Check relation: $N_{Ed} \leq N_{pl,Rd}$ EN 1993-1-1 6.2.3 (6.5)

Combination: [1]: ULS envelope 1

$N_{pl,Rd} = n \times A \times \frac{f_y}{\gamma_{M0}} = 1 \times 23.6\ cm^2 \times \frac{235.00\ MN/m^2}{1.00} = 555.07\ kN$ EN 1993-1-1 6.2.3 (6.6)

$A = h_p \times t_p = 236.2\ mm \times 10.0\ mm = 23.6\ cm^2$

Check relation becomes: $75.00\ kN \leq 555.07\ kN$

Work Ratio: 13.51 % Passed

6.2.1.1 Compression Yielding Verification

Check relation: $N_{Ed} \leq N_{pl,Rd}$ EN 1993-1-1 6.2.4 (1)

Combination: [1]: ULS envelope 1

$N_{pl,Rd} = n \times A \times \frac{f_y}{\gamma_{M0}} = 1 \times 19.2\ cm^2 \times \frac{235.00\ MN/m^2}{1.00} = 451.21\ kN$

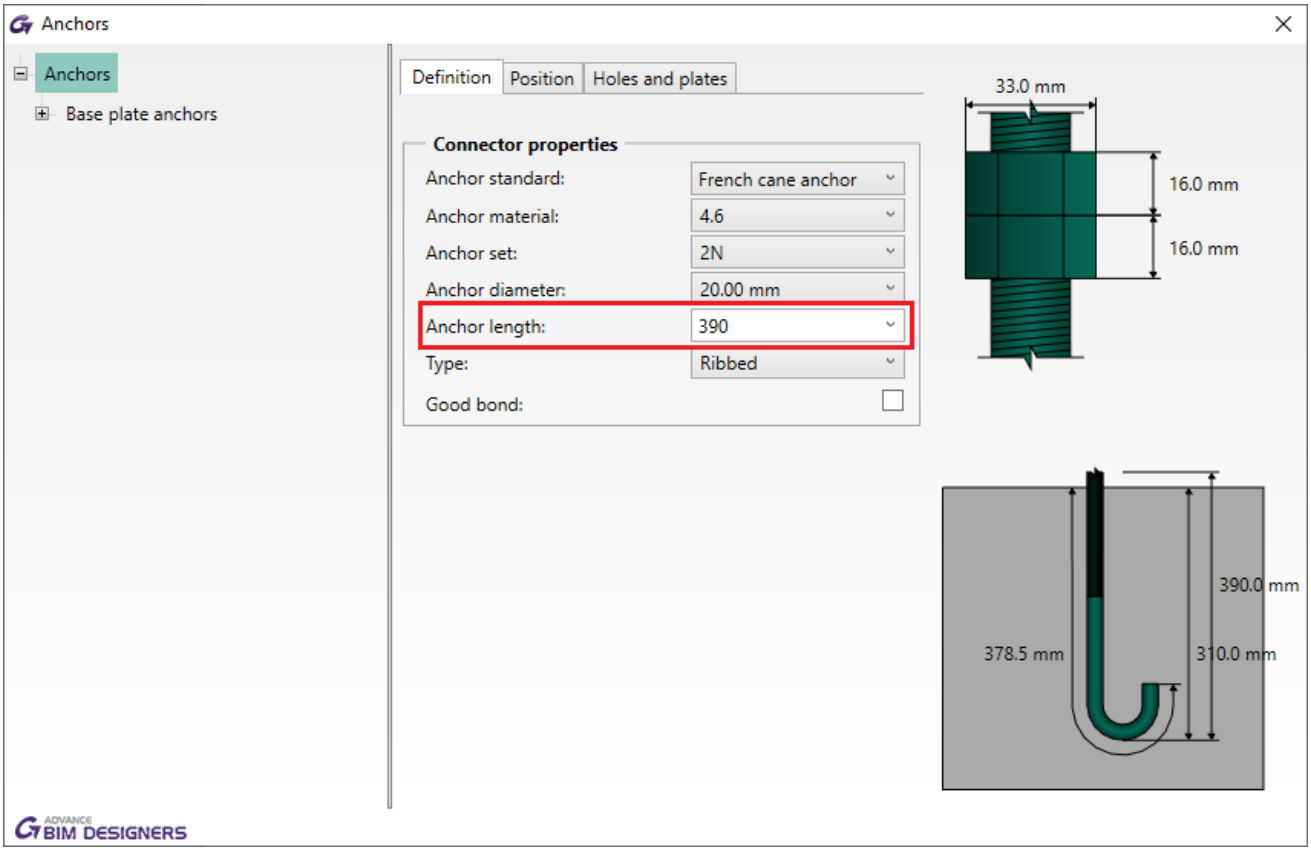
$A = h_{30} \times t_p = 192.0\ mm \times 10.0\ mm = 19.2\ cm^2$

Check relation becomes: $-25.00\ kN \leq 451.21\ kN$

Work Ratio: 5.54 % Passed

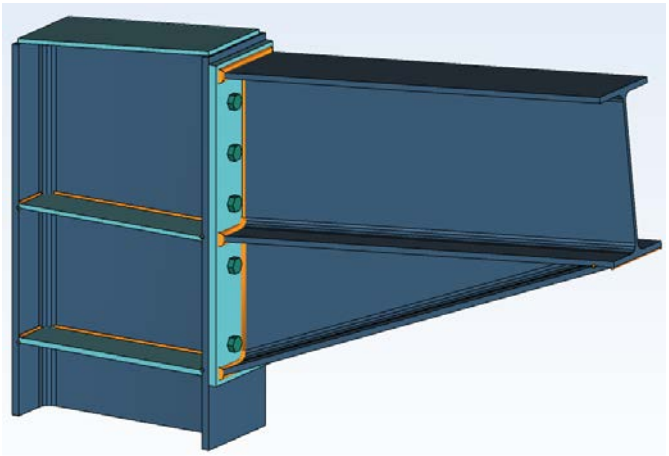
Base Plate - Possibility to input Anchor length

Starting with 2020 version, the length of the anchors for the Base Plate connection can be entered manually and it can be different from the standard values.



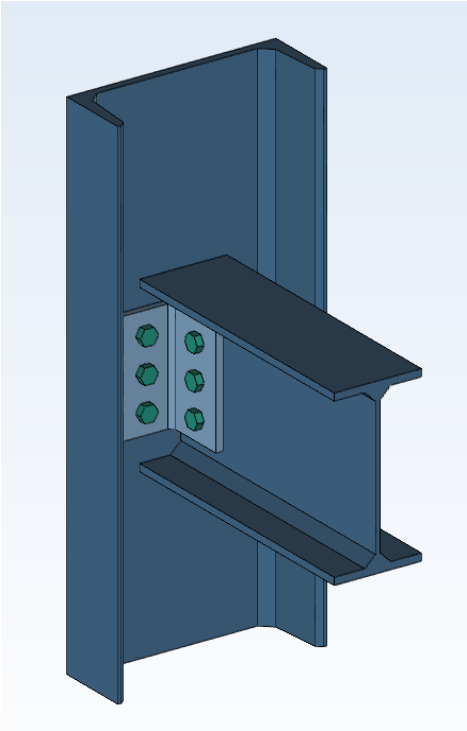
Cap plate for MEP connection

The MEP connection can be configured with a Cap Plate and all the verifications are done accordingly.



Clip Angle connection - U section for main element

The main element from the clip angle connection can be defined as a U section



New verifications for MEP, Apex and Gable Wall connections

1. Verification for the stiffeners of the external bolts

This verification is related to the stiffener resistance & welds, and includes:

- calculation of external stiffener
- calculation of welds between stiffener and EP / flange

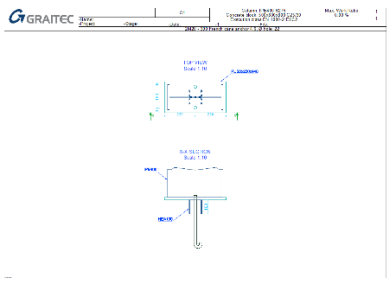
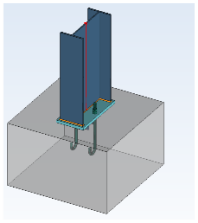
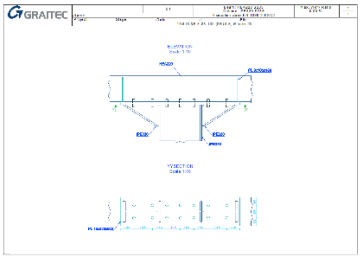
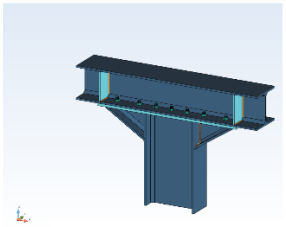
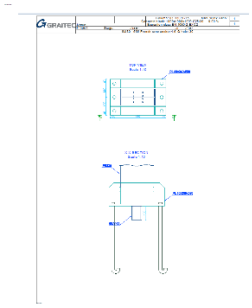
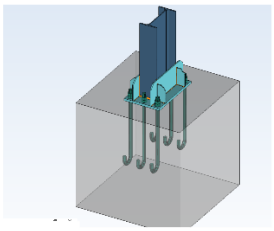
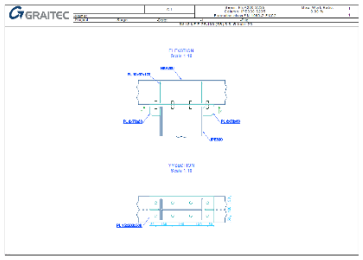
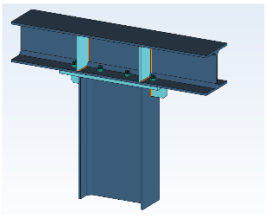
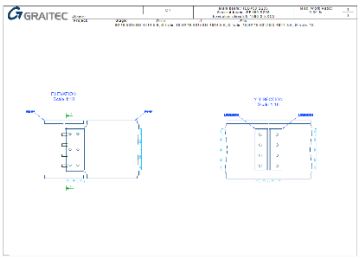
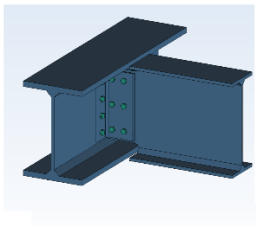
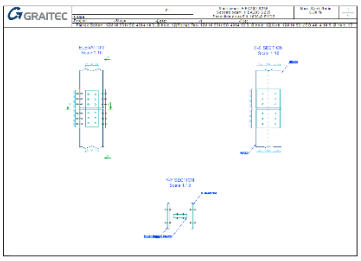
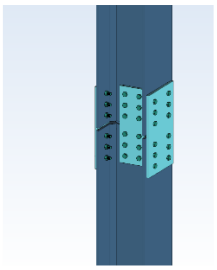
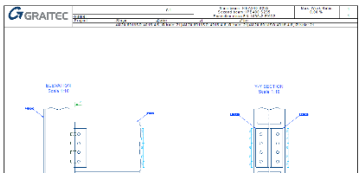
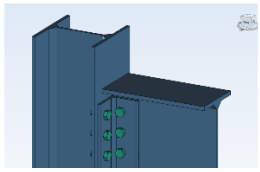
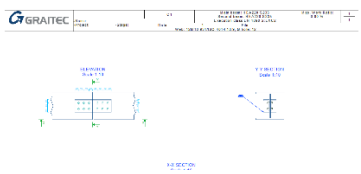
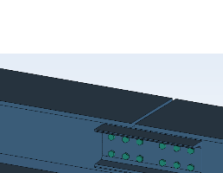
2. Verification of stiffeners between bolts of external rows

This verification is a resistance verification (compare with tension efforts from bolts), limited only for the most tensioned bolt row and includes:

- calculation of external stiffener
- calculation of welds between stiffener and EP / flange

Drawing improvements

With each new version, the drawings generated automatically by the BIM Designers Steel Connection are improved. In this version, the views are better aligned, and the paper space is optimized.

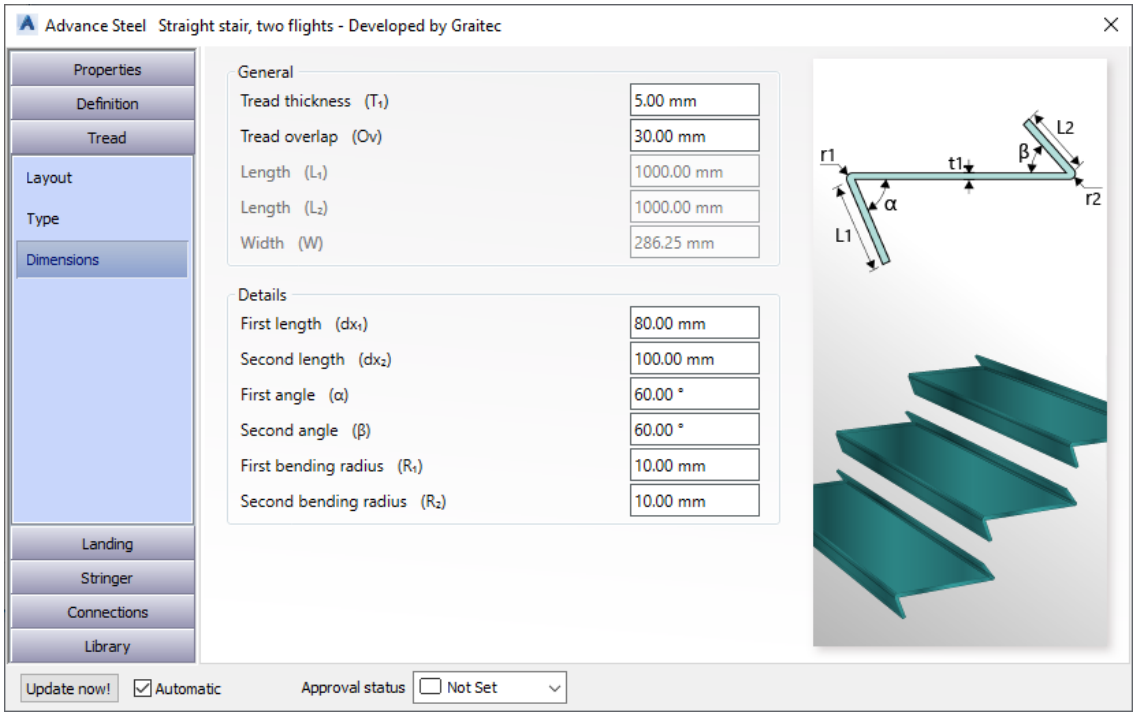

















Stairs and Railings Designer

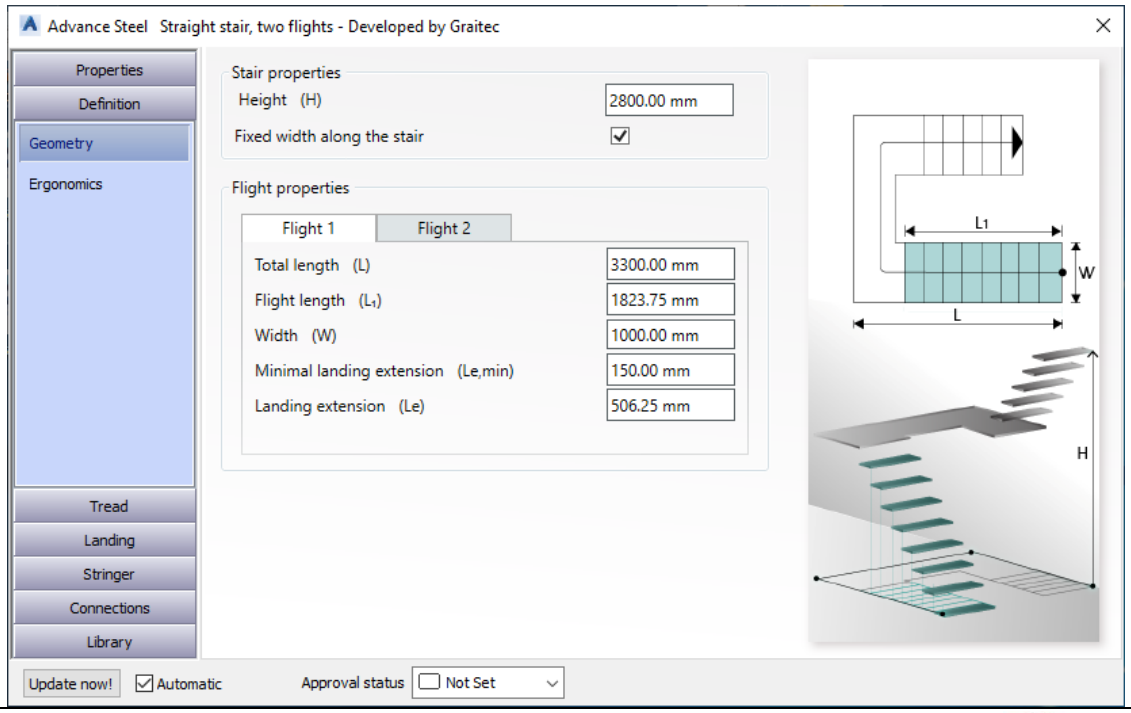
Novelties

New GUI

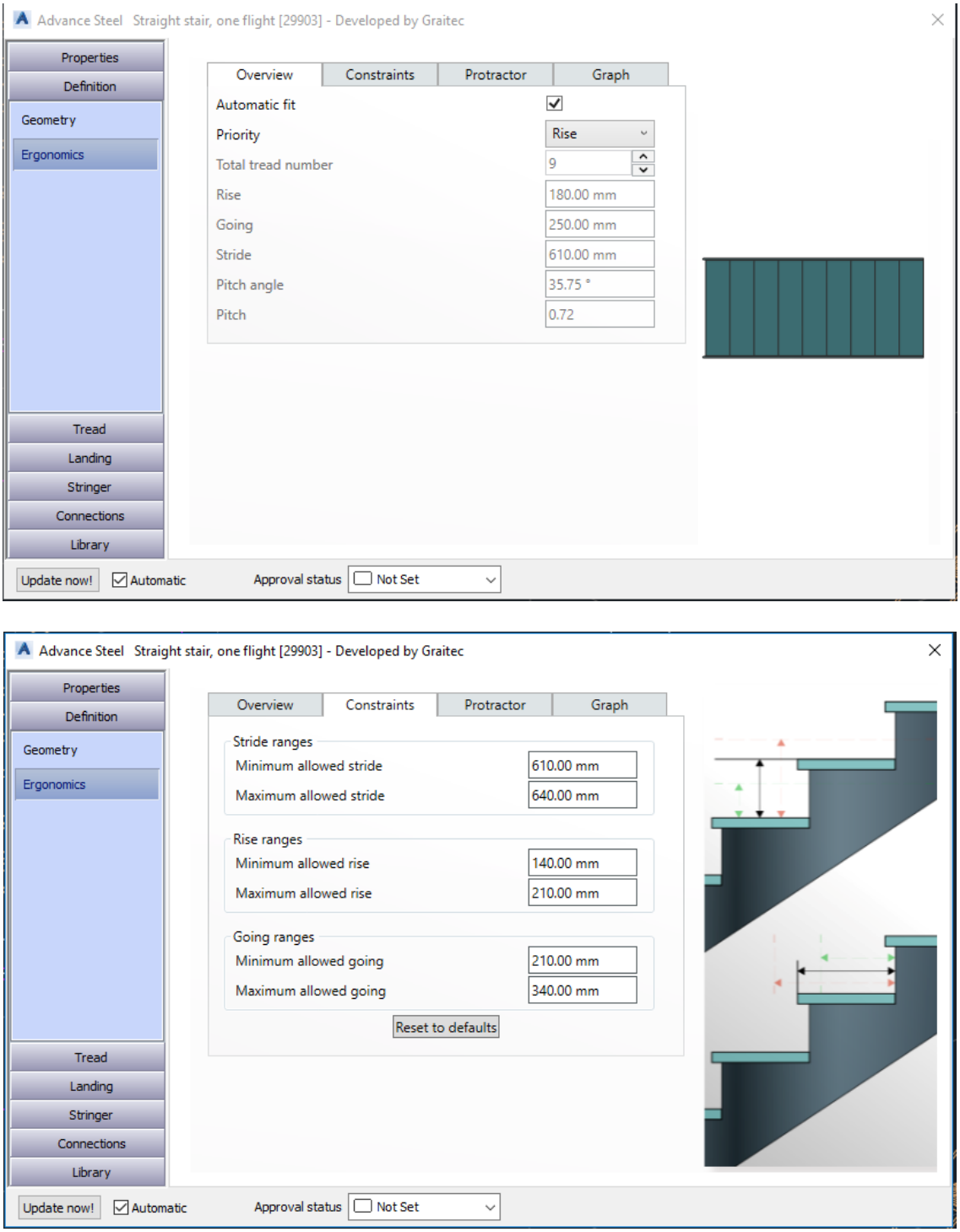
The Stair Designer for 2020 has an updated GUI with an entire new organization and detailed images, for a better user experience**.**
Consistent design is intuitive design, therefore, the interface for Stairs has been completely redesigned, providing information in a more consistent way, with a representation that is more easily understood by users.



Emphasizing on visual and functional consistency, the key points become usability and learnability, producing a user-friendly interface that encourages exploration.



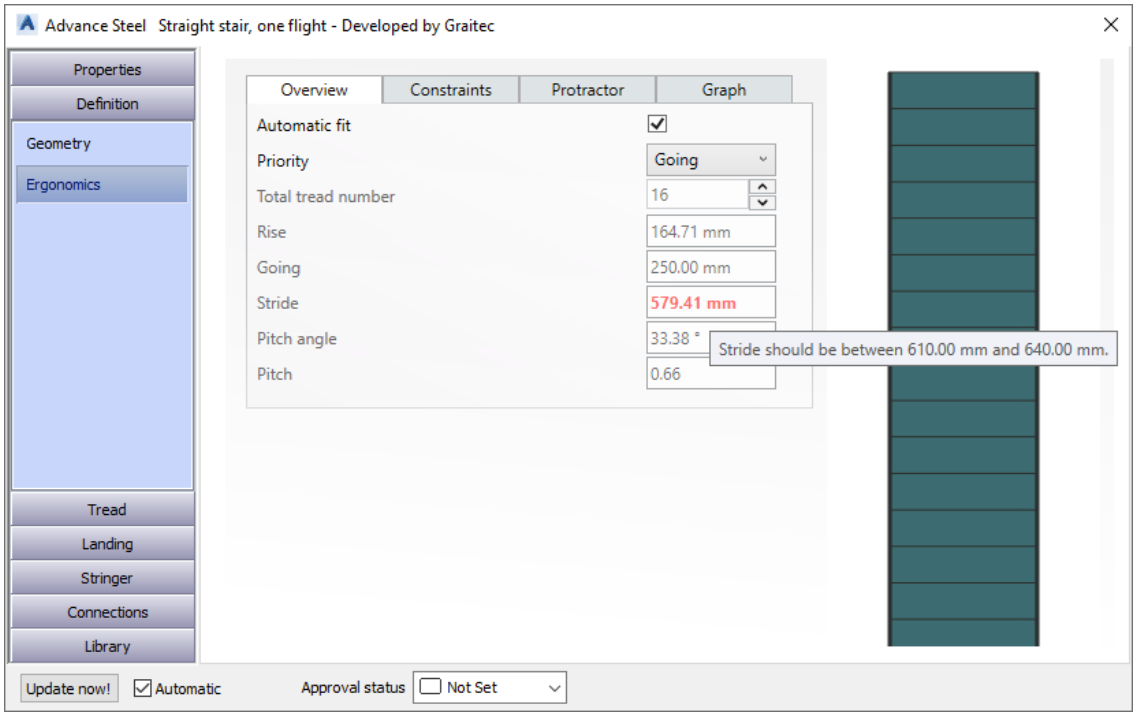
- Advanced calculation algorithm, contained in an *Ergonomics* tab, allowing automatic as well as manual adjustments, all within ranges contained in ***Constraints*** sub-tab.



Constraints sub-tab

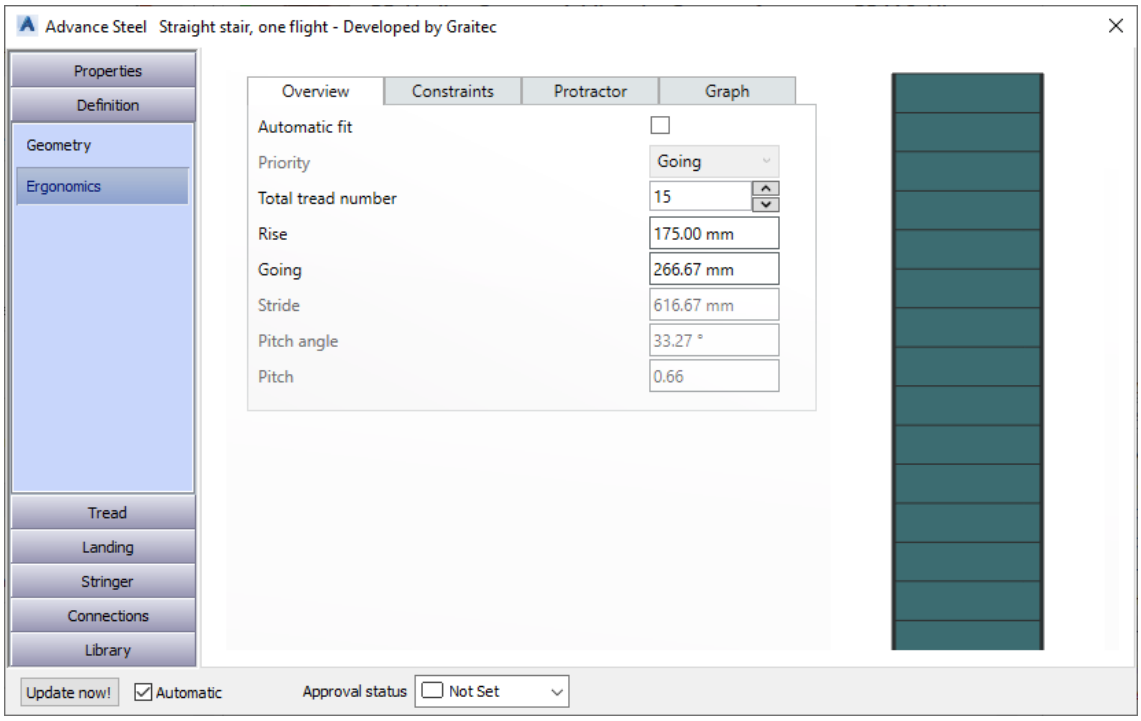
Stairways are an essential component in the circulation and egress systems of most buildings, industrial or residential. They are also the site of accidents; for this reason, the design is controlled by a set of regulations, gathered in the ***Constraints*** tab. These ranges are user-defined stairway requirements, to determine dimensional limits for the rise, going or stride, which are respected either for the "***Automatic fit"*** option or for manually adjusted values.

The "***Automatic fit"*** is a calculation method that finds the optimal set of parameters (rise, going, number of treads), in accordance with a preset priority (going, rise or stride). If a calculated value is outside the range of the acceptable results defined in the ***Constraints*** tab, a warning is displayed: the value is colored in red and the tooltip will inform you on the acceptable range.



Note*: The automatic calculation will give the optimum result in accordance with the set priority and constraints*

Once the automatic calculation is unchecked, you are allowed to juggle with the parameter values, while still assuring the overall stair geometry (total height, total lengths). Also, the modified parameter will adjust to the closest value which ensures, for example, a height that is a multiple of rises, or a length that is a multiple of goings.

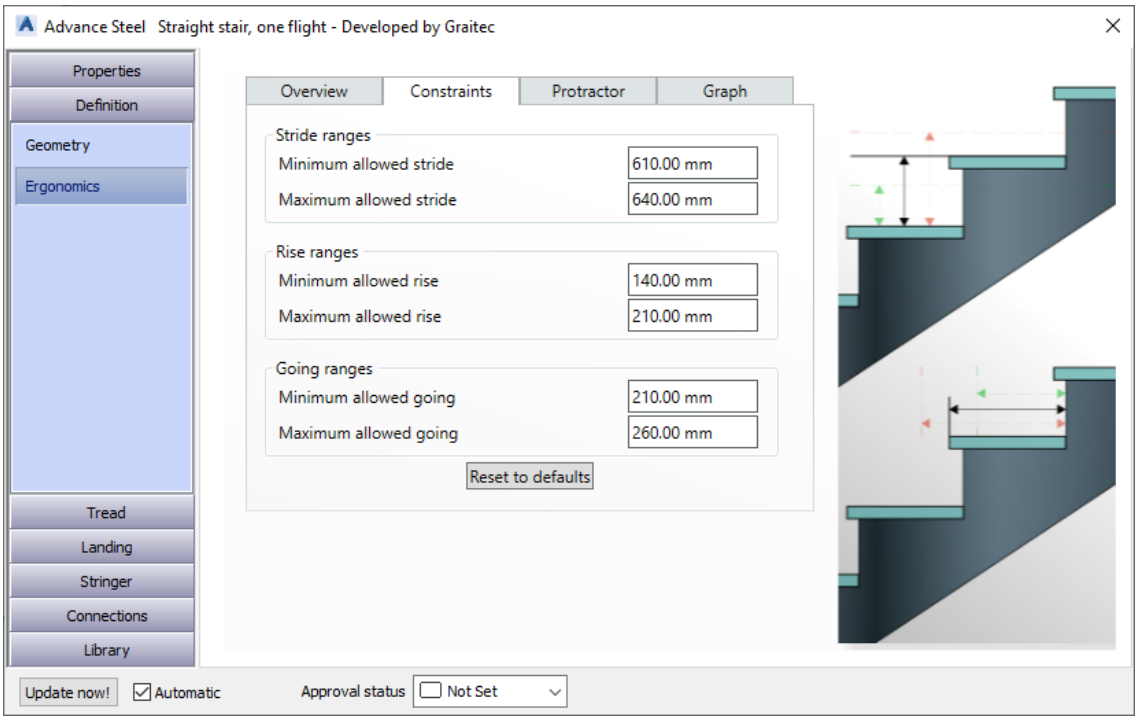


Note*: One the "**Automatic fit**" option is unchecked, the stair parameters are available for editing*

Results verification

The results verification mechanism is marking the values which are not within the specified ranges; the markings are in red and detailed tooltip.

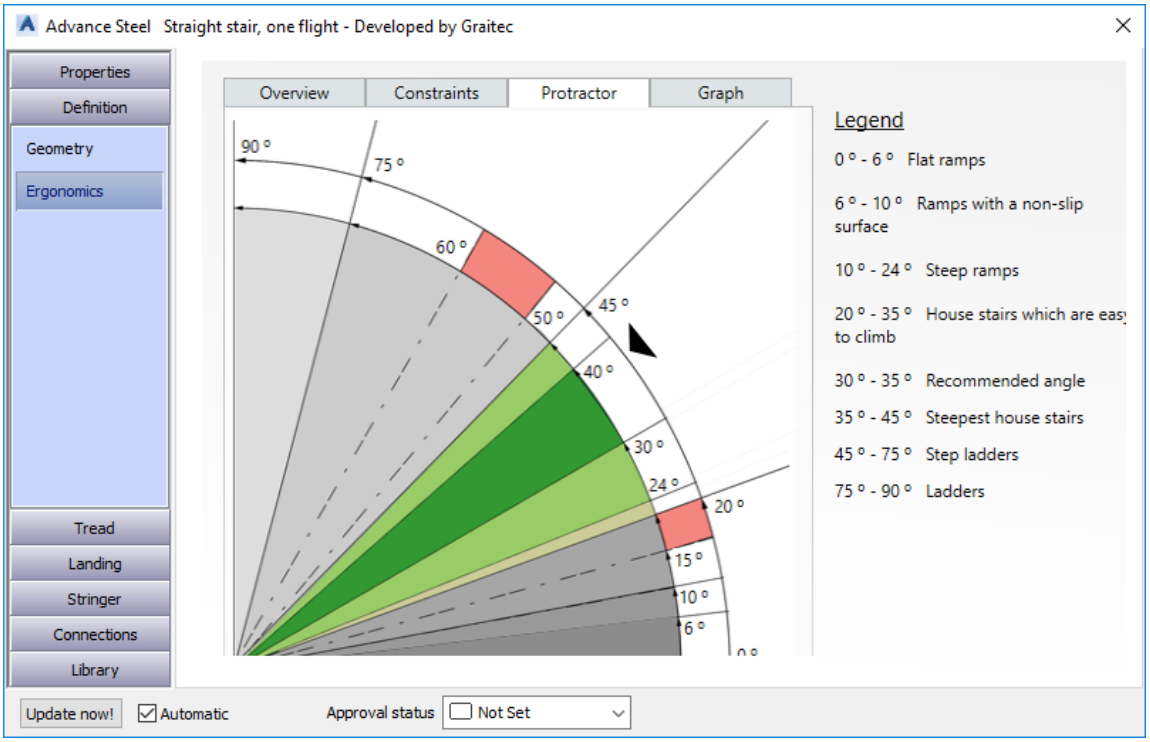
Minimum/ maximum allowed stride, rise or going have a default set of values, but they can also be user-defined, if other limitations are imposed to the current project. The new ranges will be taken into account, when notifying the user if the stair parameters fit in these limits.



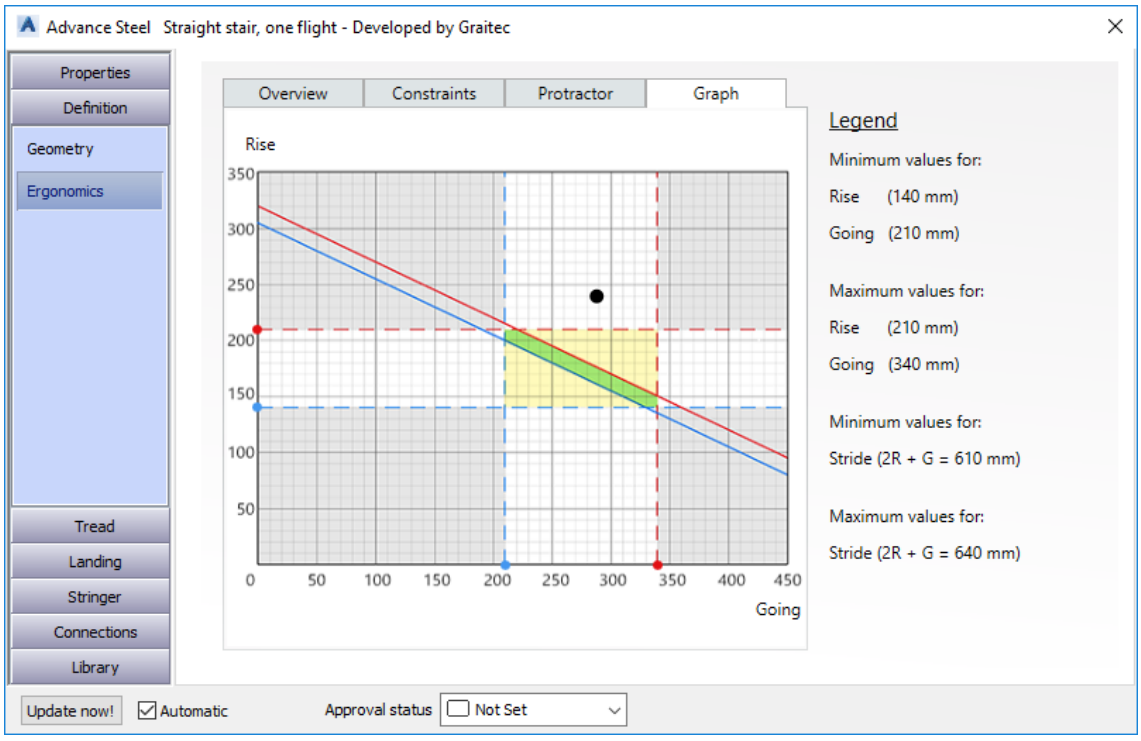
Graphical representation for the obtained results

The new Protractor and Graph tabs are offering a graphical representation for the obtained results, in order to provide a quick verification if a stair is comfortable or not.

The human body movement dictates the dimensions and relationships of stair risers and treads, which have been regulated to make vertical motion safe and easy. Steep stairs make climbing more tiring and dangerous, while shallow stairs with small angles are inefficient for human stride. Taking into account the minimum and maximum measurements of risers and treads, generally, stair codes and guidelines prefer an angle between 30-35^{o} range.



The diagram will indicate if the modeled stair is comfortable or not, by comparing with general guidelines regarding minimum or maximum values for rise, going or stride. For an optimum stair, the rise and going should converge to the area marked with green.

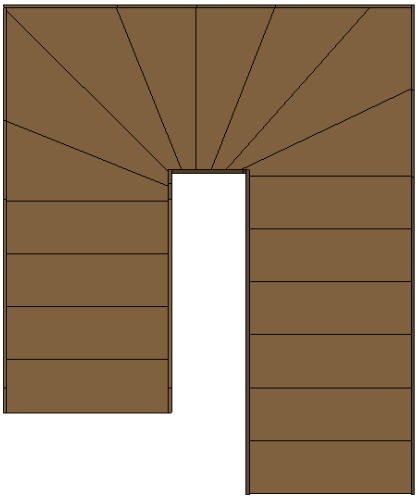


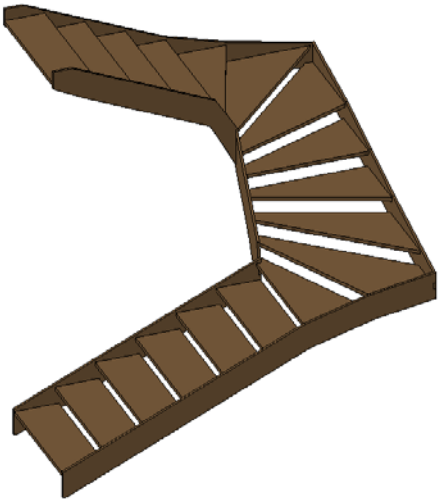
Improvements

Improved algorithm for balanced stairs with three flights

The algorithm for balanced stair with three flights has been improved (for U and Z-shaped stairs), allowing a continuous balancing area, from first to last flight (with no straight treads along the run line).

The steps are therefore, equally distributed along the tread line, in order to create a sequence of calculations between two successive flights or a continuous balancing.

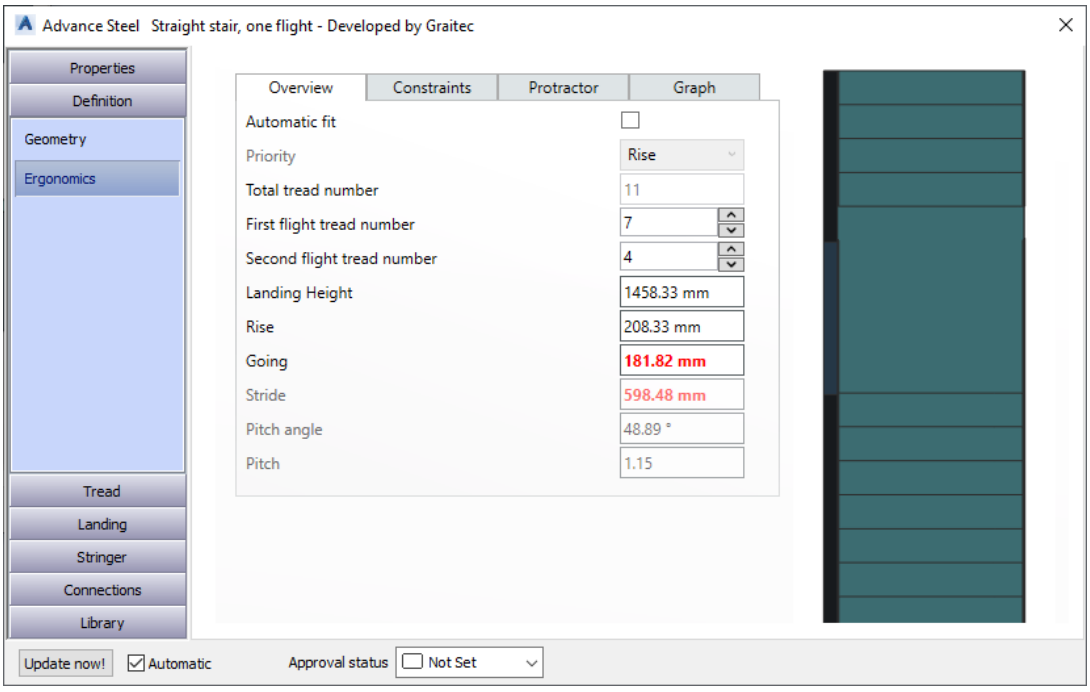




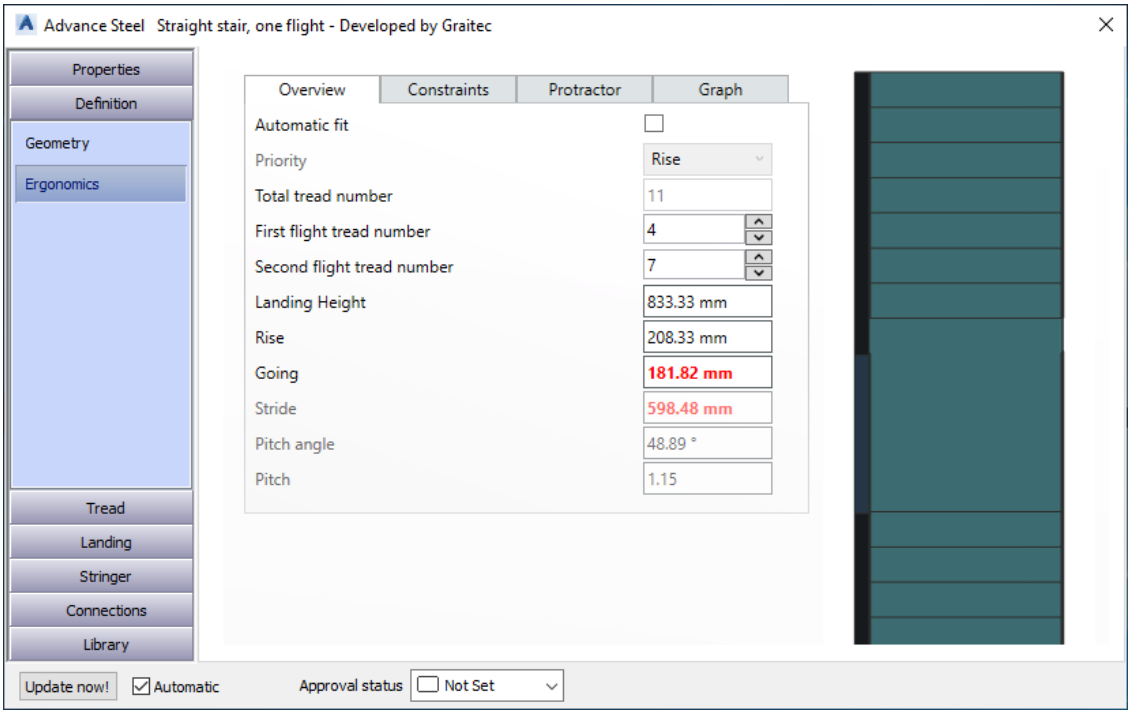
“Landing Height” - New parameter

“Landing Height” is offering the possibility to read and adjust the position of the intermediate landing in the stair assembly

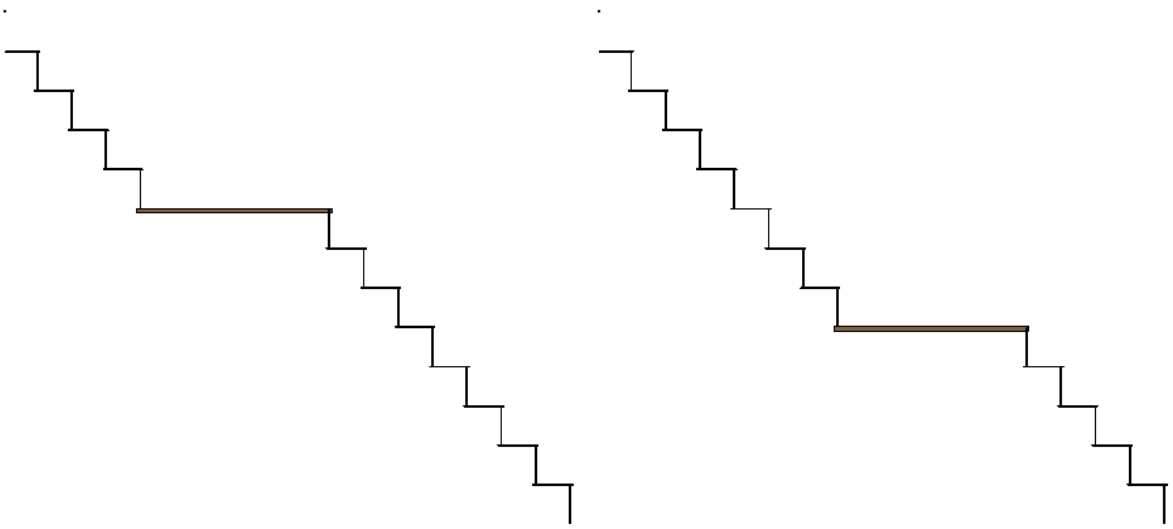
The parameter for landing height is available in *Ergonomics* tab and not only as a read-only information, but as an editable one. Of course, the final value will be approximated in accordance to the rise and going.



Note: *Landing Height before adjustments*



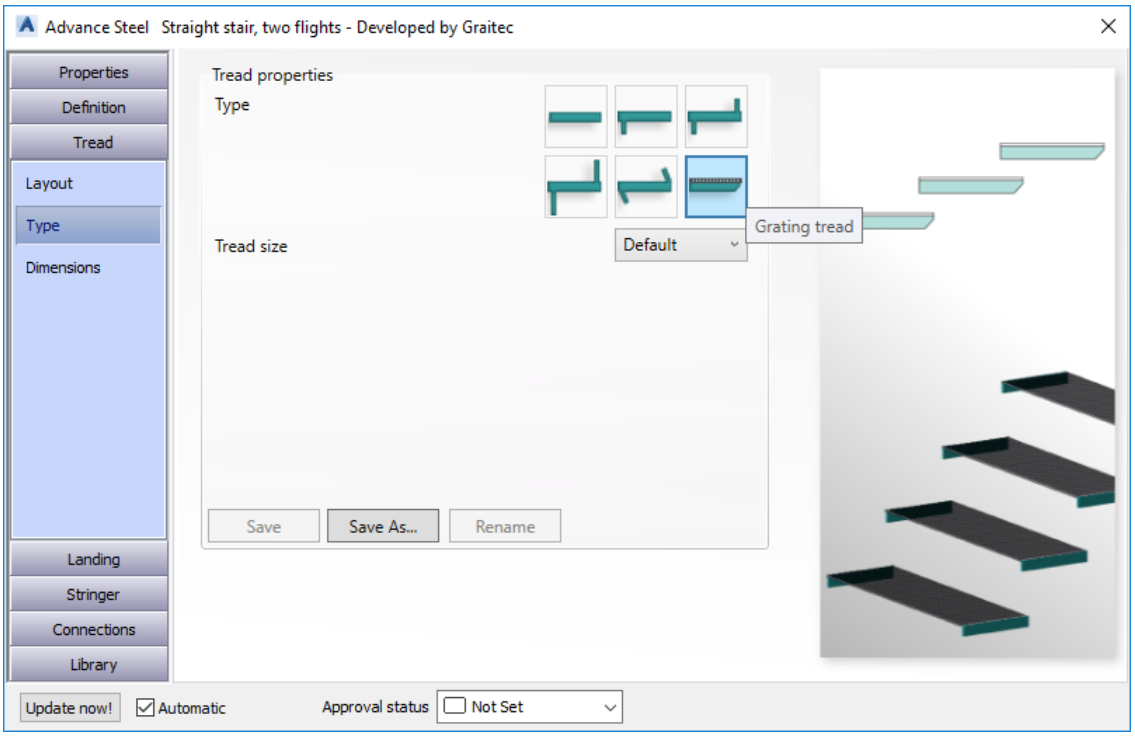
Note*: Landing Height after adjustments*



Note*: Position of the landing before and after adjusting the height value*

New type of treads (treads from variable gratings)

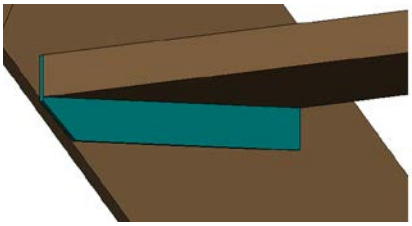
Gratings are now available as stair tread type. A various range of types can be chosen from the library.



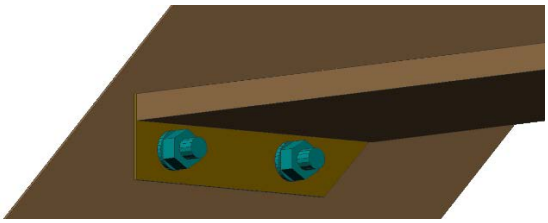
Specific connections for grating treads are also available: with plate support, either welded or bolted to the stringer.

Welded connection

Bolted connection



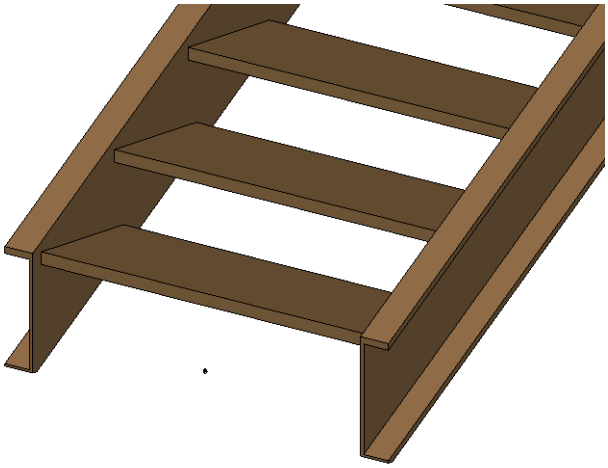
Detail – welded connection



Detail – bolted connection

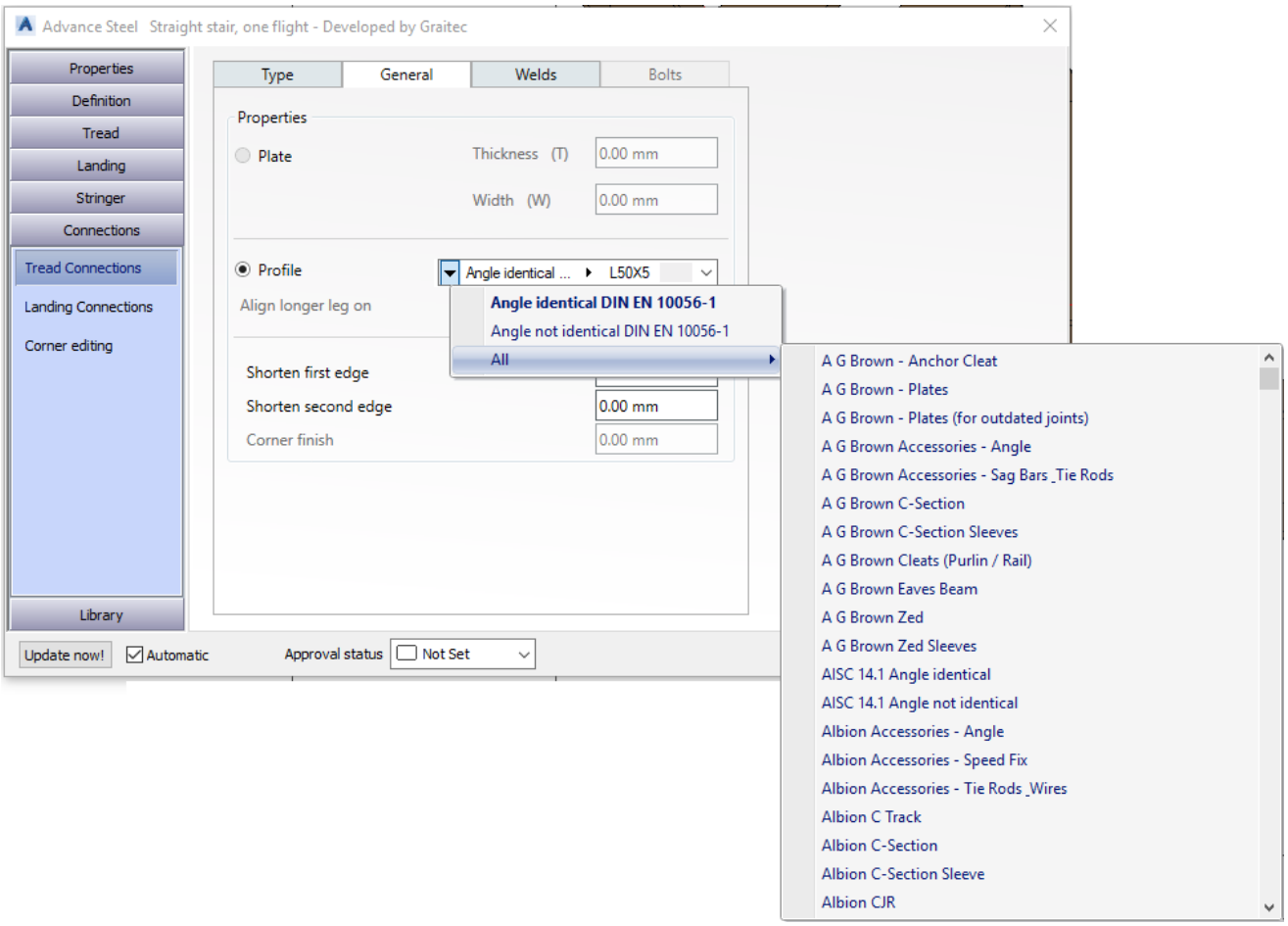
Profiles for stringers: channels, flats

New section profiles can now be chosen for the stringers. The libraries have been extended to channel and flat sections.



New options for step mounts: supports made from angle profiles

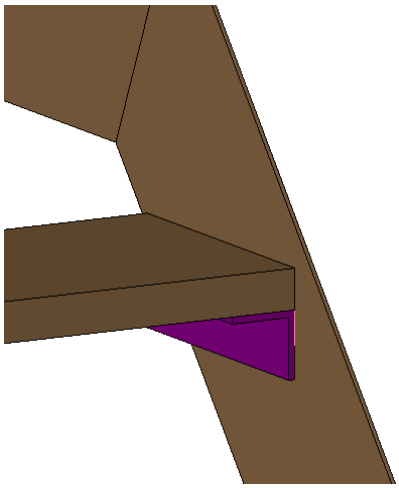
The tread support can now be modeled from an angle profile, not only from a plate.



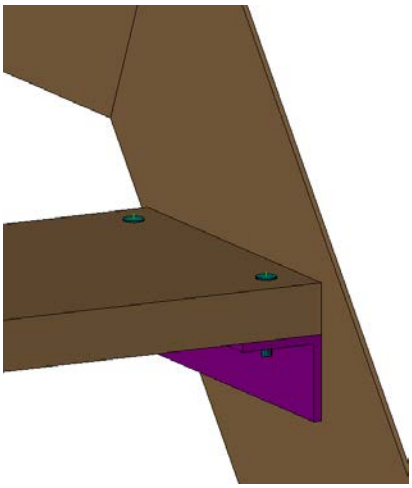
New connections for treads (connections for angle supports)

An angle profile is available as a type of support, for a standard or a folded tread, having specific connections with the tread or stringer:

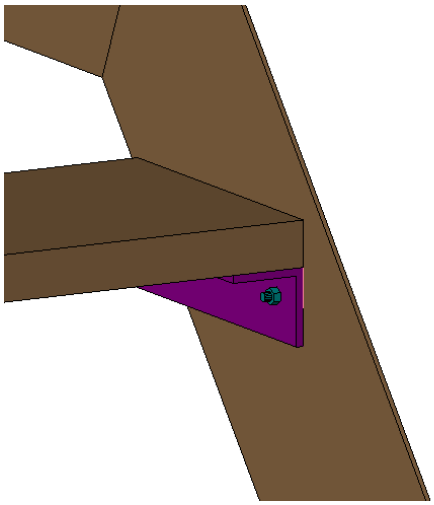
- The connection of the support with the tread can be welded or bolted;
- The connection of the support with the stringer can be welded or bolted.



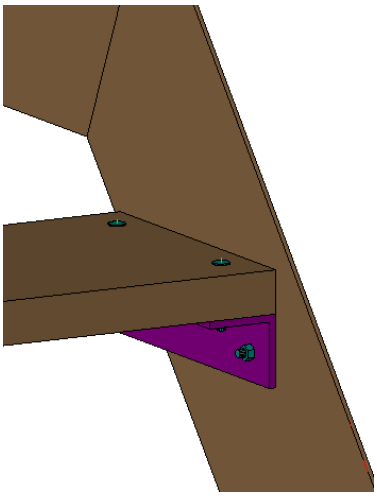
Welded-welded



Bolted-welded



Welded-bolted



Bolted-bolted

Railing

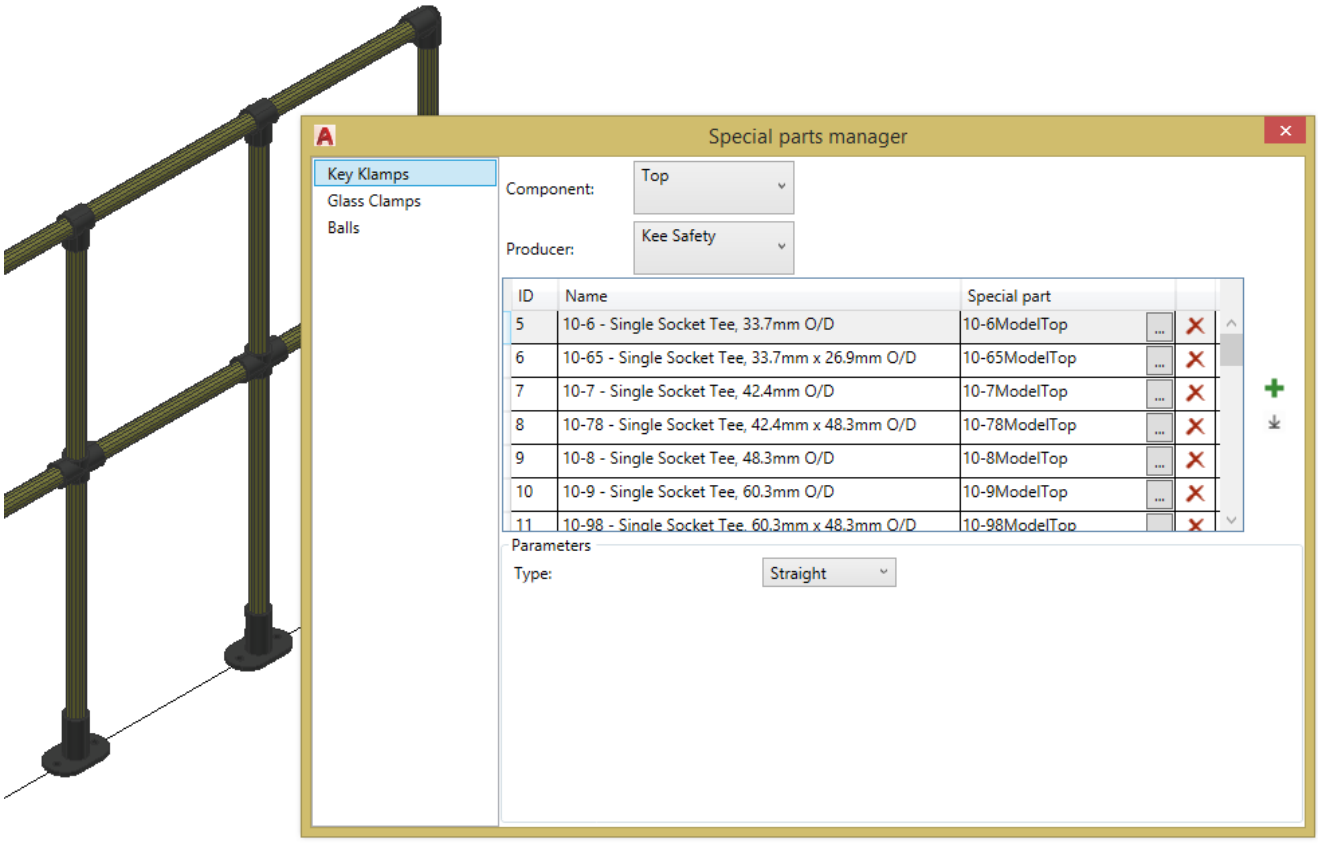
Novelties

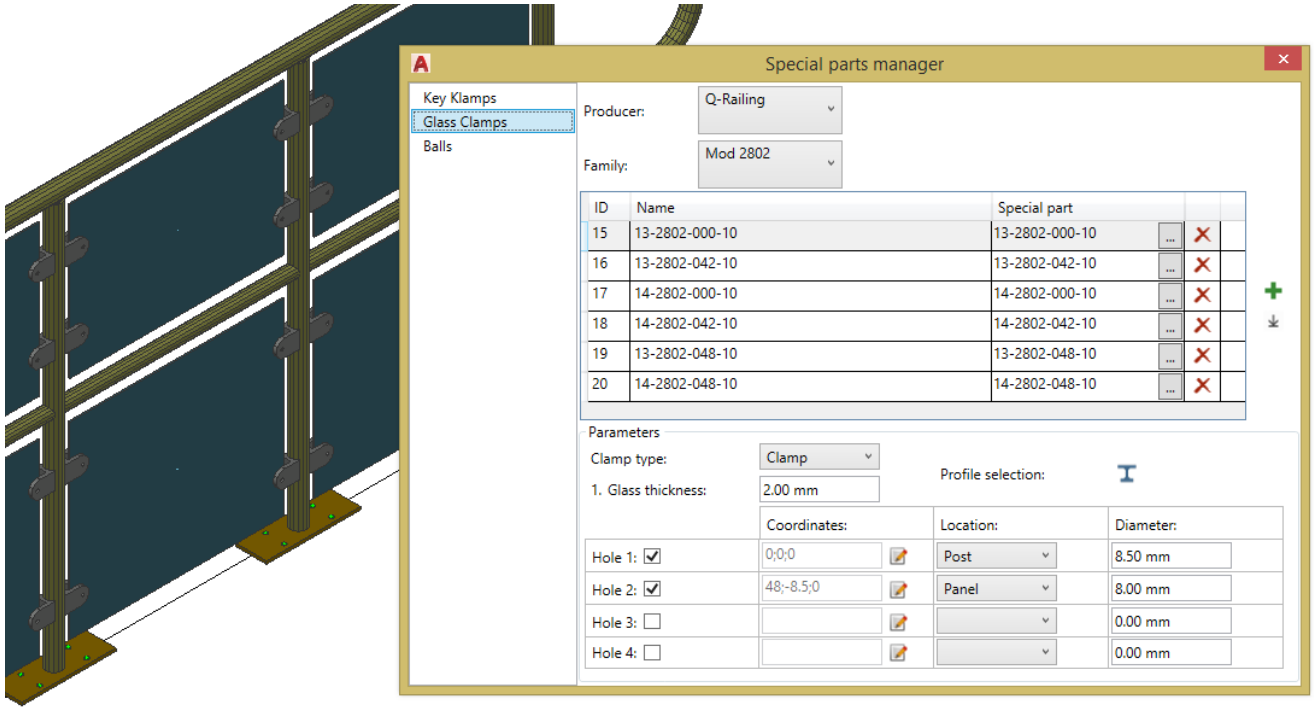
Special Part Manager

The manager gathers all the necessary settings for the users to add and customize a producer or non-standard special part in the database, specific for Railing connections. The type of special part (component) is linked to the joint – once added in the Special parts manager, the special parts will become available inside the joint, under the specific component.

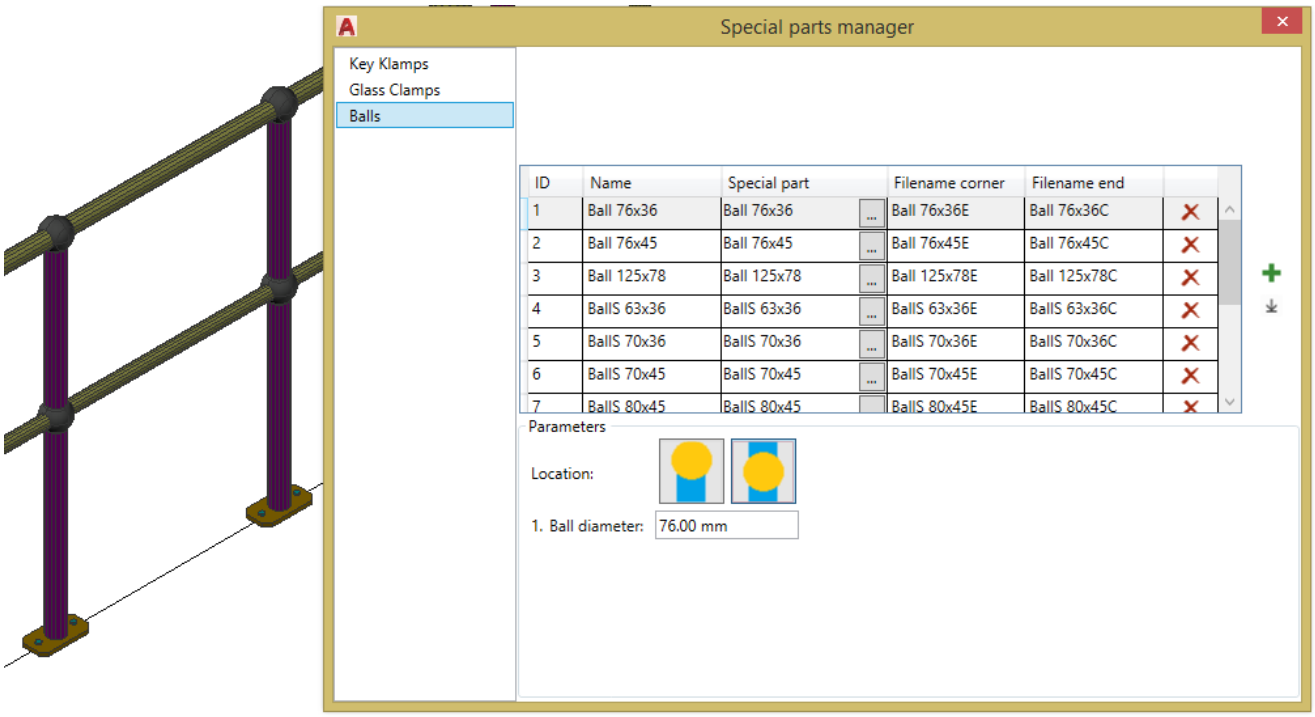
The following components can be customized:

- Glass clamps
- Key clamps
- Ball post

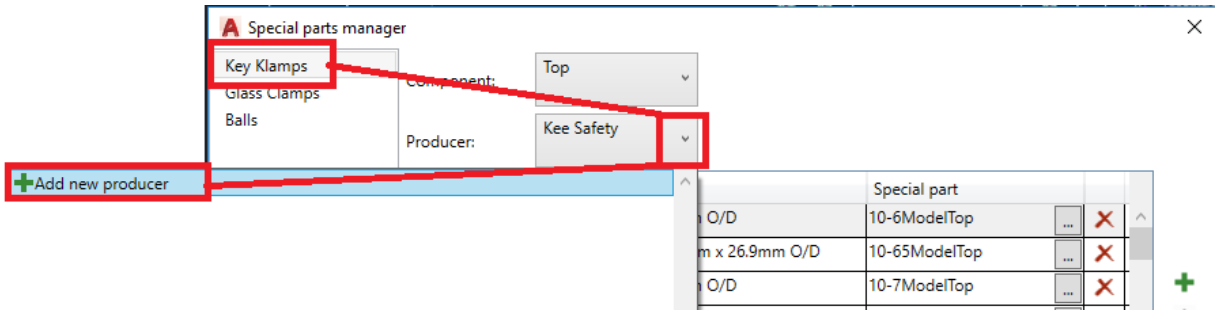




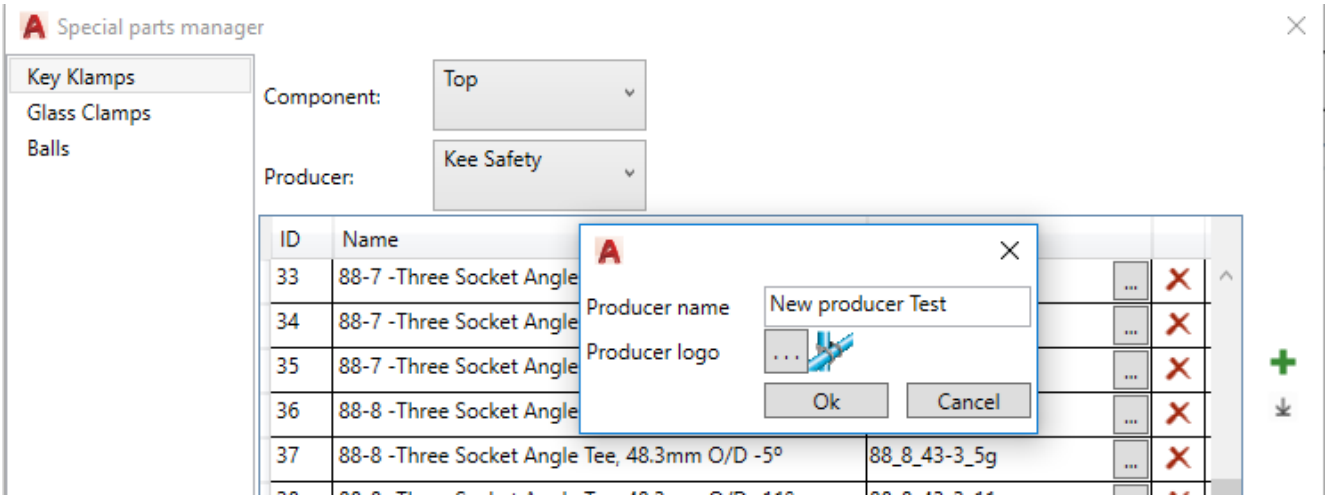
Glass clamps

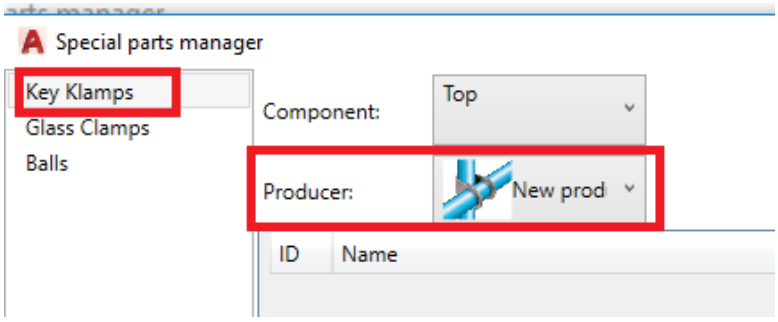


Ball Types and Sizes



New producer can be added


Special parts manager
Key Klamps
Glass Clamps
Balls
Component:
Top
Producer:
Kee Safety
ID
Name
33
88-7 -Three Socket Angle
34
88-7 -Three Socket Angle
35
88-7 -Three Socket Angle
36
88-8 -Three Socket Angle
37
88-8 -Three Socket Angle Tee, 48.3mm O/D -5°
88_8_43-3_5g
Producer name
New producer Test
Producer logo
Ok
Cancel


Special parts manager
Key Klamps
Glass Clamps
Balls
Component:
Top
Producer:
New prod
ID
Name