

# GADVANCE BIN 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<sup>®</sup> environments.

Advance BIM Designers 2020 also introduces a **new module for the creation of reinforcement in Concrete Slabs** in the **Autodesk Revit**<sup>®</sup> 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<sup>®</sup>.
- New options for reinforcement generation in Revit<sup>®</sup>, 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.



#### 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.







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

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

Localisation settings			x
Localisation			
Country	The United Kingdom 🔻		
Interface Language	English - UK 🔹		
Documents Language	English - UK 🔹		
Standards			
Combinations	EC0 •	The United Kingdom 🔹	]
Earthquake	EC8 •	General 🔹	]
Reinforced Concrete	EC2 •	The United Kingdom 🔻	
		France	
		ermany	el
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		📕 Romania	
		🗮 The United Kingdom	
		- Poland	
		General General	I





#### 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;





- N [kN] N [kN] N Scale = 1 Mx Scale = 20 My Scale = 1 9187,1 9187,1 N 2821,8 Mx 175,5 My 0 4702,6 Mx [kN·m] N 2821,8 Mx -175,4 N -710,3 🕽 🏹 🚖 Torsor = 🗍 a = 0 My [kN·m] -175 4y [kN·m] 175.5 Mx 82,5 Mx -2.6 My 2296,8 My 0 Mx [kN·m] Mx [kN · m] Mx /2.6 My -2296.8 🖸 🗐 🏹 👱 🖶 Torsors 🛛 ULS SLS Extremities 72 Level 1 🔻 Мv Work Rati Sn= 7479,6 kN Torsor Limit state Combinati N Mx My Angle
- 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.

	Strips methol	od		Imposed strip width	0 mm	
	Composed b	ending consideri	ng edge stiffeners			
orm	nal force / Averag	ge strip normal	force [kN/m]			
	54,8	14,7	81,6	134,5	81,4	
ase	normal stress [N	MPal		157,2		

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 2<sup>nd</sup> 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:

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



Ok Apply Cancel





#### Calculations

elect TAB for alt

Standard 14 4100

Apply

ates, CTRL adds, SHIFT uns

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

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6



Ok Cancel



- 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  $\rightarrow$  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.

	Date: 04-09-2019	Proje	ct:					Date:	04-09-2019	
Max spacing between vertical bars Real spacing between bars from web Real spacing between bars from stiffeners The minimal vertical reinforcement is 6 Max spacing between vertical bars	$\begin{split} s_{s,ma} &\leq \min(3 \cdot b_{s}; 40 \text{ cm}) = 400.0 \text{ mm} \\ s_{s} &= 187.1 \text{ mm} \\ s_{s} &= 200.0 \text{ mm} \\ \text{defined according to } 5.5.3.2.2 \text{ (12), } 5.5.3.4.5 \text{ (15) from EN 1998-1} \\ s_{ma} &\leq \min(s_{s,ma}; 200 \text{ mm}; 250_{sma}) = 200.0 \text{ mm} \end{split}$	Theoretical area (ml) Theoretical area (for en Real horizo entire wall)	horizontal rein horizontal rein tire wall) ntal reinforcem ntal reinforcem	aforcement aforcement nent area (/ml), nent area (for	$A_{sh} = 207.35 \text{ tr}$ $A_{sh} = 207.35 \text{ tr}$ $A_{sh,rel} = 281.4$ $A_{sh,rel} = 281.4$	mm <sup>2</sup> /m nm <sup>2</sup> /m × 5.00 19 mm <sup>2</sup> /m 9 mm <sup>2</sup> /m × 5.	00 m = 1036.73	mm² 13 mm²		
		Minimal	constructive d	dispositions						
6 Horizontal reinforcement For this verification the results were sar reinforcement area is the minimum one	nt ved for the combination giving the maximum horizontal joing giving the minimum value for VRdc (in case horizontal ).	The minimu Minimum I Maximum	al horizontal rei norizontal reinfo spacing betwee	inforcement is orcement area	defined accor $A_{shonin} = max \{$ $A_{shonin} = max \{$ $A_{shonin} = 207.3$ $s_{source} < 400 mi$	ding to 9.6.3 (0.25 · A <sub>xx</sub> 0.001 · A <sub>c</sub> 0.25 × 3317.5 0.001 × 2000 5 mm <sup>2</sup> /m m	from EN 199 52 mm² / 4000 00.00 mm²	02-1-1. 0 mm <sub>= ma</sub>	x{207.35 mm 200.00 mm	4/m 4/m
	Harizantal rainforcament	bars		1	s <sub>b</sub> = 378.5 mm	1				
Wall         Comb         V <sub>Ed</sub> V <sub>Ed</sub> 1.1         128         5.68         185.	Korresonant         Academic Academic         WR           V)         (mm2/m)         WR           69         0.00         207.35         207.35         281.49         73.66 %	7 Sh 7.1 Di	iear verificat agonal tensio	tions on failure						
	Real horizontal rainforcament	Diagonal te	nsion failure ve	erification is do	one according	EN 1998-1.	5.5.3.4.3.			
Wall Package	Reinforcement	The results	are not availabl	le.						
		7.2 Di	agonal compi	ression failur	re					
	28 × o8 (1407.43 mm <sup>2</sup> )	Diagonal co	ompression fail	ure verification	n is done acco	rding EN 19	98-1, 5.5.3.4.	2.		
0.1 Detailed calculation		Ine results	are not availab	ue.						
EN1992-1-1	g of the shear feinforcement is done according article 0.2 of the	7.3 SB	ding shear ta	ulure						
6.1.1 W 1.1		The results	are not availabl	ication is done i ile.	according EIN	1998-1, 5.5.	3.4.4.			
Combination	128 : 1x[1 G]	7.4 Sh	ear at the int	terface betwe	en concrete	cast at dif	ferent times			
Venncanon	V <sub>14</sub> < V <sub>842</sub> ; 5.08 kN < 185.09 kN Passed The element does not require design shear reinforcement	For this ver VEdi/VRd.	ification the res i.	sults were save	ed for the com	bination givi	ing the maxin	um work r	atio	
Design shear force	V <sub>Ed</sub> = 5.68 kN		Shear	r at the interf	ace between (	concrete cas	t at different	times		
Strut angle Inner lever arm	$\theta = 45.00^{\circ}$ z = 0.9L = 0.9×4000.0 mm = 3600.0 mm	Wall	Comb.	Vertical	VEd	VRdlim	VRd	WR	Status	
(6.2.2 (1))	$C_{rec} = \frac{0.18}{0.18} = \frac{0.18}{0.12} = 0.12$			reinf.	(I-N)	(I-N)	(1-N)	1		
Paster taking account the effective	γ <sub>c</sub> 1.50	1.1	131	2412.74	8.65	2880.00	877.04	0.99 %	Passed	
height	$k = 1 + \sqrt{\frac{200 \text{ mm}}{d}} = 1 + \sqrt{\frac{200 \text{ mm}}{3600.00 \text{ mm}}} \le 2 \rightarrow k = 1.24$	1.1	245	1507.96	8.81	3323.08	771.10	1.14 %	Passed	-
Longitudinal reinforcement ratio (6.2.2(1))	$\rho_{\rm L} = \frac{A_{\rm d}}{b_{\rm s} \cdot d} = \frac{452.39 \ {\rm mm^2}}{200.0 \ {\rm mm} * 3600.0 \ {\rm mm}} \leq 0.02 \rightarrow \rho_{\rm L} = 0.63 \ \% {\rm o}$	Shear at the 6.2.5.	interface betw	een concrete c	ast at differen	t times verif	ication is don	according	EN 1992-1,	
Minimal resistant shear force (6.3N)	$\nu_{\min} = 0.035 \cdot k^{3/2} \cdot fck^{3/2}$	7.4.1 SH	ear at the inter 11	flace between	concrete cas	t at differen	t umes EC2			
Decign value for the chear registered	$v_{min} = 0.035 \times 1.24^{1/2} \times 25.00^{1/2} = 0.24 \text{ MPa}$	Combinati	on	1	131: 1.35x[1 (	G]+1.5x[2 Q	1			
(6.2.a) & (6.2.b)	$V_{nde} = Max \begin{cases} I C_{Ede} \cdot \mathbf{k} \cdot (100\rho_L \cdot \mathbf{l}_{eb})^{-1} + \mathbf{k}_1 \cdot \sigma_{ep} J \cdot \mathbf{b}_w \cdot \mathbf{d} \\ (\nu_{min} + \mathbf{k}_1 \cdot \sigma_{ep}) \cdot \mathbf{b}_w \cdot \mathbf{d} \end{cases}$	Shear force			$V_{14i} = 8.65 \text{ kN}$	•				
	[0.12×1.24(100×0.63 %e×25.00) <sup>10</sup> + +0.15×0.00 MPa]×200.0 mm×3600.0 mm	(EN 1992-1	snear resistance I. (6.5))	2	$v_{Rd,lies} = 0.5 \cdot b$ $V_{Rd,lies} = 0.5 \times$ $V_{Rd,lies} = 2880$ .	o <sub>s</sub> - d · v · t <sub>ct</sub> 200.0 mm ×: .00 kN	3200.0 mm × 9	).54×16.67	MPa	
	(0.24 MPa + 0.15×0.00 MPa)× ×200.0 mm×3600.0 mm	Strength re- cracked in	duction factor f shear	for concrete	$v = 0.6 \cdot \left[1 - \frac{f}{2!}\right]$	$\left[\frac{x}{50}\right] = 0.54$				
	$V_{nkc} = Max \begin{vmatrix} 1.50, i.2 & kN \\ 185.69 & kN \end{vmatrix} = 185.69 & kN$	Effective de Maximum	epth of section shear resistance	e verification	$d = 0.8 \cdot l_w = 0$ $V_{Ed} \le V_{Rd,lin}$ :	.8 × 4000.0 m 8.65 kN ≤ 2	um = 3200.0 m 880.00 kN	m		
RC Wall Designer 2020	Page 17 of 22	RC Wall D	esigner 2020						Page 18 of	22

 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.

← Wall 1 ・										
Normal stress / Average st	trip normal stress [MPa]									
				0,01						
0,01	0,01	0,01	0,01	0,01						
Normal force / Average strip normal force [kN/m]										
				1,46						
1,68	1,62	1,57	1,53	1,49						
Base normal stress [MPa]										
0.01				0,01						
[102: 1.35x[1 G]	mal stress [MPa] 🔹 🖲 Bottom 🔘 Midd	le ◎ Top ◎ Imposed h= 0,00 m	Normal stress / Average strip norm	nal stress [MPa] • Abscissa 0,00 m						







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.

	erties								
Available	Name	Longitudinal Section	Transversal Section	Longitudinal Spacing (A)	Transversal Spacing (B)	Longitudinal Diameter (Ф 1)	Transversal diameter (Φ ₂ )	Longitudinal Number of Wires (N 1)	Trai Wir
-	A252	251 mm²/m	251 mm²/m	200 mm	200 mm	8 mm	8 mm	12	24
1	A193	192 mm²/m	192 mm²/m	200 mm	200 mm	7 mm	7 mm	12	24
1	A142	141 mm²/m	141 mm²/m	200 mm	200 mm	6 mm	6 mm	12	24
1	A393	393 mm²/m	393 mm²/m	200 mm	200 mm	10 mm	10 mm	12	24
1	B1131	1131 mm²/m	251 mm²/m	100 mm	200 mm	12 mm	12 mm	24	24
1	B785	785 mm²/m	251 mm²/m	100 mm	200 mm	10 mm	10 mm	24	24
1	B503	503 mm²/m	251 mm²/m	100 mm	200 mm	8 mm	8 mm	24	24
1	B385	385 mm²/m	192 mm²/m	100 mm	200 mm	7 mm	7 mm	24	24 ,
		•	"	I					•
					NI				
			F	Øij	•Ø₂		-1		
			F	Ø <sub>L</sub>	₩2 <b>4</b> Ø2				
			F H	Ø <sub>11</sub> ;	+Ø2		N1		
				Ø <sub>1,1</sub> 00	+Ø2		N1		
				 Ø1_□	₩2 +Ø2 ···		N1		
					+Ø2		N1		

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<sup>®</sup>. 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<sup>®</sup> structural results package.

Results Package to Use								
	Name	Provider	Туре	Creation Time	Status			
•	GRAITECAdvanceDesignResults	GRAITEC Advance Design	Static	11/8/2018 11:26 AM +01:00	🕑 Up-to-Dat			
1	GRAITECAdvanceDesignResults	GRAITEC Advance Design	RequiredReinforcement	11/8/2018 11:26 AM +01:00	🕑 Up-to-Dat			
Val	I Groups and Resultant Forces	ottom Resultant Forces 💌						

**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<sup>®</sup> Analysis Display Styles.

Gr Diagrams Settings	×
Diagram	
Diagram type Theoretical Reinforce	ement on Y
Iso Regions Presentation	
Gradient	Show values
Ranges	Show legend
Command	
Show settings on command	
	OK Cancel

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<sup>®</sup> viewport and the dedicated configuration dialog:







🚱 Mesh Display Settings				23
Legend		Slices		
Legend Width	9	Slice density		4
Legend Height	18	Maximum elevatio	n	10
Force reinforcement mesh legends to start from	n 0	Number of slices		18
Labels		Mesh		
Size	12,41	Mesh nodes colour	r	
Nodes label colour		Mesh wire colour		
Cells label colour		Show nodes	Show mesh	
Zone Generation		Node size		6
Spacing step	100,0 mm	<b>A</b> 15 15 1		
Preview fabric marks while defining zones		Mntialiasing	Shadow and Lighting	
Grid Generation		Show labels on	ly for positive values	
Spacing on X	1000 mm	Use white for ce	ells with zero or negative values	
Service on V			2	
spacing on t	1000 mm			
Single Grid				
Show Labels				
Reference Point	Center of Gravity 🔻			
ISO Lines				
Add extra ISO lines for regions outside legend	bounds			
			Or	Cancel
			UK	

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, it is enough to press one button: Generate Reinforcement (available on the GRAITEC Slab ribbon) in order to get full 2D reinforcement cage for a slab.

🕼 Slab - Reinforcement Sc	olution			×				
Reinforcement Solutions	Bar Parameters	Meshes parameters						
Multilayer method								
Same configuration	n for top and bot	tom reinforcement						
Top reinforcement								
O Bottom reinforcement								
Reinforcement Pa	attern		Bars	•				
Maximum no of e	density layers		1	•				
Layer Number		Minimum Coverage	Туре					
1		100.00 %	Bars					
				Ok Cancel				





#### 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<sup>©</sup> 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<sup>®</sup> 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<sup>®</sup> 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<sup>®</sup> 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.

💪 Slab - Re	nforcement Zones	3
Filter		
Solution:	Bottom   Layer: Layer	
Bar zor	25	_
Del Laye	Name Direction Diameter X Diameter Y Spacing X Spacing Y Overlap X Overlap Y Real reinf X Real reinf Y Offset X Offset Y	
<b>X</b> 1	Zone 1 Two Ways 🔻 🔊 🔊 200 mm 200 mm 100 mm 100 mm 3,93 cm²/m 2,51 cm²/m 0 mm 0 mm	
Mesh 2	ones	
Del Laye	Name Mesh Type Lap Splice Position Diameter X Diameter Y Spacing X Spacing Y Overlap X Overlap Y Real reinf X Real reinf Y Offset X Offset X	7
<b>X</b> 1	Zone 1 W5/4 • Aligned • 6 mm 6 mm 102 mm 102 mm 100 mm 100 mm 3.17 cm²/m 3.17 cm²/m 0 mm 0 mm	
	SIGNERS Ok Cancel	





### *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<sup>®</sup>.

#### 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.

Gr	Model	Results	Settings	
Beam type •	H -	am span 1		
Beam typ	be		-	Spans M
Stand Bea	dard am	Corbel	Ţ	

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.

Gr Main									
Beam span 1 V									
Left support	Span	Span		Right support					
Name	Name	2	T 1.1	Name					
Width (b1):	300 mm Lengt	:h (ln):	500 mm	Width (b 2 ):	0 mm				
			•	Cantilever					
				Height	Variable 🔹				
			•	Length (a')	100 mm				
			n _	Thickness (e)	20 mm				
		Width (b Height Free end height (f	(h): 500 mm (b): 400 mm	Columa	∔ a a				
				Ok Apply	Close				





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.



#### 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):

15		72		तीः	No pr	ecas	t •				
M	nin	Section	Openings			Ũ	Prec	ast Bear	m	Q Ka	Ø. Reinforced
IVIC	am	Section	openings •			ф	Asyı	mmetric	Precast	sumptions	Concrete
		Sp	an Geomet			d	Reb	ate		Desi	gn Assumpti
						% Ø	Can	tilever			
						-	Prec	ast Slab	)S		
				_						-	

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:

		Heam span 1	-		
✔ Left		Links shape	Closed links 🔹	<b>I</b> Right	
lange width (l 1 ):	50 mm	Width (b w ):	200 mm	Flange width	(I 2 ): 67 mm
Flange (t i ): hickness	100 mm	Height (h):	500 mm	Flange thickness	(t r ): 125 mm
Slab depth (h i ):	100 mm	b <sub>ert1</sub> →	b <sub>ett2</sub>	Slab depth	(h r ): 125 mm
Compression (b eff,1 ): lange width	50 mm	•	• ////h,	Compression (b flange width	eff,2 ): 67 mm
Diameters	ø8 🔹		•	Diameters	ø8 •
pacing	70 mm	N///////	t,	Spacing	70 mm
	Custom 👻				Custom
		  ₊,  ₊b	→l←→l		
				Ok Ar	oply Close 🕯

Rebate:

Gr Rebate		×
Beam span 1	• →	Apply cantilever on sides:
Width	(B): 250 mm	☑ Left
Top cover	(T): 20 mm	✓ Right
Lateral cover	(L): 20 mm	
Rebate width	(a): 70 mm	H CON H
Depth	(H): 100 mm	
Offset	(O): 0 mm	
Longitudinal reinforcement	(ø)1: Ø8 🔹	
Transverse reinforcement	(ø)2: Ø8 ▼	
Considered in calcul		le∎
		Ok Apply Close 🖗





• Cantilever:

Gr Cantilever		
Beam span 1	• →	Apply cantilever on sides:
Width	(B): 250 mm	☑ Left
Top cover	(T): 20 mm	🗹 Right
Lateral cover	(L): 20 mm	
Support width	(a): 50 mm	
Depth	(H): 200 mm	
Offset	(O): 0 mm	
Longitudinal reinforcement	(ø)1: Ø8 🔹	
Transverse reinforcement	(ø)2: Ø8 🔹	
		Ok Apply Close 🖗

• Precast Slabs:

Gr Precast Slabs									X
		-	<del> Beam span</del>	1					
🔽 Left		-	1 66	- (2)(2)		-			Right
Slab thickness	(t 1 ): 50 mm				****	Slab thickness	(t 2 ):	50 mm	
Support width	(l 1 ): 40 mm		<u>**/////</u>		// <u>//</u> //	Support width	(  2 ):	40 mm	
Trapezoi	dal links	•	L,		L <sub>2</sub>	Trapezoi	dal links		•
Distance	(L 1 ): 10 mm					Distance	(L 2 ):	10 mm	
			000	8 0)	8				
GIN DESIGN	ERS					Ok	Apply	Clo	se 👔

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**



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:

ĺ	Gr Opened Links
Main Section Openings Span Geometry rs	Beam span 1   Opened Links   Extend links   Provide pins   Extend pins or stirrups   Anchorage   180° hook
	CADVANCE Ok Apply Close W

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.

	🕞 Bar Splitting
	Splitting Check the maximum stock length of bars
	Maximum stock length 12000 mm
	Split bars that are longer than maximum stock length
	Split method Bars lapping 🔻
Beam Bar Bar Cace I	⊂ Lap length ○ Automatic
Reinforcement Assumptions r	© Diameter dependent: 50 x ø
	Same for all diameters: 300 mm
	Tension bars spliced in one section
	Transversal reinforcement in the lap zone
	Ok Apply Close 🕅





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:

Туре	Span	Details	Value	Limit
8	T 1.1	The imposed maximum bar length has been exceeded.	14965 mm	12000 mm
Calcul	ation results	rrors and warnings		

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.

Split method	Welding -
Welding	
Lap length for welded splice	100 mm



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

Split method	Mechanical couplers 🔻
Mechanical couplers	
Gap for mechanical couplers	10 mm



**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.

Split method	Bars lappir	ng 🔻
Lap length		
Diameter dependent:	50	хø
Same for all diameters:	300 mm	]
Tension bars spliced in on	e section	
Transversal reinforcement	in the lap zone	



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:

	Bars on multiple spans
	Top bars extended across the entire beam
	Bottom bars extended across the entire beam
and for Anti-arack have	
and for Anti-crack bars:	
and for Anti-crack bars:	Longitudinal 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.

Transversal Longitudinal Anchorage Anti-crack Assembly				
Continuity Supports	Diameters			
Splice bars	Minimum diameter ø8	•		
	Maximum diameter	•		
	Lap length <ul> <li>Auto definition</li> <li>Diameter dependent:</li> <li>Same for all diameters:</li> </ul>	50 300 mm	хø	

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

	1	Deflection verificatio	n	
Span	L/d	Limit	Work Ratio	Status
1	15.90	77.73	20.46 %	Passed
The limit for L/d is ca	alulated according EN	1992-1-1, 7,4,2, (7,1)	6.a or 7.16.b).	

		I	ntermediate va	lues		
Span	d	ρ	ρ'	ρ	K	Correction
	(mm)	(‰)	(‰)	(‰)		
1	459	1.3	0	5	1.3	2.12
2	459	1.3	0	5	1.3	2.12

2020

			Deflection	verification			
Span	A <sub>req,tension</sub>	Areq.comp	A <sub>prov,tension</sub>	A <sub>prov,comp</sub>	Limit	L/d	WR
	(mm²)	(mm²)	(mm²)	(mm <sup>2</sup> )			
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.

		Crack	width v	verificat	ion				
Span - Section	Abscissa	Section	W <sub>k,top</sub>	W <sub>k,bot</sub>	S <sub>r,max</sub>	$\epsilon_{sm}-\epsilon_c$	W <sub>k,max</sub>	Wlim	WR
	(mm)	position	(mm)	(mm)	(mm)	(‰)	(mm)	(mm)	
1 - Right support	7000	Тор	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	Тор	0.042	0.013	299	0.14	0.042	0.400	10.54 %

2020

2019

		Crack	width v	verificat	ion				
Span - Section	Abscissa	Section	$W_{k,top}$	W <sub>k,bot</sub>	S <sub>r,max</sub>	$\epsilon_{sm}-\epsilon_c$	$\mathbf{w}_{k,\text{max}}$	$\mathbf{w}_{\mathrm{lim}}$	WR
	(mm)	Position	(mm)	(mm)	(mm)	(‰)	(mm)	(mm)	
1 - wk Max	7000	Тор	0.16	0	272	0.6	0.16	0.4	39 %
2 - wk Max	0	Тор	0.16	0	272	0.6	0.16	0.4	39 %





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

Main fea	atures & 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).

Wall	b,		l <sub>n</sub>	b2	🔲 Wall
	h ⊨ b <sub>w</sub>	Width Height	(b w ): (h):	200 mm 500 mm	
Coating Type Relative waterproof coating	ces Upper and	lower faces	•		Column Width (b c ): 0 mm

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.

Waterproof coating	
Diameter	ø16 🔻 🗸 Auto

### 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.





Transversal		A-A
Anchorage		i
Anti-crack		
Assembly	Desire estimat	
Continuity	Design settings	
Supports	Minimum effective height (d)	450 mm
Splice bars		-30 1111
	Maximum spacing	150 mm
	Minimum spacing	50 mm
	Apply Annex J according to EN 1992-1-1	
	Longitudinal bars	
	Bars defined continuously across the entire beam	
	Extend over intermediate supports Lap length	5 ø
	Whole support	
	Extend over edge supports	

• 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.





Transversal		
Longitudinal		
Anchorage		
Anti-crack		
Assembly		
Continuity	Design settings	Anchorage and lap lengths calculations
Supports	Default method of anchorage 135° hook 🔻	Welded transverse bars
Splice bars	Fully anchored reinforcement	Confinement by transverse pressure
	Impose hook length	Additional permanent load(G) 0 kN
	Minimum hook length 5 ø	'Good' quality of the bond condition
	90° hook length for seismic dispositions	Magnification of anchorage lengths for coismic
	Anchorage at support face	<ul> <li>wagnification of ancrorage lengths for seismic</li> </ul>

# New tab on the Ribbon

Main fea	tures & 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.

Gr	Model Res	ults Sett	ings
Project settings • General	<b>S</b> Localisation	Units Imp Set	Image: Chee       Image: Chee

# New quick commands on the Drawing view



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.

•	Assumptions •
	Calculate
	Calculated Reinforcement
1	Model
$\geq$	Drawing
Ì٢.	Views +
ΠΠ	Units
	Generate Report
<b>-</b>	Print drawing
_	(Ctrl+P)





# 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:

Gr Drawing Settings		×										
Drawing Styles Bending details Printer Settings	Views arrangement											
Drawing Style Views												
	Elevation											
Drawing Styles (cm)	Scale	Auto Scale 🔻										
Drawing Styles (mm)	Section 1											
	Scale	Auto Scale 🔻										
A3 420x297_M1	Symbol B											

# 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.

Combinations	Project site	uation						
Design	ULS:	E	QU	S	TR	G	EO	
	SLS:	Chara	cteristic	Free	quent	Quasi-p	ermanent	
_	Combinat	ion Table						
Г	Number	of combir	nations	10				
_	ID	Case	Coefficient	Case	Coefficient	Case	Coefficient	
	101	1	1,00					
	102	1	1,35					
	103	1	1,00	2	1,50			

# 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 fe	eatures & 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.

Bar Schedule
✓ Enabled
📄 🗋 📟
01 - ISO 3766 🔹
Туре
4. ISO 3766 🔹

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:
  - o 0 for hook angle 0;
  - o 1 for hook angle 90;
  - o 2 for hook angle between 90 and 180;
  - o 3 for hook angle 180;
  - o -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	Length of each bar (Method A)	Number of members	Number of bars in each member	Total number	Total Length	Shape code	End	Hook			Bendin	ıg dime	nsions			Index
			mm	(mm)				(mm)				а	b	с	d	e	R	h	
т	1	B500B	8	7760	1	3	3	23280	21	1	1	120	7550	120			16	99	
т	2	B500B	8	7200	1	2	2	14400	00	0	0	7200					16	0	
т	3	B500B	8	1895	1	3	3	5685	11	0	1	1800	110				16	•	
т	4	B500B	8	1895	1	3	3	5685	11	1	0	1800	110				16	*	
т	5	B500B	8	7000	1	3	3	21000	00	0	0	7000					16	0	
т	6	B500B	6	1370	1	24	24	32880	51	2	2	450	150	115	115		12	98	
т	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.

Concrete										
Concrete class	C25/30 •									
Concrete f ck	25,00 MPa									
ρ	2500,00 kg/m <sup>3</sup>									
High strength concrete (Annex B of EN 1992-2)										
High strength concrete										
Concrete with silica fum	e									
Aggregate Size	30 mm									

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



To facilitate the defining of the Model Partial Factor ( $\gamma_{Rd}$ ) 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.

Gr EC8 Seismic Norm	×
Seismic bearing capacity Seismic bearing capacity	
Soil type	Loose dry sand 🔹
Υ <sub>Rd</sub>	1,15
Seismic analysis parameters	
γ <sub>I</sub>	0,8

### 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<sup>®</sup> environment

With the Advance BIM Designers 2020 version, the modeling capabilities of reinforcement in Autodesk Revit<sup>®</sup> 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:

GRAITEC Concrete GRAITEC Slab GRAITEC Detailing

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.

File	Archited	cture	Structure	Steel	Systems	Insert	Annotate	Analyze	Massing & S	Site Collabor	ate View	Manage	Add-In	is GRA	ITEC Conc	rete GRA	ITEC Slab	GRAITEC Det	ailing	Graitec PowerPack
Advanc Desig Abo	ce BIM gners out	Design Status	Create Design Grou	up 🌡	금 Import 호 Export 호 Synchroniz	Geor	netry Desig	n Reinfor Assump	cement C tions	Loads and ombinations	Calculate Calculations	Diagrams	Edit C Rebar D	Generate Drawings Result	Bar Schedule	Generate Report	<b>S</b> Localisation	n Design Templates Op	X Cu Cu Par tions	stomize Drawings stomize Reports rameter Mapping

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.

File	Archited	cture S	tructure	Steel	Syster	ms Insert	Annotate	Analyze	Massing & Si	e Collaborate	View	Manage	Add-Ins	GRAITEC Conc	rete (	GRAITEC Slab	GRAITEC Detailing	Graitec PowerPack	
6	-	###		≝≞	=		🚺 Rebar Set	•		🔄 Assign to She	et (	🗿 Browse F	Reinforcement			- <b>1</b>	Symbols 8	2 Dimensions 🔻	
	011.4	+++++					🙀 Rebar In	Element 🔹	<b>1</b>	🖉 Set Rebar Nu	mber	🛱 Select by	Rebar Numb	er 🤼			250        Show Reb	ar	
Desig	gners	Rebar	Cage	Rebar	Lines [	Distribution	Trim/Exte	nd •	Rebar visibility	近 Renumber Re	bar	👰 Delete by	/ Rebar Numb	er Drawings	ваг Schedul	e Detail So	hedule hema 📲 Clean and	Refresh	
Abo	out					Reinforcen	nent			Nu	mbering	and Selectio	on			Dra	awing	ы	

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

File	Archited	cture	Structure	Steel	Systems	Insert	Annota	te Analyze	Massi	ng & Site	Collabo	rate View	Manage	Add-I	ns GRAIT	EC Concrete	GRAITEC Slab	GRAITEC Detailing	Graitec PowerPack
G	7		14			t t	#	<u>₿</u>	₩	-	4	<b>6.</b>		F	<b>—</b>		¢		
Advanc Desig	e BIM ners	Design Status	Import Analysis Re	F sults	Reinforcement Solutions	Reinfor Aı	rcement F rea	Reinforcement Diameters	Mesh List	Botto Reinforce	om ement	Top Reinforcement	Genera Reinforce	ate ment	Bottom Diagrams	Top Diagrams	Diagrams Settings		
Abo	ut	Project			As	sumptio	ns				Gener	rate reinforcem	ent			Results			





# **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.





				Connection method				Staggered
Maximum length of s	plit		•	Lapped bars			•	
Aaximum split length	2500.0 mm From start towa	ards end	•		b	†	I	a 
′ariable bars length ◎ Symmetric ● Minimal length	<b>SL SL</b>	<u>, sl., sl.,vľ</u>		Lap length Shift direction	b © [ @ Positi	50 x Ø = 600.0 500.0 mm ion 2 (Right)	) mm	a 400.0 mm
								Mode Split Rebar Create only dividing lines
olitting preview	2500.0			2500.0		1534.3		Cross section preview
olits for odd rows				Splits for even rows -				
	nd Len	igth		Start E	nd	Length		
Start E		0.0 mm	A.				*	
Start Ei 0.0 mm 2	500.0 mm 250	0.0 11111						
Start         Ei           0.0 mm         2           2000.0 mm         4	500.0 mm 250 500.0 mm 250	00.0 mm						

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	SL_SL_SL_SL_VL	3000.0	3000.0	1000.0
From end to start	VL SL SL SL SL	1000.0 3000.0	30	000.0
From ends to center	SL_SL_VL_SL_SL	3000.0	1000.0 30	000.0
From center to ends	VL_SL_SL_SL_VL	2000.0	3000.0	2000.0

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:



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.

Connection method	I
Lapped bars	•
	<u> </u>
Lap length	b 🙆 50 x Ø = 600.0 mm
	© 500.0 mm
Shift direction	Position 2 (Right)

• **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.

Connection method				
Mechanical couplers				
		1		
Coupler		Transition Coupler 🔹		
Туре		ø12 B500B 🔹		
Gap length	c	18.0 mm		

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

Connection method		
Simple connection	•	
Gap length	c 0.0 mm	]





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.

t	b	c	d
			a h
Lap length	I	o	50 x Ø = 600.0 mm
Offset length	¢	: 0.0	mm
Crank height		n 24.	0 mm
Alpha	i	a 9.0	0°
Crank length	c	85.	6 mm
	1		I

#### 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.

	2500.0			2500.0		1534.3	
	2100.0		2	500.0		1934.3	
lits for odd rov	WS			Splits for even ro	WS		
Start	End	Length		Start	End	Length	
Start 0.0 mm	End 2500.0 mm	Length 2500.0 mm	*	Start 0.0 mm	End 2100.0 mm	Length 2100.0 mm	
Start 0.0 mm 2000.0 mm	End 2500.0 mm 4500.0 mm	Length 2500.0 mm 2500.0 mm	•	Start 0.0 mm 1600.0 mm	End 2100.0 mm 4100.0 mm	Length 2100.0 mm 2500.0 mm	



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.

Gr Split at Lines		
Configuration		
Keep dividing lines		
Shift rebars for lap	ing	
Preview		
2018.5		3515.8
	l	
ADVANCE		
CT BIM DESIGNERS		OK Car

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.

Properties	×
R	~
Lines (Thin Line	s) (1) 🔻 🖶 Edit Type
Graphics	\$
Line Style	Thin Lines 📃 👻
Detail Line	G.DetailLineStyle
Dimensions	G.DividingLine1End
Length	G.DividingLine1Start
congen	G.DividingLine2End
	G.DividingLine2Start
	Hidden Lines
	Liner

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.

(	Gr Split at Lines
	Configuration
	Shift rebars for lapping
	Preview 1000.0 1000.0 980.1
	<u>_</u>
	OK Cancel





# **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<sup>®</sup>. 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.

Gy Footing - Reinforcement Assumptions	
Footing Reinforcement Wall Reinforcement	
Starter bars Reinforcement cage	✓ Starter bars         Starter bars shape         Reinforcement type         □ Anchorage length of         (L): 35 Ø
	Diameter     ø10       Minimum spacing     (S): 250 mm       1 starter bar every     1       Starter bars length
S S S S	Lap length(H):150 mmReduction for seismic effects100,00 %Reduction for non-seismic effects100,00 %
Safety Safety hooks for bars up to	Longitudinal reinforcement     Links       Number of lavers     Q): 3     Binder type     Pins
	Diameter Ø10 • Diameter Ø8 •
	Ok Cancel

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

Design Stat	tus							8
<b>v</b>	Level 🔻	Туре 🔻	Template	Mark 🔻	GTC Id 🔻	Status 🏾 🔻		GTC File
☑ 🐇	Level 0	Continuous footing	No template metric 🔻	SC 1	2388	Calculated OK	o 🖹 🕅	
🖹 Ap	ply template	💦 Reset Calculation	Create New Group				Synchronize folder:	😫 😫
	DESIGNERS							Close

Gr Footing				<b>X</b>			
Calculation results Errors and warnings							
Verification type	Combination	Value	Limit	Work Ratio			
Bearing resistance (/m)	106: 1x[1 G]+1x[2 Q]	158,70 kN	335,83 kN	<mark>47</mark> ,26%			
Compressed surface (/m)	108: 1x[1 G]+0.5x[2 Q]	83,49 %	67,00 %	80,25%			
Sliding (/m)	101: 1x[1 G]	1,00 kN	73,72 kN	1,36%			
Settlement (/m)	106: 1x[1 G]+1x[2 Q]	0,84 cm	5,00 cm	16,83%			
Reinforcement	Real	Theor	etical	Ratio			
Bottom Along X (/m)	3,70 cm²	3,67	cm <sup>2</sup>	100,81%			
G ADVANCE BIM DESIGNERS Close							







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).

G Footing - Generated F	Reinforcement	×
Footing Reinforcement	Supported element longitudinal reinforcement	Supported element transversal reinforcement
Reinforcement cage		Bar mark: 5
		General Settings
	Q1 <u>\$2</u>	Diameter: ø8 🔹
		Quantity (Q1): 2
		Quantity 2 (Q2): 2
		Spacing (S1): 276 mm
		Spacing 2 (S2): 107 mm
		Covers
	+	Bottom (B): 101 mm
	2 14	Lateral 1 (L1): 59 mm
		Lateral 2 (L2): 59 mm
		Lateral 3 (L3): 35 mm
Reinforcement Section	ıs L1++++L2	Lateral 4 (L4): 35 mm
Theoretical Reinforcem	ient	Hooks
0,00 cm <sup>2</sup>		Angle 1 0,00 ° 🔻
Real reinforcement	1	Angle 2 0,00 ° ▼
1,01 cm		Length 1 0 mm
Restore from calculation	n	Length 2 0 mm
		Ok Cancel





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<sup>®</sup>. 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.

F Import Analysis Results						
Results Package to Use						
Name	Provider	Туре	Creation Time	Status		
GRAITECAdvanceDesignResults 1	GRAITEC Advance Design	Static	2-15-2019 1:14 +01:00	🕑 Up-to-Date		
GRAITECAdvanceDesignResults 1	GRAITEC Advance Design	RequiredReinforcement	2-15-2019 1:14 +01:00	🕑 Up-to-Date		
Wall Groups and Resultant Forces Import Wall Groups Bot	tom Resultant Forces 💌					
CARCHARCE OK Cancel						

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

G Advance BIM Designers	Design Status	Create Design Group	🛃 Impor Export	t ronize	Geometry	<b>D</b> esign	Reinforce
About		Footing o	or Column				Assumption
		Multispar	n Beam				
		Wall or Sł	near Wall				

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.

all Web Reinford	cement Linkage Reinf	forcement Opening Rei	nforcement		
Vertical Bars Iorizontal Bars Fabrics ransversal Bars			2	t+¥2 +¥1	
	Wall & Level		1 Heinforcement Section Theoretical reinforcem Real reinforcement:	▲ ↓ ▼ ns nent: 27,27 cm <sup>2</sup> 52,02 cm <sup>2</sup>	Vertical package #1 Vertical package #2 Vertical package #3 Vertical package #4
	Bars				Vertical package #5 Vertical package #6
	n: Bottom offset Left offset	3 (Y1): 0 mm (X1): 37 mm	Diameter Top offset Right offset Spacing	(Ø): ø12 ▼ (Y2): -525 mm (X2): 5349 mm (S): 374 mm	Vertical package #7
	Hooks				
	Hook Length	(L1): 0 mm (1): 0,00 °	Hook Length	(L2): 0 mm (2): 0,00 ° •	Add Remove







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.

G Reinforcement Visibility	X
HIDDEN       Image: Select by filter         Select by filter       Image: Select by filter	Reinforcement Visibility Rebar Fabric Area Path Range of operation Active view Project
(	OK Cancel





# 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.

Г	Stiffenerr			~
	Cy surreners	Conserved Characteria		X
	Column stiffeners	General Chamters		
	Upper	D-fi-iti-		
	✓ Lower	Type:	Total	Id
	Center	01-		
	Diagonal stiffeners	Geometry		
	🗉 📃 First diagonal	Thickness: (T)	10.0 mm	
	Second diagonal	Length: (L) Shortened	54.5 mm	T
		Shortening: (d)	10.0 mm	
	Cover plates			
Gr Welds			×	
□ Velds				
Column stiffeners	Geometry			
Beam stiffeners	Weld size:	6.0 mm		
Web stiffeners	Weld type:	Fillet V		
	Weld quality:	snop		
Column wish to and plate				
Column web to end plate				
Count nanges to end plate				
E Copy from [Column web to end	platej			
Haunch stiffeners to column		11-		
Haunch stiffeners to beam		-		
		_		
		-		
	u			

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.

Gr Plates	5 941 Andrea 100 Langer	
Base plates Base plate Base plate Shim plates Group 1 Group 2 Group 3 Leveling plate	Thickness: (T) Count: (n) Width Layout Width: (W) Shortened Symmetrical: First edge: (d 1)	Varies
ADVANCE	Second edge: (d 2 ) Length Layout Length: (L) Shortened Symmetrical: First edge: (d 3 ) Second edge: (d 4 )	25.0 mm 25.0 mm 25.0 mm

# **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:  

$$\frac{N_{Ed}}{N_{Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \le 1$$

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

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

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

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

Work Ratio: 88.05 %

Passed

EN1993-1-1 6.2.1 (6.2)

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	
$a \ge 3mm$	

• Minimum weld seam length verification  $l_{eff} \ge max(6 \times a; 30 mm)$ 

EN 1993-1-8, 4.5.2 (2)

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 EN 1993-1-1 6.2.3 (6.5) Check relation: $N_{Ed} \le N_{pl,Rd}$ Combination: [1]: ULS envelope 1 $N_{\text{pl,Rd}} = n \star A \star \frac{f_y}{\gamma_{M0}} = 1 \star 23.6 \text{ cm}^2 \star \frac{235.00 \text{ MN/m}^2}{1.00} = 555.07 \text{ kN}$ EN 1993-1-1 6.2.3 (6.6) $A = h_p \times t_p = 236.2 \text{ mm} \times 10.0 \text{ mm} = 23.6 \text{ cm}^2$ Check relation becomes: 75.00 kN ≤ 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 $N_{\text{pl,Rd}} = n \star A \star \frac{f_y}{\gamma_{M0}} = 1 \star 19.2 \text{ cm}^2 \star \frac{235.00 \text{ MN/m}^2}{1.00} = 451.21 \text{ kN}$ $A = h_{30} \times t_p = 192.0 \text{ mm} \times 10.0 \text{ mm} = 19.2 \text{ cm}^2$ -25.00 kN ≤ 451.21 kN Check relation becomes: 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.

Gr Anchors			×
Anchors	Definition Position Holes	and plates	33.0 mm
Base plate anchors	Connector properties		
	Anchor standard:	French cane anchor	~ 16.0 mm
	Anchor material:	4.6	
	Anchor set:	2N	~ 16.0 mm
	Anchor diameter:	20.00 mm	~
	Anchor length:	390	~
	Туре:	Ribbed	~
	Good bond:	[	
			378.5 mm

#### 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.

Advance Steel Straig	ht stair, two flights - Developed by Graitec		×
Properties	General		
Definition	Tread thickness (T <sub>1</sub> )	5.00 mm	4
Tread	Tread overlap (Ov)	30.00 mm	L2
Layout	Length (L1)	1000.00 mm	
Type	Length (L <sub>z</sub> )	1000.00 mm	α τ2
Dimensions	Width (W)	286.25 mm	L1
	Details		*
	First length (dx1)	80.00 mm	
	Second length (dx <sub>2</sub> )	100.00 mm	
	First angle (α)	60.00 °	
	Second angle (β)	60.00 °	
	First bending radius (R1)	10.00 mm	
	Second bending radius (R <sub>2</sub> )	10.00 mm	
Landing			
Stringer			
Connections			
Library			
Update now! Automa	tic Approval status Not Set	~	

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

Properties	Stair properties		
Definition	Height (H)	2800.00 mm	
Geometry	Fixed width along the stair	$\checkmark$	
rgonomics	Flight properties		
	Flight 1 Flight 2		L1 →
	Total length (L)	3300.00 mm	│ └─── <b>↓</b>
	Flight length (L1)	1823.75 mm	×
	Width (W)	1000.00 mm	H
	Minimal landing extension (Le,min)	150.00 mm	
	Landing extension (Le)	506.25 mm	
		A 10 - 10 - 10 - 10 - 10 - 10 - 10 - 10	Н
Tread			
Landing			
Stringer		~	
Connections			
Library			





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

Properues	Overview	Constraints	Protractor	Graph	]
Definition	Automatic Et	constraints	rioductor		
try	Automatic III			•	
mice	Priority			Kise °	
mics	Total tread numb	er		9	
	Rise			180.00 mm	
	Going			250.00 mm	
	Stride			610.00 mm	
	Pitch angle			35.75 °	
	Pitch			0.72	
Tread					
Landing					
Stringer					
Connections					
Library					

Advance Steel Straight stair,	one flight [29903]	- Developed by Gr	aitec		×
Properties	Overview	Constraints	Protractor	Graph	
Definition Geometry	Stride ranges	unal stride		10.00 mm	
Ergonomics	Maximum allo	wed stride	(	640.00 mm	
	Rise ranges	wed rice	[.	40.00 mm	
	Maximum allo	wed rise	[2	10.00 mm	
	Going ranges		Γ.		
	Minimum allov Maximum allo	wed going wed going	4	40.00 mm	Image: 1 = 1 = 1
		Reset t	o defaults		
Tread					
Landing					
Stringer					
Connections					
Library					
Update now! Automatic	Approval sta	atus 🗌 Not Set	~		

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.

- C-W	Overview	Constraints	Protractor	Graph		
Aut	omatic fit			✓		
Pric	prity			Going	~	
Tot	al tread numb	er		16	<u> </u>	
Rise	2			164.71 mm		
Goi	ng			250.00 mm		
Stri	de			579.41 mm		
Pito	h angle			33.38 ° Stride	e should be betwe	en 610.00 mm an
Pite	:h			0.66		
read						
nding						
ringer						
ections						

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.

Definition	Overview	Constraints	Protractor	Graph	
etry	Automatic fit				
incu y	Priority			Going ~	
nomics	Total tread numb	ber		15	
	Rise			175.00 mm	
	Going			266.67 mm	
	Stride			616.67 mm	
	Pitch angle			33.27 °	
	Pitch			0.66	
Tread					
Landing					
Stringer					
Connections					
Library					

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.

Advance Steel Straight sta	air, one flight - Develo	ped by Graitec			×
Properties	Quantieur	Constraints	Protractor	Graph	
Definition	Overview	Constraints	FIGUACION	Graph	
Geometry	Stride ranges				
	Minimum allow	ed stride	6	10.00 mm	<b>•</b>
Ergonomics	Maximum allow	ved stride	64	40.00 mm	
	Rise ranges				
	Minimum allow	ed rise	14	40.00 mm	
	Maximum allow	ved rise	2	10.00 mm	
	Going ranges		_		
	Minimum allow	ed going	2	10.00 mm	
	Maximum allow	ved going	20	50.00 mm	i →
		Reset t	o defaults		
Tread					
Landing					
Stringer					
Connections					
Library					
Update now! Automatic	Approval stat	us 🗌 Not Set	~		

#### 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° 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.

Ove	rview Constraints	Protractor	Graph	
Automa	atic fit	. [		
Priority			Rise v	
Total tr	and number		11	
Total tre			7	
First flig	int tread number		· ·	
Second	flight tread number	-	4 🗸	
Landing	g Height		1458.33 mm	
Rise			208.33 mm	
Going			181.82 mm	
Stride			598.48 mm	
Pitch ar	ngle		48.89 °	
Pitch			1.15	
ead				
nding				
inger				
ections				





Note: Landing Height before adjustments





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



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#### 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.

Advance Steel S	Straight stair, two flights - Developed by Graitec	×
Properties Definition Tread	Tread properties Type	
Layout Type	Tread size	
Dimensions	Save Save As Rename	
Landing		
Stringer		
Connections		
Library		
Update now!	Automatic Approval status Not Set 🗸	

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







# 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.

Properties	Type	General	Welds	Bolts			
Definition		1					
Tread	Properties						
Landing	Plate		Thickness (T)	0.00 mm			
Stringer			Width (W)	0.00 mm			
Connections					_		
d Connections	Profile		Angle identical	▶ 150X5 ×			
na Connections	Alian longer le		Angle ident	tical DIN EN 10056-1			
ig connections	Alightiongerie	.y 0.1	Angle not ic	dentical DIN EN 10056	1		
er editing			All		· •	A G Brown - Anchor Cleat	
	Shorten first e	edge (				A G Brown - Plates	
	Shorten secor	nd edge		0.00 mm		A G Brown - Plates (for outdated joints)	
	Corner finish			0.00 mm		A G Brown Accessories - Angle	
						A G Brown Accessories - Sag Bars _ Tie Rods	
						A G Brown C-Section	
						A G Brown C-Section Sleeves	
						A G Brown Cleats (Purlin / Rail)	
						A G Brown Eaves Beam	
Library					_	A G Brown Zed	
te now! Automat	tic Approval	I status 🗌 Not S	et v			A G Brown Zed Sleeves	
						AISC 14.1 Angle identical	
						AISC 14.1 Angle not identical	
						Albion Accessories - Angle	
						Albion Accessories - Speed Fix	
						Albion Accessories - Tie Rods _Wires	
						Albion C Track	
						Albion C-Section	
						Albion C-Section Sleeve	
						Allhian CIR	





#### 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.







# 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

Key Klamps       Component:       Top         Glass Clamps       Producer:       Kee Safety         ID       Name       Special part         5       10-6 - Single Socket Tee, 33.7mm O/D       10-6ModelTop         6       10-65 - Single Socket Tee, 33.7mm x 26.9mm O/D       10-65ModelTop
Glass Clamps Balls Producer: ID Name 5 10-6 - Single Socket Tee, 33.7mm O/D 6 10-65 - Single Socket Tee, 33.7mm x 26.9mm O/D 10-65ModelTop X
Producer: Kee Safety ID Name Special part 5 10-6 - Single Socket Tee, 33.7mm O/D 10-6ModelTop X 6 10-65 - Single Socket Tee, 33.7mm x 26.9mm O/D 10-65ModelTop X
ID     Name     Special part       5     10-6 - Single Socket Tee, 33.7mm O/D     10-6ModelTop       6     10-65 - Single Socket Tee, 33.7mm x 26.9mm O/D     10-65ModelTop
5         10-6 - Single Socket Tee, 33.7mm O/D         10-6ModelTop          ×         ^           6         10-65 - Single Socket Tee, 33.7mm x 26.9mm O/D         10-65ModelTop          ×
6 10-65 - Single Socket Tee, 33.7mm x 26.9mm O/D 10-65ModelTop 🗙
7 10-7 - Single Socket Tee, 42.4mm O/D 10-7ModelTop 🗙
8 10-78 - Single Socket Tee, 42.4mm x 48.3mm O/D 10-78ModelTop 🛄 🗙
9 10-8 - Single Socket Tee, 48.3mm O/D 10-8ModelTop 🛄 🗙
10 10-9 - Single Socket Tee, 60.3mm O/D 10-9ModelTop 🛄 🗙
11 10-98 - Sinale Socket Tee. 60.3mm x 48.3mm O/D 10-98ModelTop





# What's New in GRAITEC Advance BIM Designers 2020

A	_	Allow	S	pecial parts	manag	er						×
Key Klamps Glass Clamps Balls	Produc Family:	ter:	Q-Railing Mod 2802	Ŷ								
	ID	Name					Special par	t				
	15	13-2802-0	000-10				13-2802-00	0-10		×		
	16	13-2802-0	042-10				13-2802-04	2-10		×		
	17	14-2802-0	000-10				14-2802-00	0-10		X		÷.,
	18	14-2802-0	042-10				14-2802-04	2-10		×		Ŧ
	19 13-2802-048-10				13-2802-048-10			8-10		×		
	20	14-2802-0	048-10				14-2802-04	8-10		X		
	Param	neters										
	Clamp type:		С	Clamp ~					-			
	1. Gla	ass thicknes	s: 2.0	00 mm		Profile s	election:	1				
·			С	oordinates:		Location		Diam	eter:			
	Hole	1: 🗸	0;	0;0		Post	~	8.50	mm			
	Hole	2: 🗸	48	8;-8.5;0		Panel	~	8.00	mm			
	Hole	3:					~	0.00	mm			
	Hole	4: 🗌					~	0.00	mm		1	

#### Glass clamps







# What's New in GRAITEC Advance BIM Designers 2020

Key Klamps	Тор
Glass Clamps	Component:
Balls	Producer: Kee Safety
	ID Name
	33 88-7 -Three Socket Angle
	34 88-7 -Three Socket Angle Producer name New producer lest
	35 88-7 -Three Socket Angle Producer logo 🧨 🗶 🕂
	36 88-8 -Three Socket Angle Ok Cancel X
	37 88-8 -Three Socket Angle Tee, 48.3mm O/D -5° 88_8_43-3_5g 🗙

# A Special parts manager Key Klamps Component: Top v Glass Clamps Producer: New prod v ID Name V V

