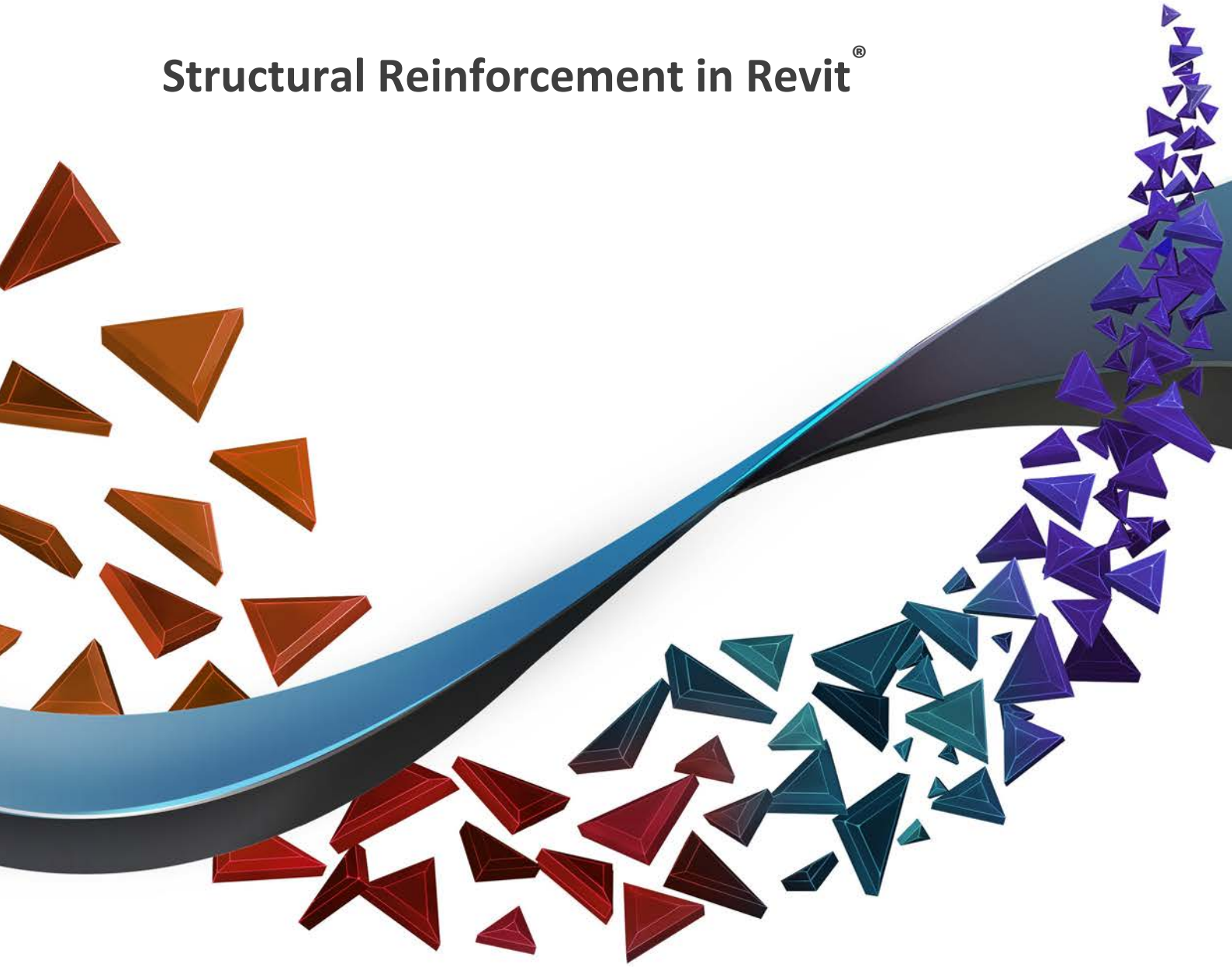
Innovation first

GRAITEC ADVANCE

TUTORIALS

Structural Reinforcement in Revit®



GRAITEC

About GRAITEC Tutorials

GRAITEC technology evolution is driven by years of practical experience and combined with user feedback to provide the most intelligent and effective structural, BIM and design workflows possible.

GRAITEC Tutorials are provided as a free resource designed to guide users in the best practice methods of applying GRAITEC software, add-ons and industry solutions to speed up, enhance or automate everyday process.

GRAITEC Tutorials are written as illustrated step by step walk-throughs and assume a certain level of industry experience in the given subject matter or know-how with the related Autodesk software.

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GRAITEC Tutorial – Structural Reinforcement

In this tutorial you will discover how to automate reinforced concrete design and documentation processes, and fine tune the drawings by applying GRAITEC Reinforced Concrete BIM Designers on Autodesk® Revit®.

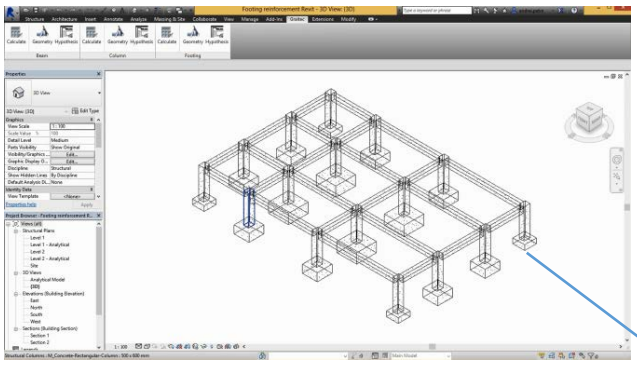
If you have not already done so, it is recommended to review GRAITEC Tutorial – Connected Structural BIM Workflows for Revit®, as this is essential to setting you with a connected BIM workflow in order to automatically generate design driven 3D rebar cages - based on local codes and Revit® families, as well as produce automatic reinforcement drawings and schedules as described in this tutorial.

The learning objectives are the following:

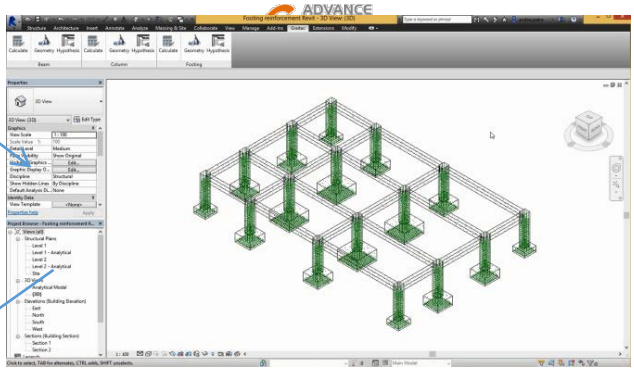
- Working with an enriched Autodesk® Revit® structural model which includes the geometry of reinforced concrete elements, loads and FEM results – See GRAITEC Tutorial – Connected Structural BIM Workflows for Revit®.
- Complete structural design assumptions and define rules according to different country design codes (Eurocode and AISC)
- Design reinforced concrete members within Revit®, view the 3D rebar cage, produce design reports with graphical results
- Automate the creation of associated detailed documentation – views, drawings schedules

Overview

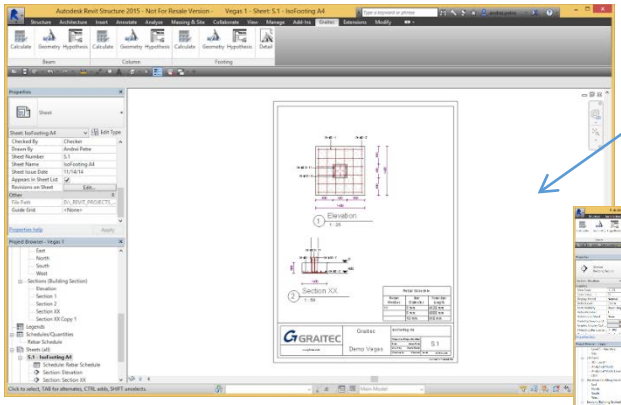
BIM promotes early cross-discipline project collaboration and data sharing which ultimately leads to shorter project delivery times, increased accuracy and more effective and efficient designs. In this tutorial we will be looking at the automation that can be achieved in the field of reinforced concrete from effective use of a connected BIM workflow using Revit® and GRAITEC Reinforced Concrete BIM Designers.

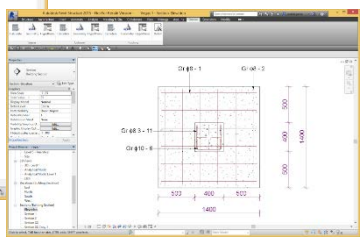


3D model in Revit®



Automatic 3D rebar generation





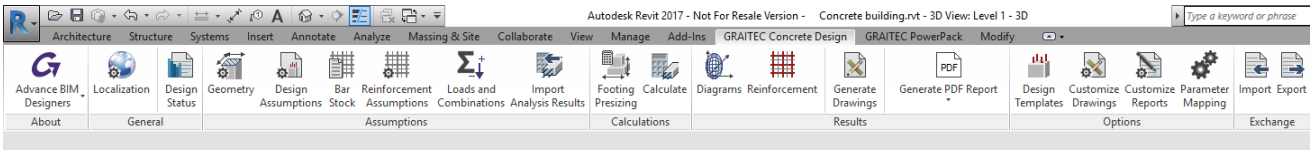
Automatic reinforcement drawings

Note:	*In this tutorial, it is assumed that the user already has a Revit® model including FEM results packages. Please refer to GRAITEC Tutorial 2 – Connected Structural BIM Workflows to discover more information about this subject.*

Part 1: Reinforced concrete design settings and preferences

Getting familiar with the ribbon

When you have installed the GRAITEC Reinforced Concrete BIM Designers, you get a specific ribbon GRAITEC Concrete Design offering all the functions required to design and document reinforced concrete members.



From the left to the right:

- **Advance BIM Designers** accessed the online help, the license management tool
- **Localization** defines the language for the GUI, the documents and the design codes to be applied
- **Design status** to access a dashboard showing the status of each member: calculated, warnings, errors…
- **Geometry** to access and change the geometry of the elements through a dedicated dialog
- **Design Assumptions** to predefine all the design assumptions related to the design code selected in the localization settings
- **Bar Stock** to define the library of available or preferred bars to reinforce the elements
- **Reinforcement Assumptions** to access and define all the reinforcement assumptions for three categories of RC members: beams, columns and footings
- **Loads and Combinations** to manage all the internal forces and\or external loads, the load cases and the combinations (works only on a single selected element)
- **Import Analysis Results** to define which set of results package from Revit® to be used to calculate the rebar
- **Footing Presizing** to pre-size the footing dimensions according the applied loads and the bearing soil capacity
- **Calculate** to run the calculation and 3D rebar cage production of the selected elements
- **Diagrams** to display graphical results on the selected element (works only on a single selected element)
- **Reinforcement**: a parametric dialog to change the produced 3D rebar cage (works only on a single selected element)
- **Generate Drawings** to generate the views and the drawings sheets of selected elements
- **Generate PDF Report** to generate a detailed design report as a PDF (other formats available in the drop menu)
- **Design Templates** to select a design template per element type: beams, columns and footings
- **Customize Drawings** to define the drawing templates to be used: views, scales, schedules…
- **Customize Reports** to define the reports templates to be used
- **Parameter Mapping** to define the mapping parameters between Revit® families and the Reinforced Concrete BIM Designers
- **Import** to import a file from the standalone version of Reinforced Concrete BIM Designers
- **Export** to export a selected member to a file for the standalone version of the Reinforced Concrete BIM Designers

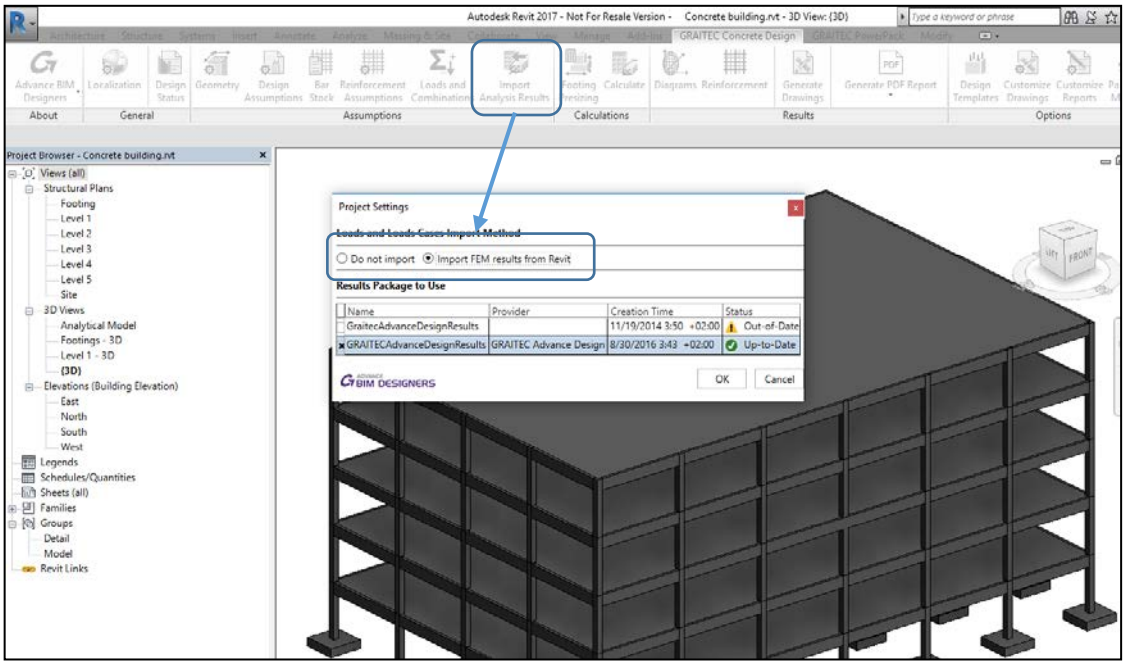
Using FEM data stored in Revit®

At this stage the assumption is that the following steps have been taken as described in GRAITEC Tutorial 2 – Connected Structural BIM Workflows:

- Revit® analytical model is optimized
- Revit® model transferred to FEM software (Advance Design shown but applies to any BIM enabled FEM software) to run calculations, post process the FEM results, generate reports and send the FEM results back to Revit®
- The FEM results are sent back to and stored in Revit® together with any other changes

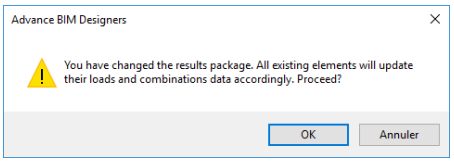
Now we will look at how we can start to design the structural elements using the Reinforced Concrete BIM Designers on Revit® and automatically get the 3D rebar cage, the design reports, the 2D views with tags-annotation-dimensions and the final drawing sheet.

The 1st step is to define which results package we want to apply to the project and to be used for to design the members and create automatically 3D rebar cages. In the GRAITEC Concrete Design ribbon, you have to click on "Import Analysis Results" and select which set of results you want to apply:



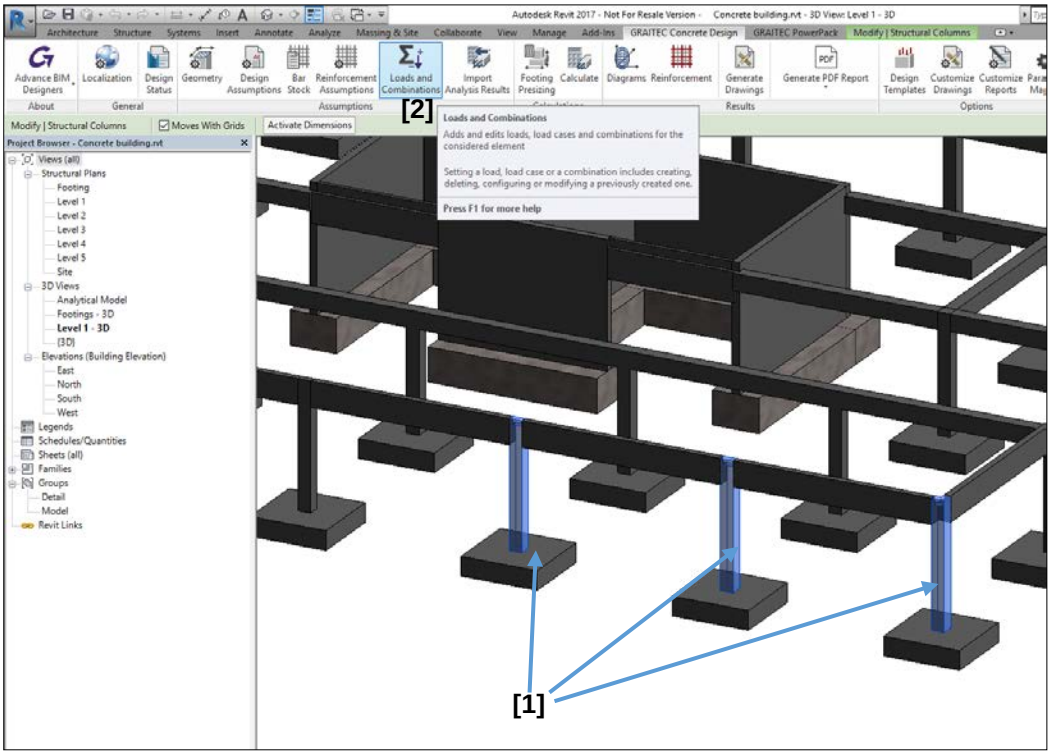
- If you select **Do not import**, it means that you will have to enter all the loads manually for each member
- If you select **Import FEM results from Revit**, the Reinforced Concrete BIM Designers will automatically detect and load the internal forces from the Revit results package shown in this dialog

***Note**:* *You will get a message asking for a confirmation to apply this new set of results: if you do so, it will overwrite all the manual loads you may have defined before using the Reinforced Concrete BIM Designers dialogs!*



To review, change or define the loads on each member to be designed, click on the Loads & Combinations icon:

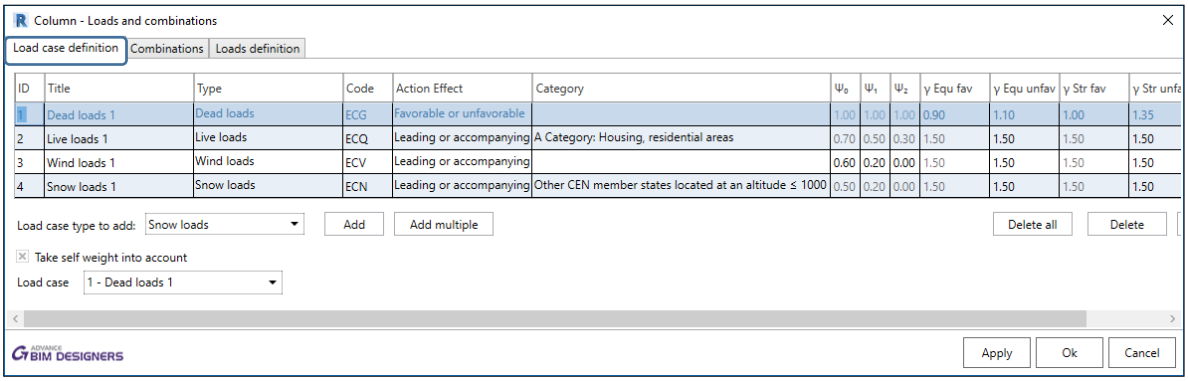
1. First select the elements on which you want to apply/change the loads
2. Click on the icon **Loads & Combinations**



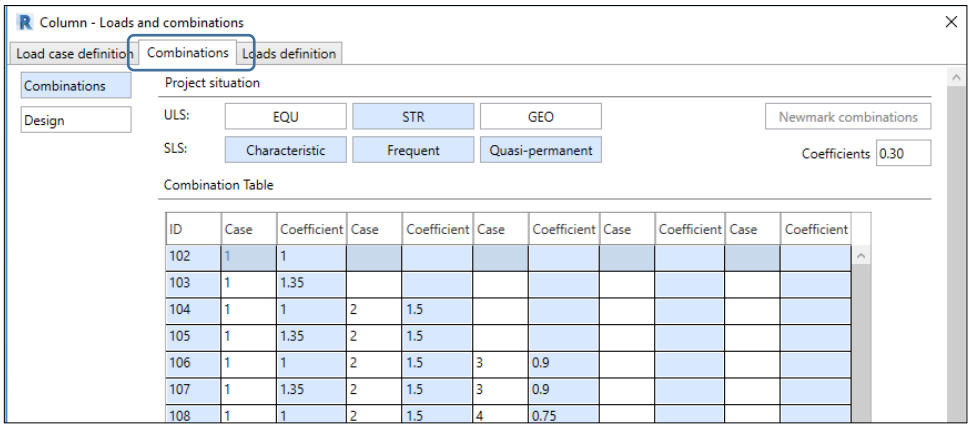
You will notice that the content of the dialog is contextual to the selection and will be different based on the element(s) selected; beams, columns or footings.

Here is an example of the dialog you will get if you select a column:

1. In the tab **Load case definition**, you can see the existing load cases (from the Revit® results package), be able to add new load cases, change the factoring coefficients, manage the self-weight, etc.



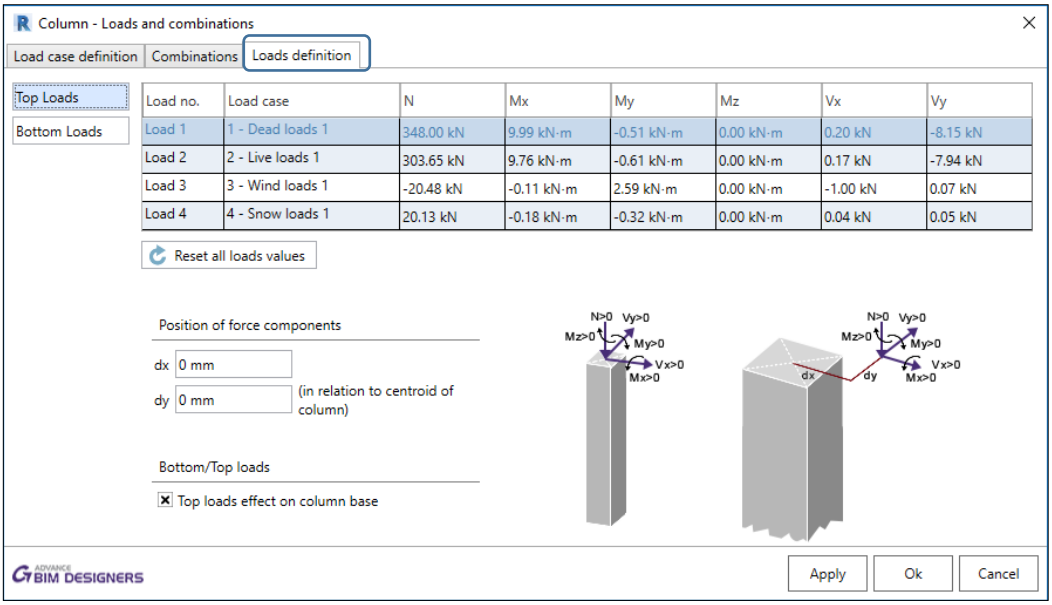
2. In the **Combinations** tab, you can automatically generate and change the combinations:



ID	Case	Coefficient	Case	Coefficient	Case	Coefficient	Case	Coefficient	Case	Coefficient
102	1	1								
103	1	1.35								
104	1	1	2	1.5						
105	1	1.35	2	1.5						
106	1	1	2	1.5	3	0.9				
107	1	1.35	2	1.5	3	0.9				
108	1	1	2	1.5	4	0.75				

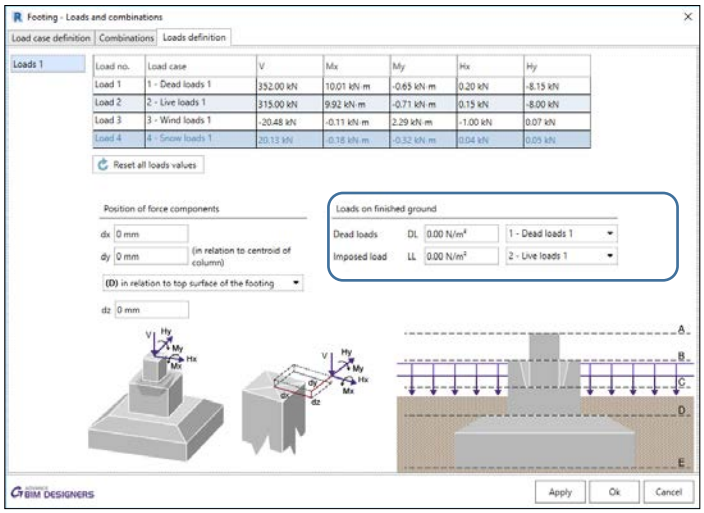
***Note**: You can run the calculation of an element without generating the combinations. In this case, the Reinforced Concrete BIM Designers will generate them automatically!*

3. In the **Loads definition** tab, you can see the defined loads, change them, define the position of the loads and impose different loads at the bottom and the top part of the column:



Load no.	Load case	N	Mx	My	Mz	Vx	Vy
Load 1	1 - Dead loads 1	348.00 kN	9.99 kN·m	-0.51 kN·m	0.00 kN·m	0.20 kN	-8.15 kN
Load 2	2 - Live loads 1	303.65 kN	9.76 kN·m	-0.61 kN·m	0.00 kN·m	0.17 kN	-7.94 kN
Load 3	3 - Wind loads 1	-20.48 kN	-0.11 kN·m	2.59 kN·m	0.00 kN·m	-1.00 kN	0.07 kN
Load 4	4 - Snow loads 1	20.13 kN	-0.18 kN·m	-0.32 kN·m	0.00 kN·m	0.04 kN	0.05 kN

In the case of a footing, you will also have the possibility to set additional loads such as for the finished ground:

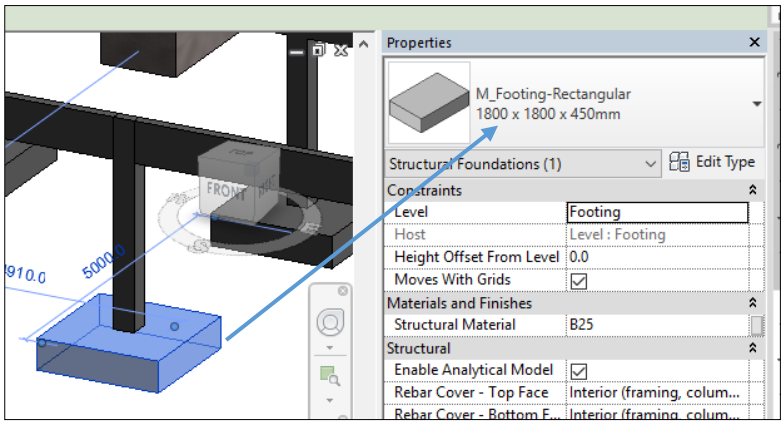


Editing the concrete members geometry

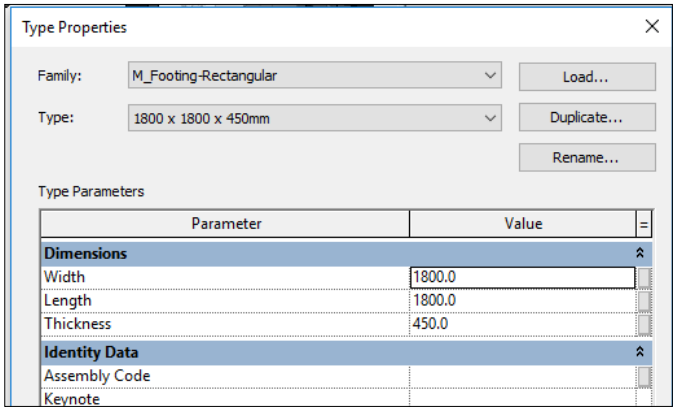
Obviously, when running on top of Revit®, the Reinforced Concrete BIM Designers automatically detect the geometry of the elements defined in the family types of Revit®.

The Reinforced Concrete BIM Designers dialogs can be an easy way to quickly change the geometry of the elements in Revit®. Let's take the example of a footing:

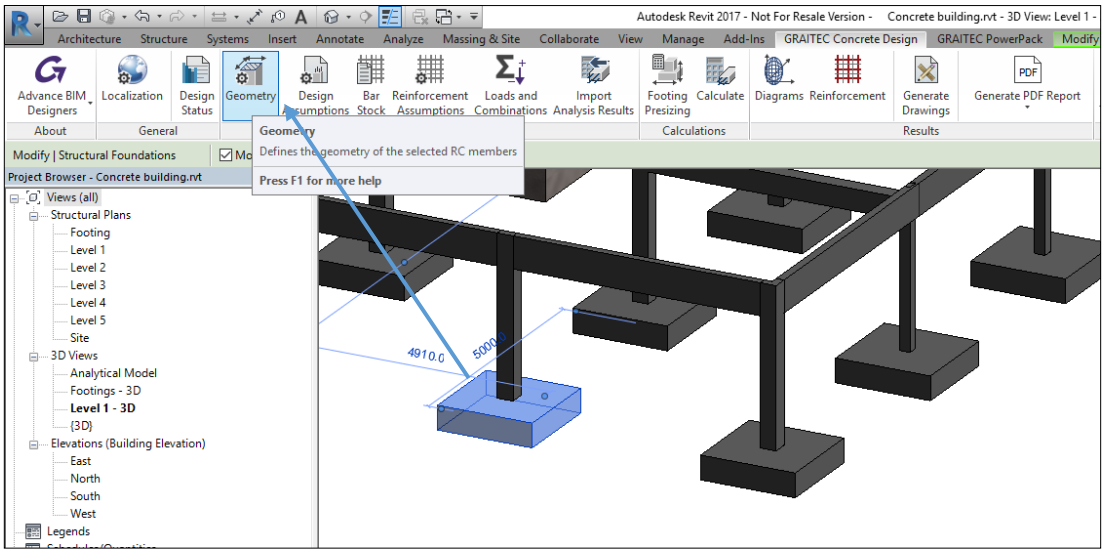
1. You have a footing defined in the Revit® model with some dimensions corresponding to a type from the Revit® family:



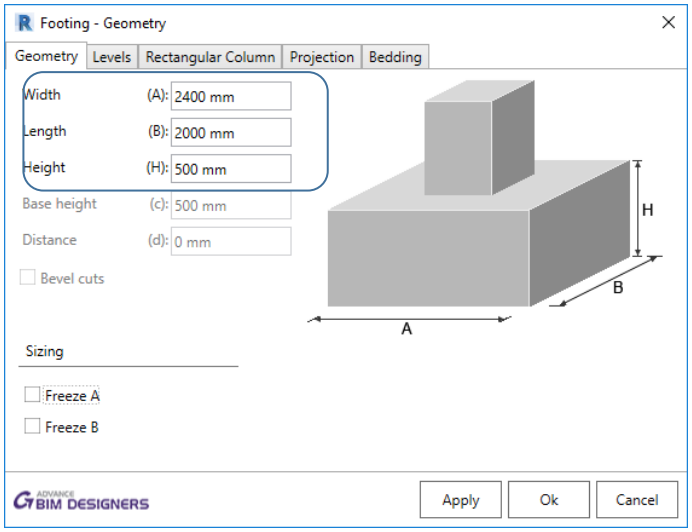
2. If you want to change the dimensions of the footing using Revit®, you would have to duplicate the existing type, change the name (careful to not make any mistakes) and impose the dimensions corresponding to the new type to be created:



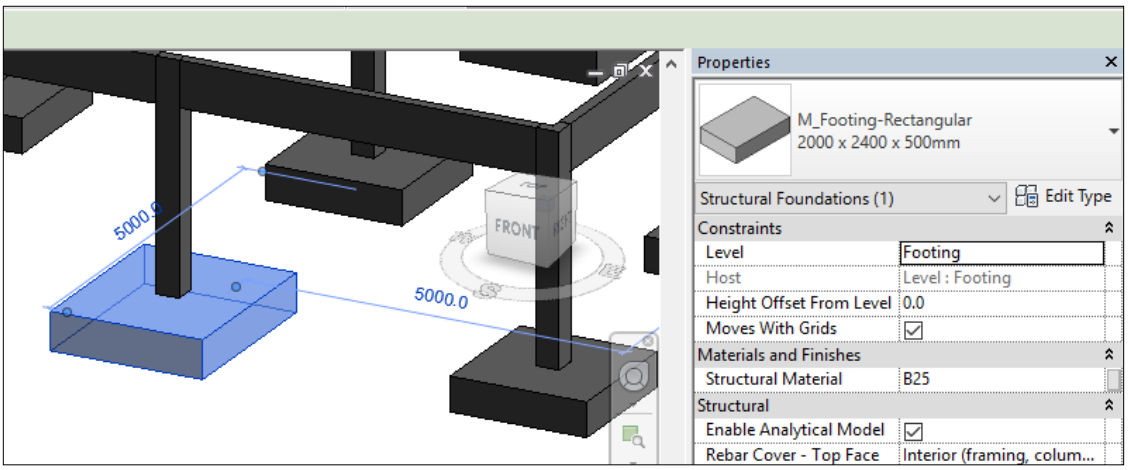
3. Alternatively with the Reinforced Concrete BIM Designers in Revit®, the workflow is simplified and more effective: Select the footing and click on the icon **Geometry** from the **GRAITEC Concrete Design** ribbon:



4. Directly change the dimensions in the **Geometry** dialog and confirm the changes (**OK** or **Apply**):



5. The Reinforced Concrete BIM Designers will automatically create a new type corresponding Revit® Family:

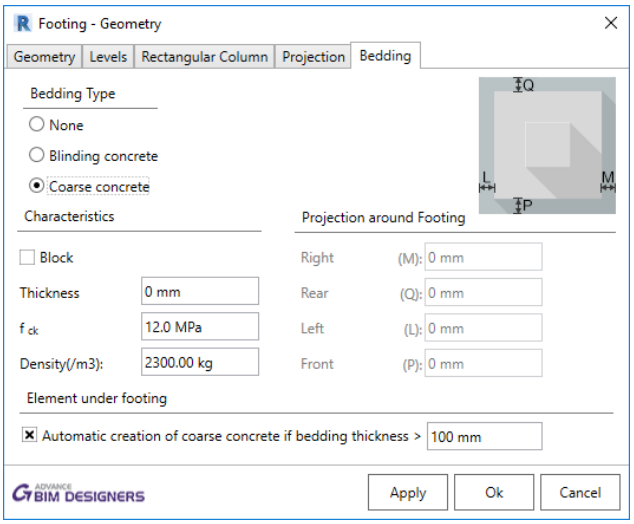


You can apply this functionality to a selection of multiple common objects.

The Reinforced Concrete BIM Designers are intuitively integrated into Revit® which means they can be used to change the dimensions of a column, footing or beam much more efficiently than using the Revit® native commands.

In the **Geometry** dialog from Reinforced Concrete BIM Designers, there are several additional geometrical parameters that do not naturally exist in the Revit® model which should be defined.

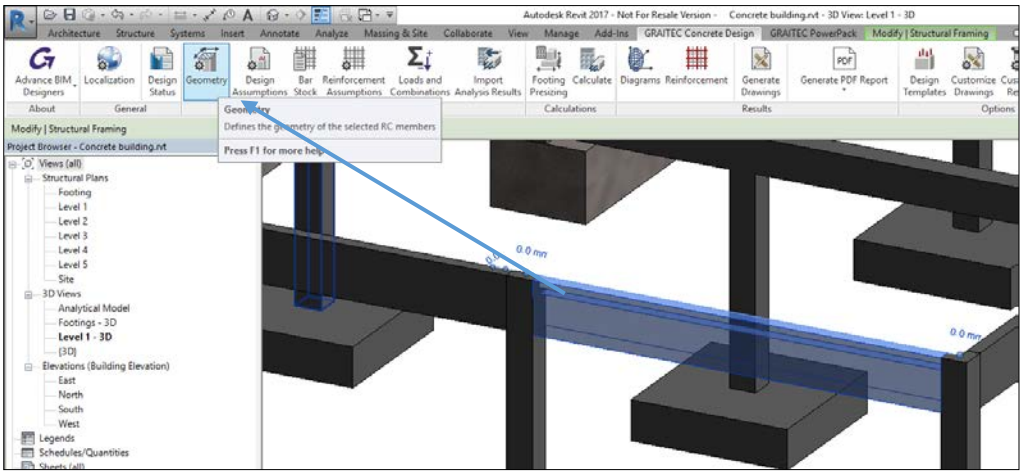
- For example, for an isolated footing, you can easily define the bedding assumptions of the footing:



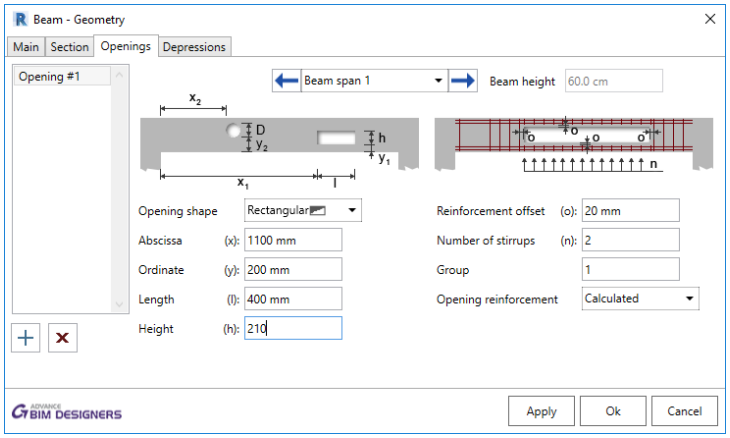
To discover all the possibilities, navigate through the different options on the tabs of the dialogs.

To illustrate the power of the Reinforced Concrete BIM Designers with a more complex example we will use the Geometry dialogue to create an opening and a depression on an existing beam:

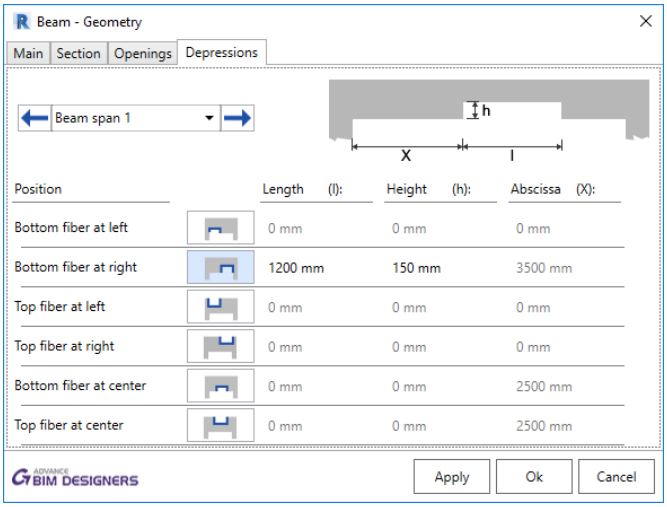
1. Select the Revit® object (in this case a beam) and click on **Geometry**:



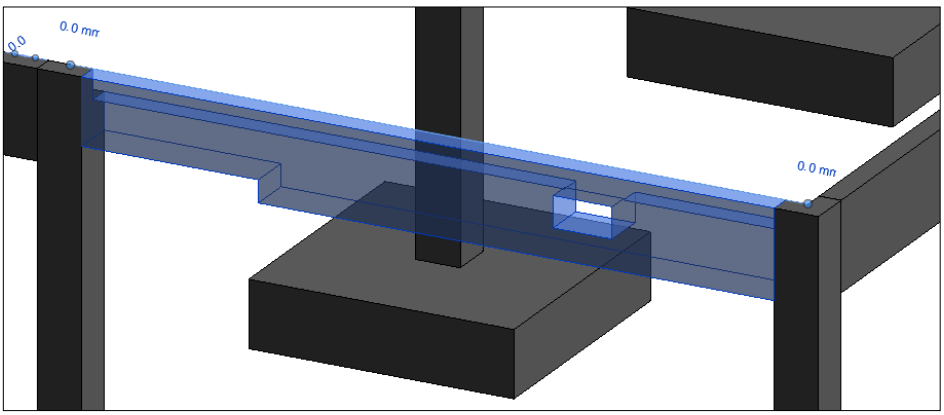
2. In the Opening tab, clicking the + allows you to define the dimensions and the position of the opening (supports multiple entries):



3. In the Depressions tab, you can also describe a depression along the span:

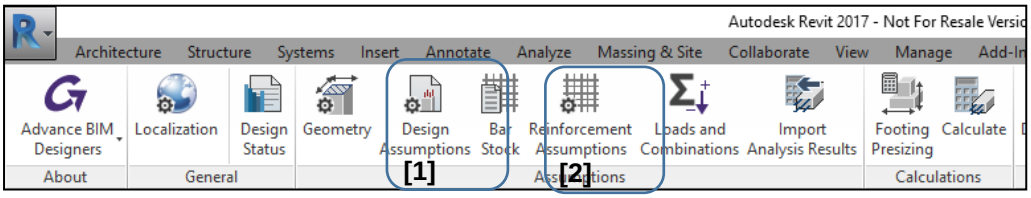


4. As soon as you validate, the Revit® geometry is changed and the geometrical features defined will be taken into account updating the model and creating a new Revit® type. These new features will also be taken into account when designing the reinforcement for the beam and producing automatically the 3D rebar cage:



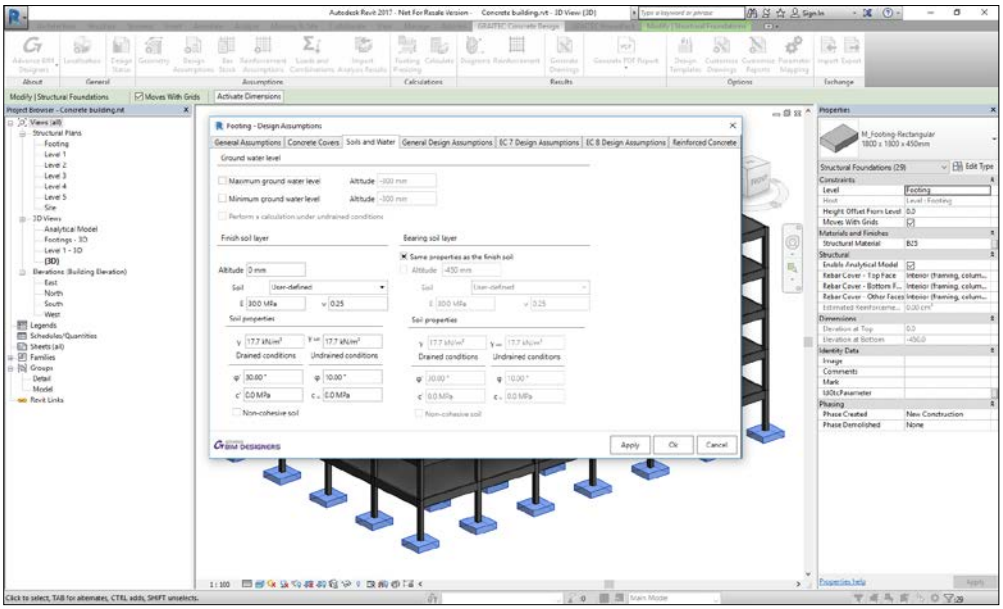
Design and reinforcement assumptions and preferences

Structural design assumptions and reinforcement preferences based on country standards and design codes are introduced in Revit® using the Reinforced Concrete BIM Designers. When an element is selected in the Revit® 3D model, the corresponding icon can be accessed on the GRAITEC Concrete Design ribbon, from which all the design and reinforcement assumptions for the selected object can be managed:

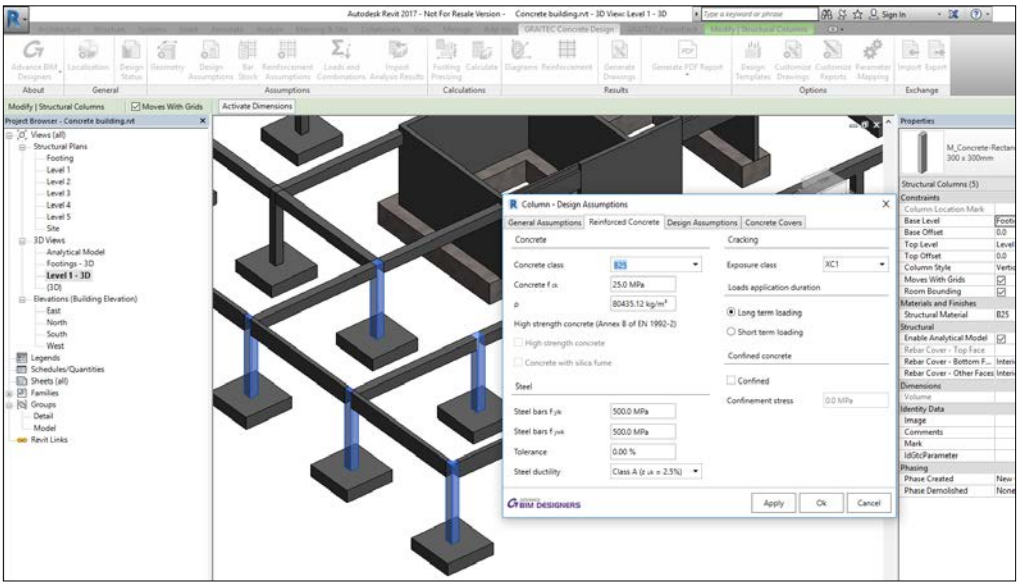


1. Clicking “Design Assumptions” will access the corresponding design assumptions for the selected elements and depending on the design codes set in the localization settings. The system is really intuitive and will only display the corresponding design assumptions options based on the selected elements.

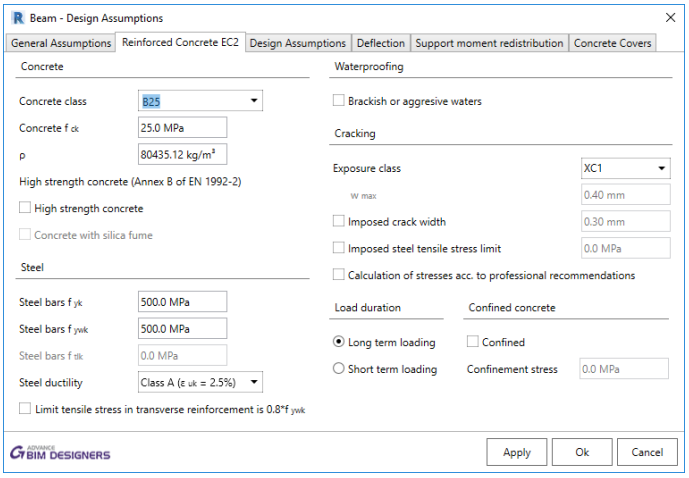
   - If one or more footings are selected the corresponding design assumptions dialog is launched by clicking the corresponding icon  from the “GRAITEC Concrete Design” ribbon:



   - Likewise, if one or more columns are selected, another dedicated dialog is launched using the same icon.



- The same principle applies when selecting reinforced concrete beams:

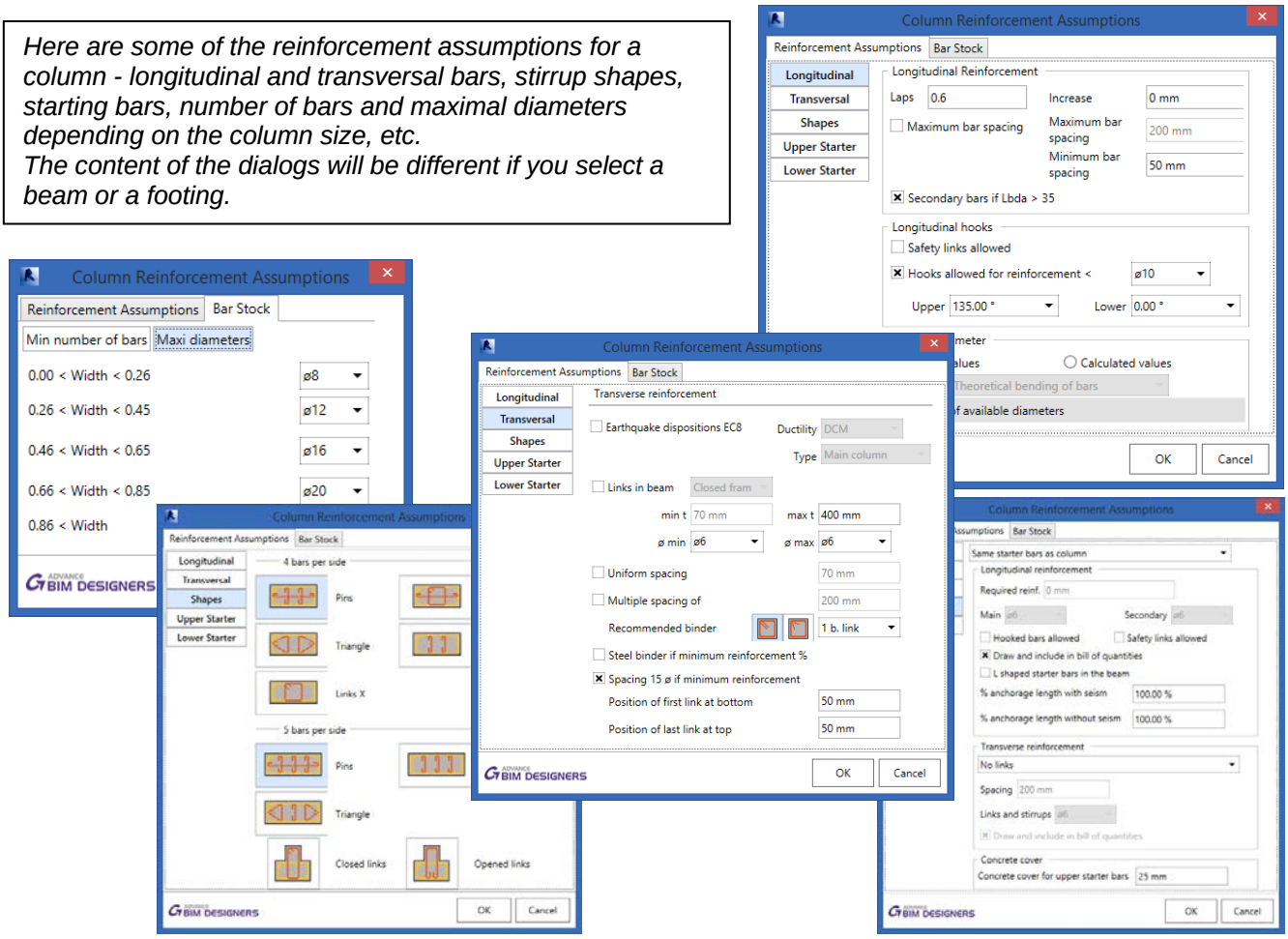


Note: *It is important to note that the content of the design assumptions dialogs is initialized with the design templates you have chosen by clicking on this icon* 

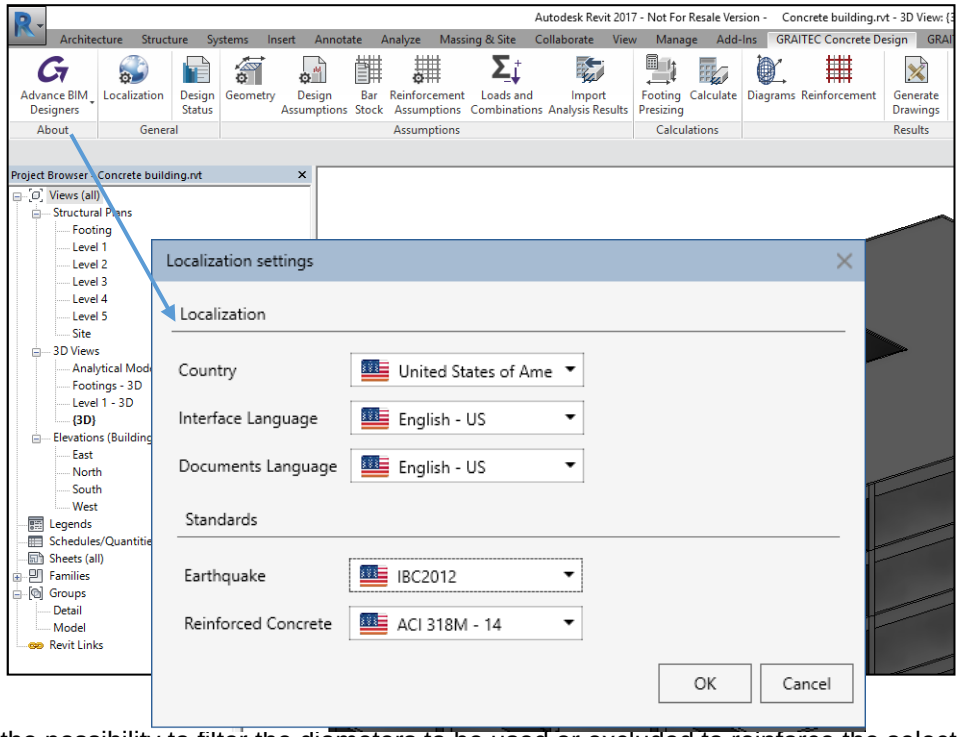
. The creation and editing of design templates can only be done using the standalone version of the Reinforced Concrete BIM Designers.

2. Clicking **Reinforcement Assumptions** will enable you to define all the preferences you want to apply for the automatic placement of bars inside the concrete members - this part will be detailed in the next chapter.

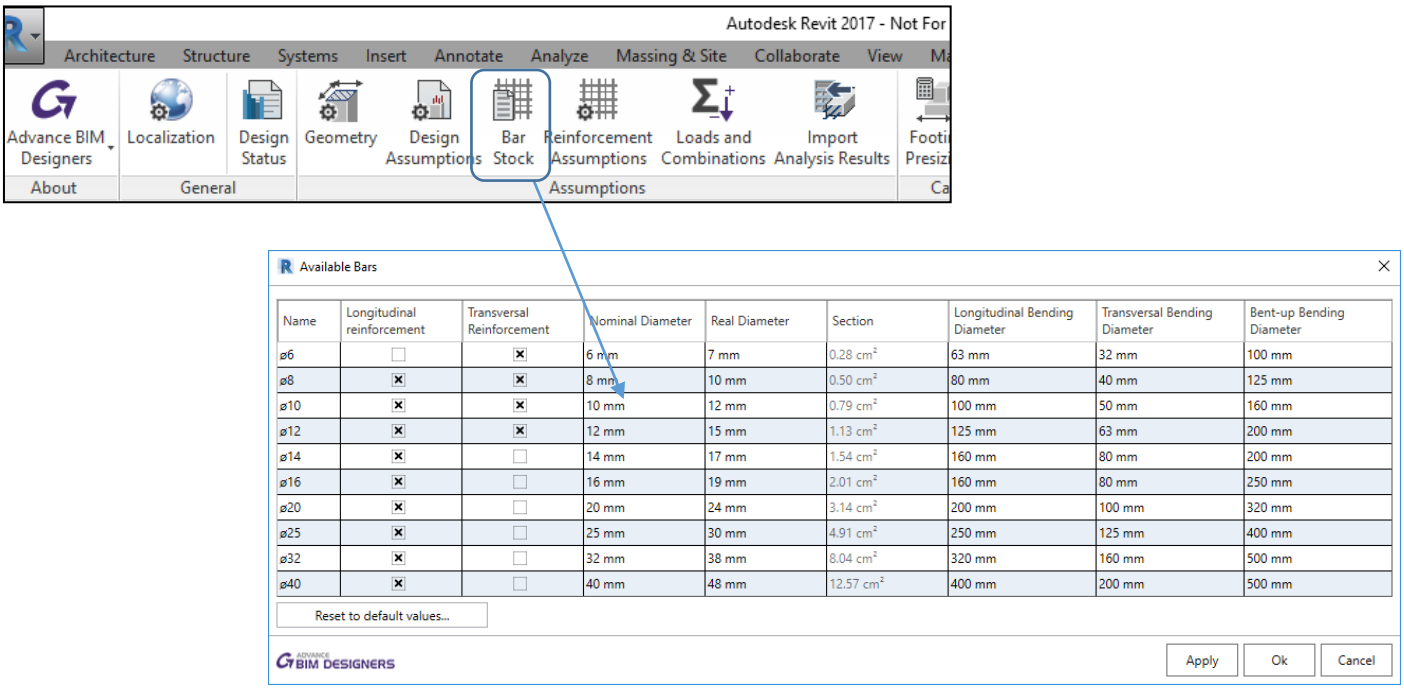
Here are some of the reinforcement assumptions for a column - longitudinal and transversal bars, stirrup shapes, starting bars, number of bars and maximal diameters depending on the column size, etc.
The content of the dialogs will be different if you select a beam or a footing.



Of course, both the design and reinforcement assumptions are country code dependent (Eurocodes with different national appendixes, US codes and Canadian codes) and the user can set the design codes through the **Localization** dialog:



The user also has the possibility to filter the diameters to be used or excluded to reinforce the selected elements. This definition can be done at the level of the selected elements or for the entire project.

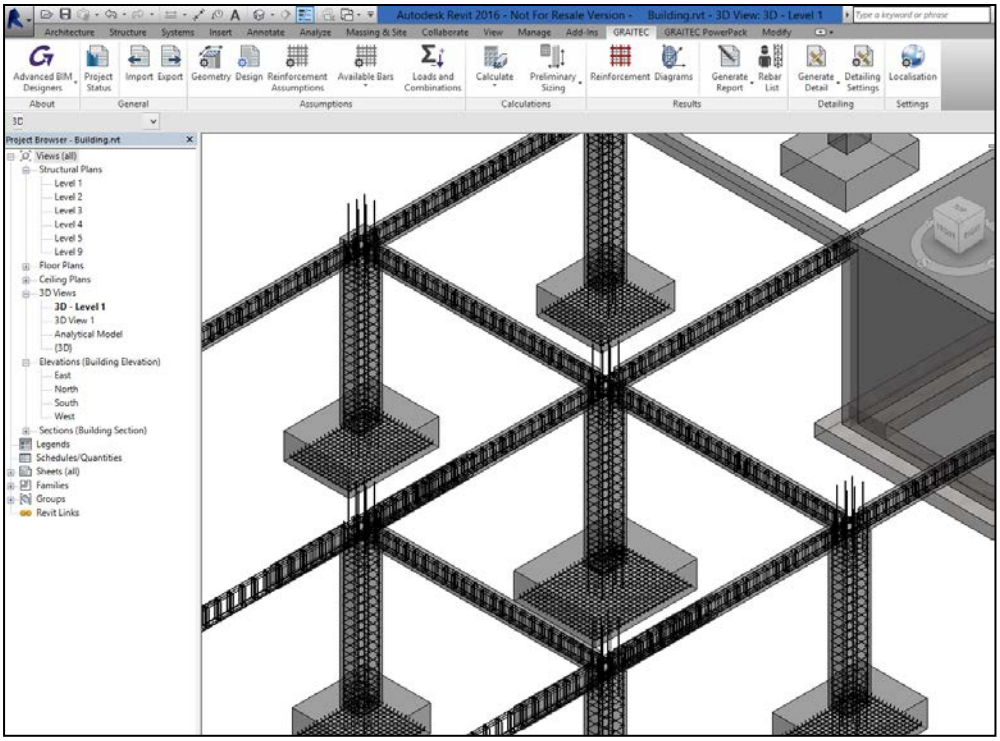


Part 2: Automatically producing 3D rebar cages in Revit®

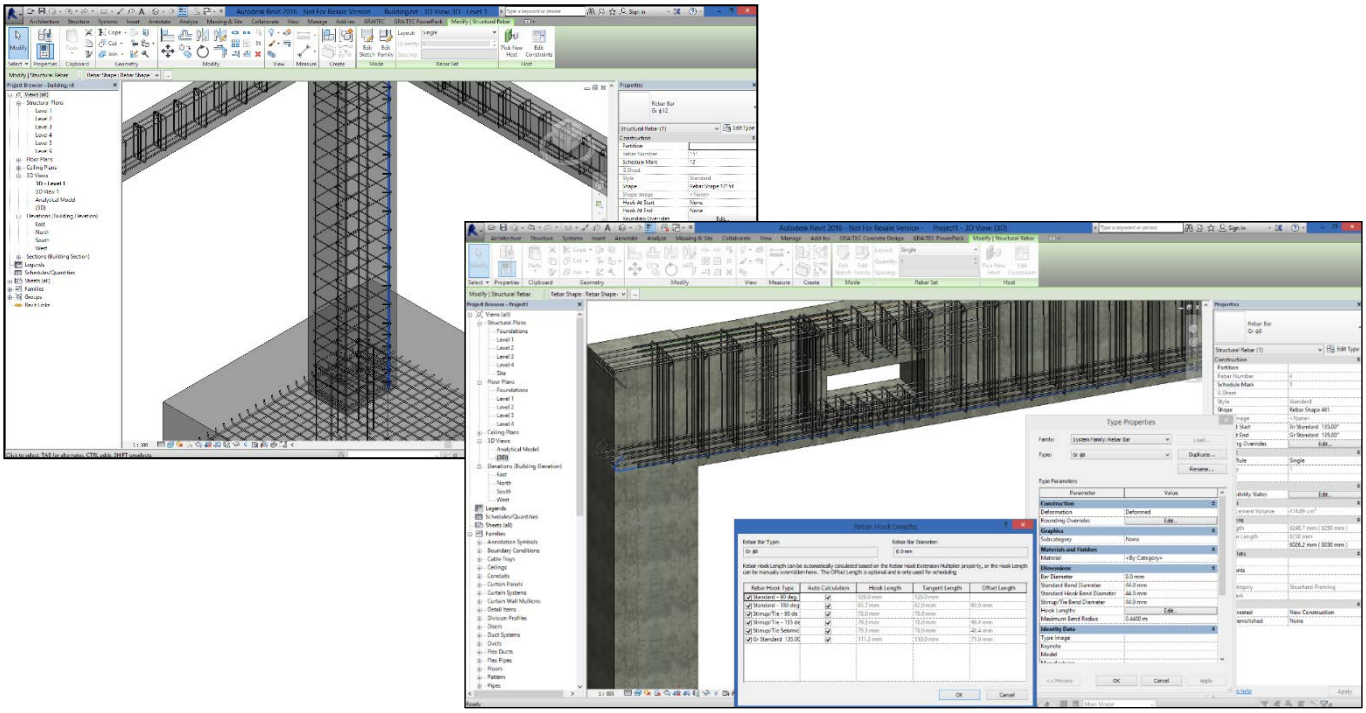
Integrated reinforced concrete design in Revit®

Once you have defined and happy with the assumptions (geometry, design and reinforcement assumptions, bar stocks…), you can run the calculation of the reinforced concrete members (beams, columns and footings) and get the 3D rebar cage.

Just press the Calculate icon and get the 3D rebar cage on the corresponding elements:

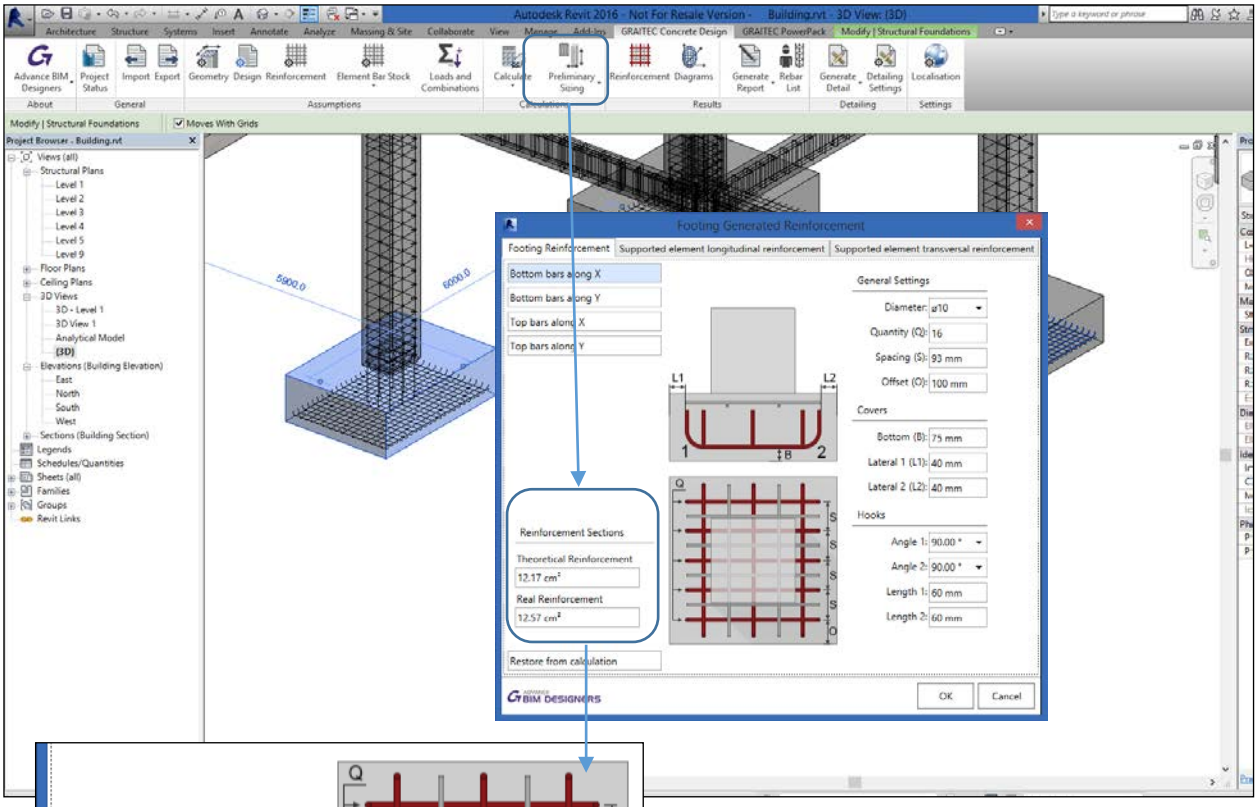


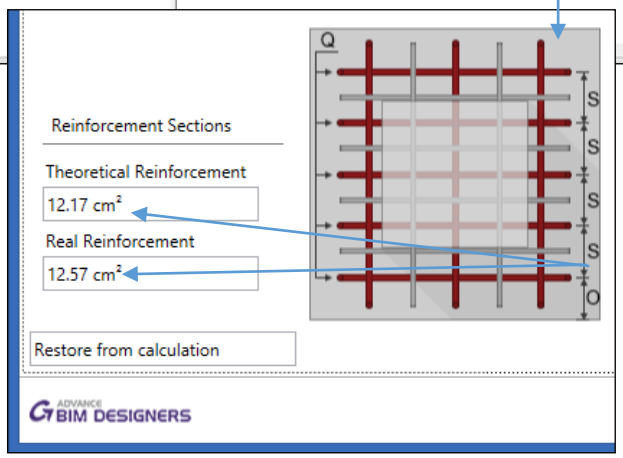
The created bars are native Revit® objects which can be changed through the default Revit® properties and functionalities:



With the Reinforced Concrete BIM Designers, you can design and instantly create 3D rebar cages for single selected elements, or design the whole model and get the complete 3D rebar cages for all supported elements in a few minutes, compared to hours when working with standard Revit® tools!

Also, an important point is the fact that the Reinforced Concrete BIM Designers are dedicated to 3D rebar production. All the 3D rebar cages produced are parametric. At any time, you can select an element (footing, column, and beam) and click on the 'Reinforcement' icon to change or adjust the 3D rebar cage in the parametric reinforcement dialog:

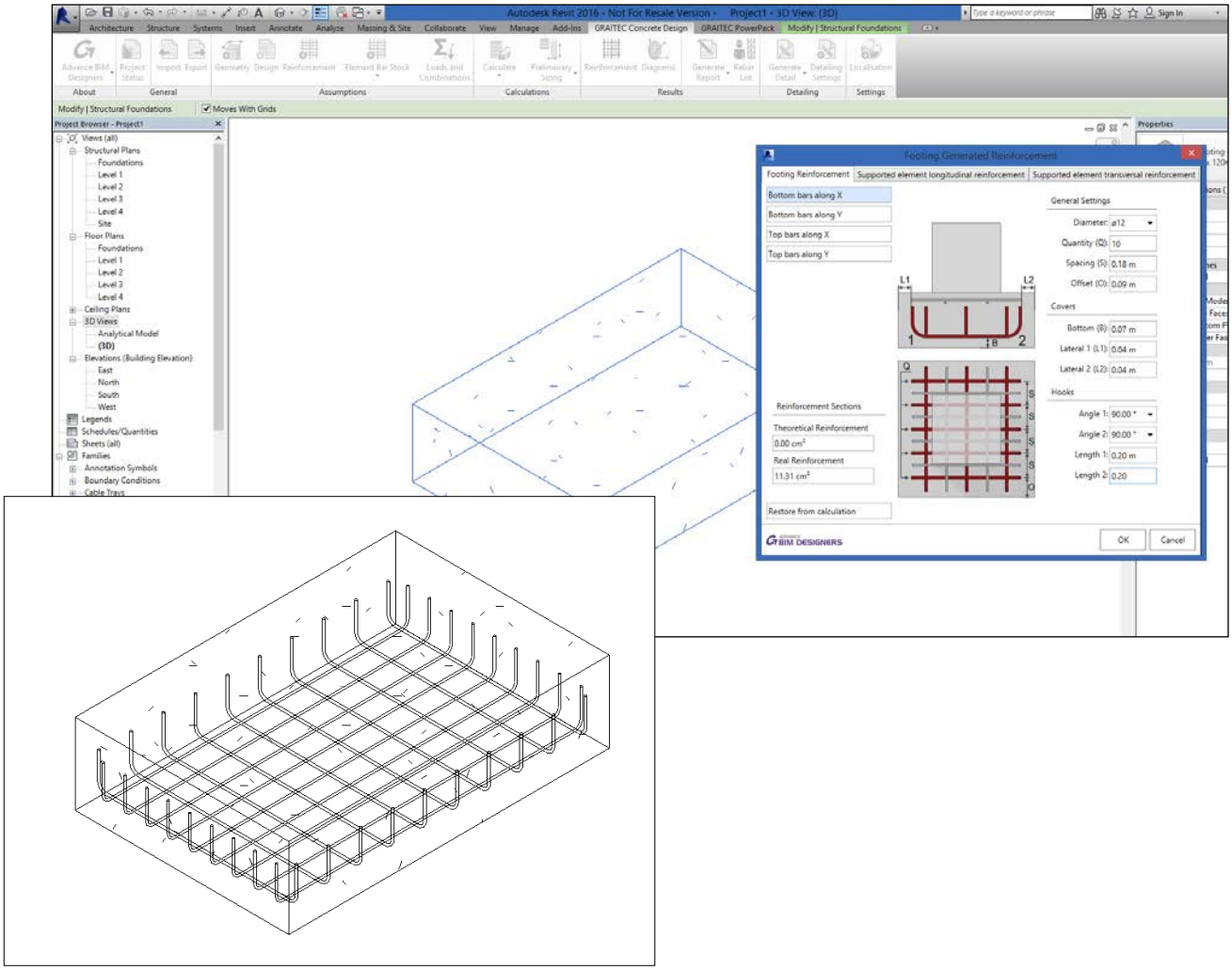




When you make a change in this dialog, the design is updated in real-time and you can immediately check if the real reinforcement defined fits with the design requirements. If not, you will get an error message and the text will be displayed as red.

Rebar generator

The parametric reinforcement dialog can also be used on its own as a 3D rebar cage generator without defining any design assumptions or imposing FEM results. In this case, just select a structural element (column, footing, beam) and click on the '*Reinforcement*' icon from the ribbon:

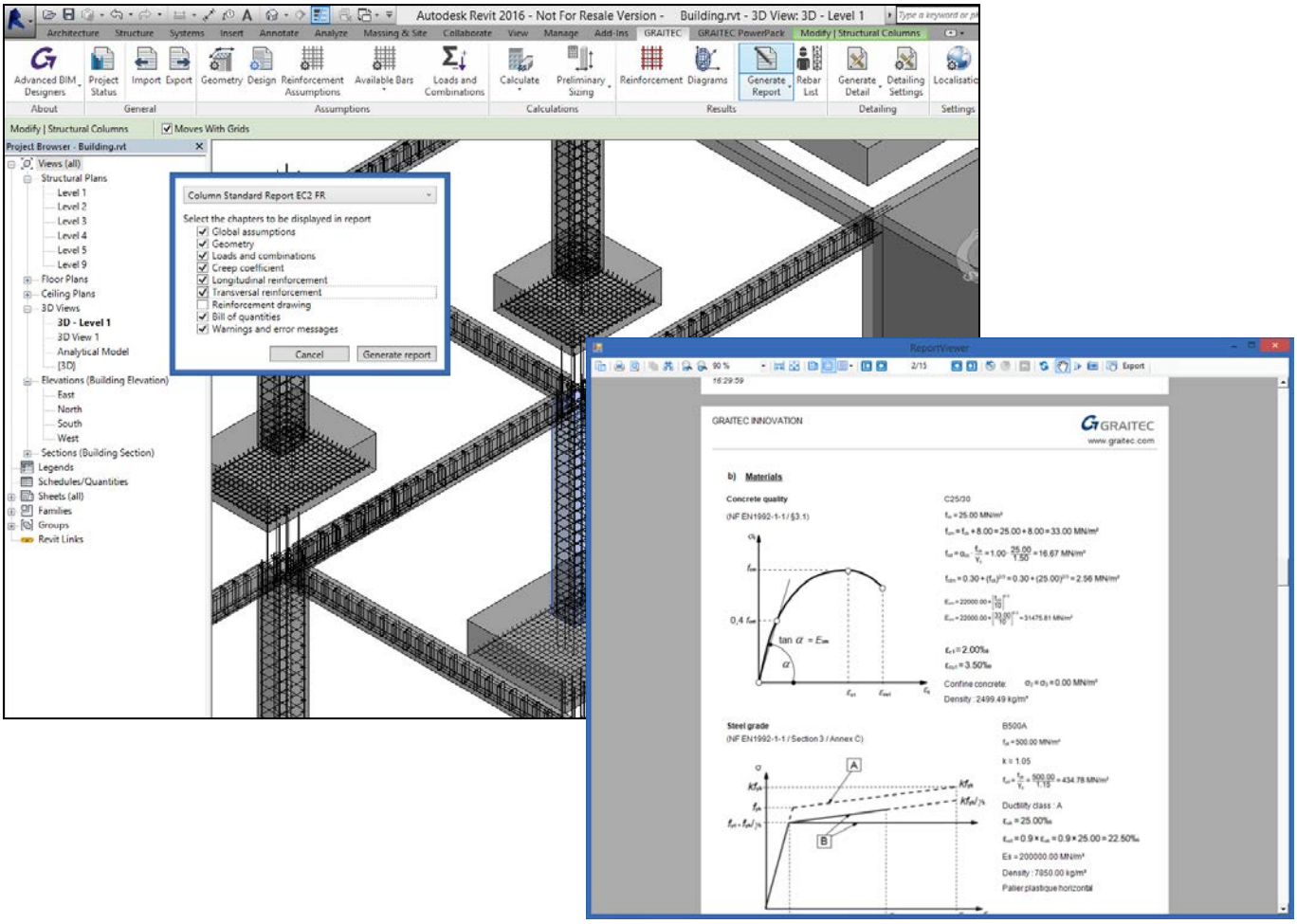


A 3D rebar cage will be produced as specified using Revit® families which can continue to be applied in a standard Revit® process!

Detailed design reports

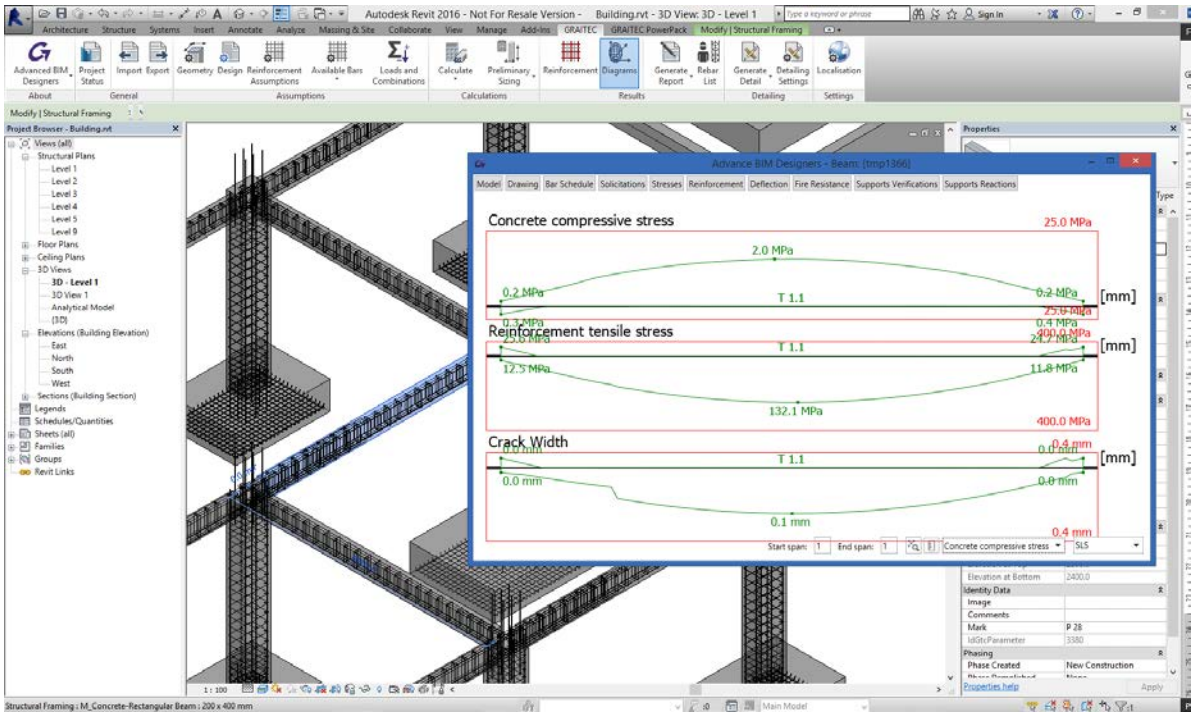
Detailed design report can be created from Revit® using the GRAITEC Reinforced Concrete BIM Designers. All the design detail and calculations will be included in a technical document, including all the formulas and corresponding articles from the selected country standard, the numerical applications and the corresponding graphics.

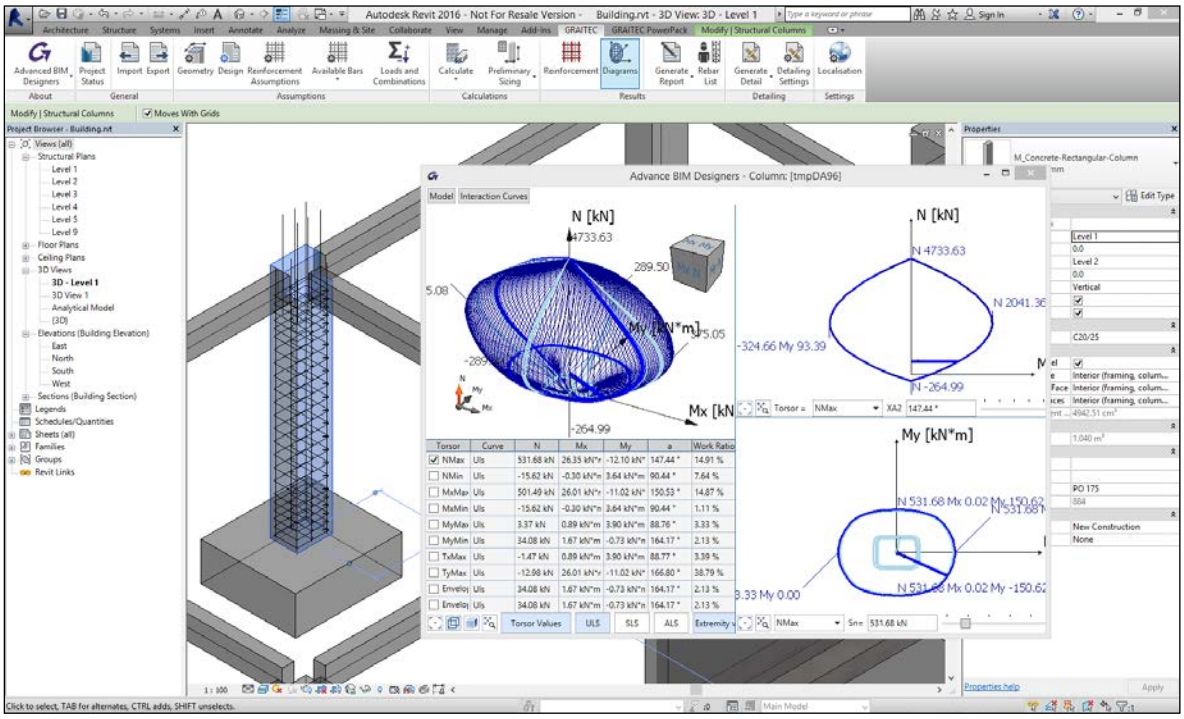
To generate a design report, just select and element in the model, pick the **Generate Report** icon from the ribbon, select a report template and define the level of details, then click 'Generate report'.



In addition to the detailed design reports, you can also access the integrated graphical post-processing engine in order to visualize the design results directly from Revit® showing the interaction curves on columns, stability verification on footing, crack width check and stress diagrams on beams.

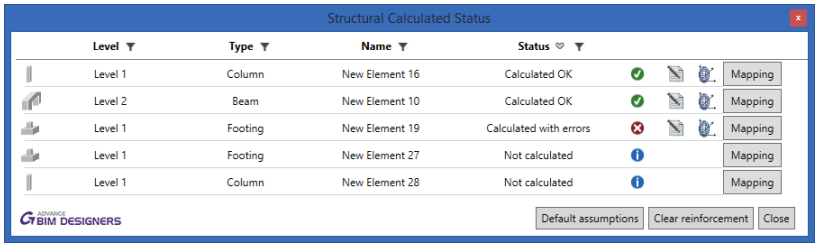
For this, just select an element and activate the function 'Diagrams':





It is important to prove or justify how bars are calculated and how the results achieved. Of course it is expected that the calculated elements will not be checked one by one, that would waste too much time. However at any time the **Project Status** dialog can be called up to present a dashboard displaying which elements have been calculated, which, if any have errors or warnings, and which still need to be designed.

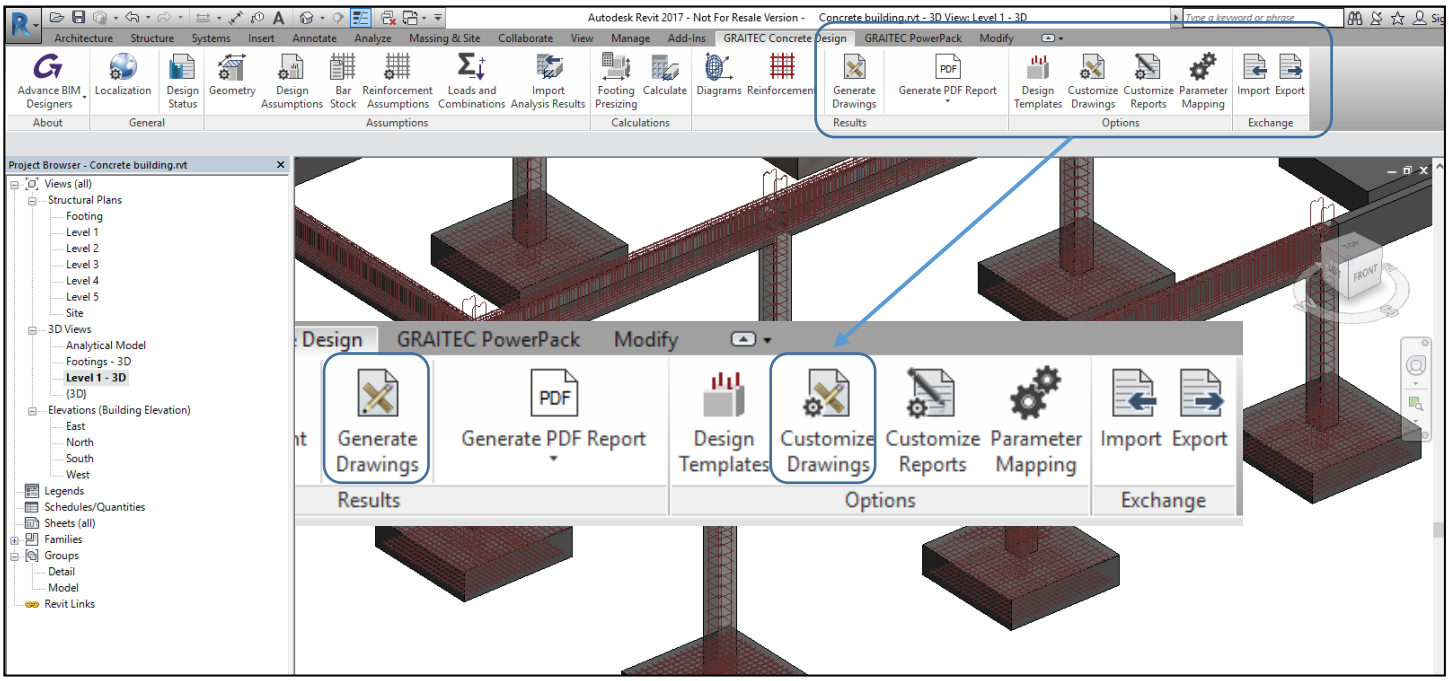
This is the main reinforcement dashboard of your Revit® project:


Structural Calculated Status
Level
Type
Name
Status
Level 1 Column New Element 16 Calculated OK Mapping
Level 2 Beam New Element 10 Calculated OK Mapping
Level 1 Footing New Element 19 Calculated with errors Mapping
Level 1 Footing New Element 27 Not calculated Mapping
Level 1 Column New Element 28 Not calculated Mapping
BIM DESIGNERS
Default assumptions
Clear reinforcement
Close

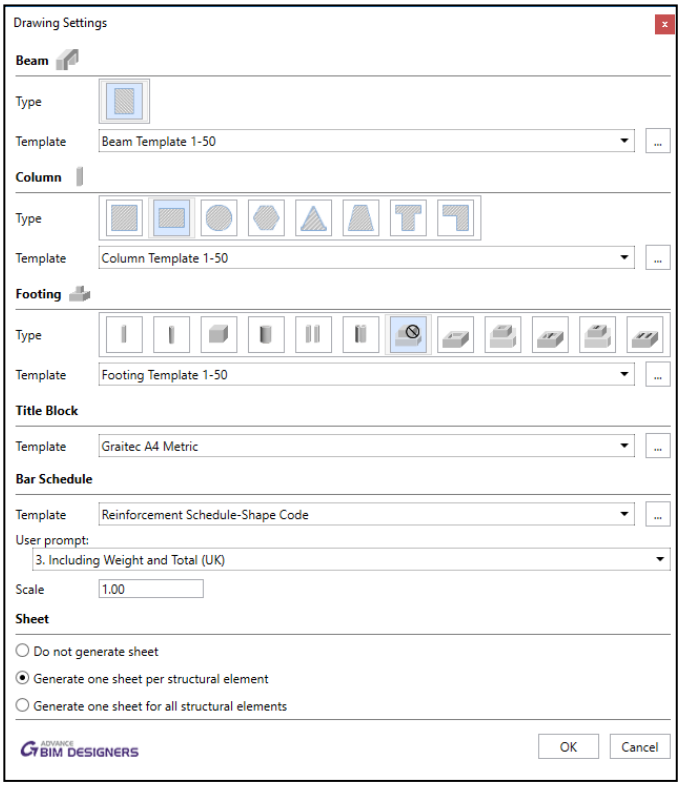
Part 3: Automatically produce the reinforcement drawings

The creation of reinforcement drawings is also automated with the Reinforced Concrete BIM Designers. Based on the designed 3D reinforcement, the application is able to create the required section views, place annotations and dimensions, produce bar schedules, bill of quantities and consolidate all views of a single element on a drawing sheet.

There are two functions available from the “GRAITEC Concrete Design” ribbon:

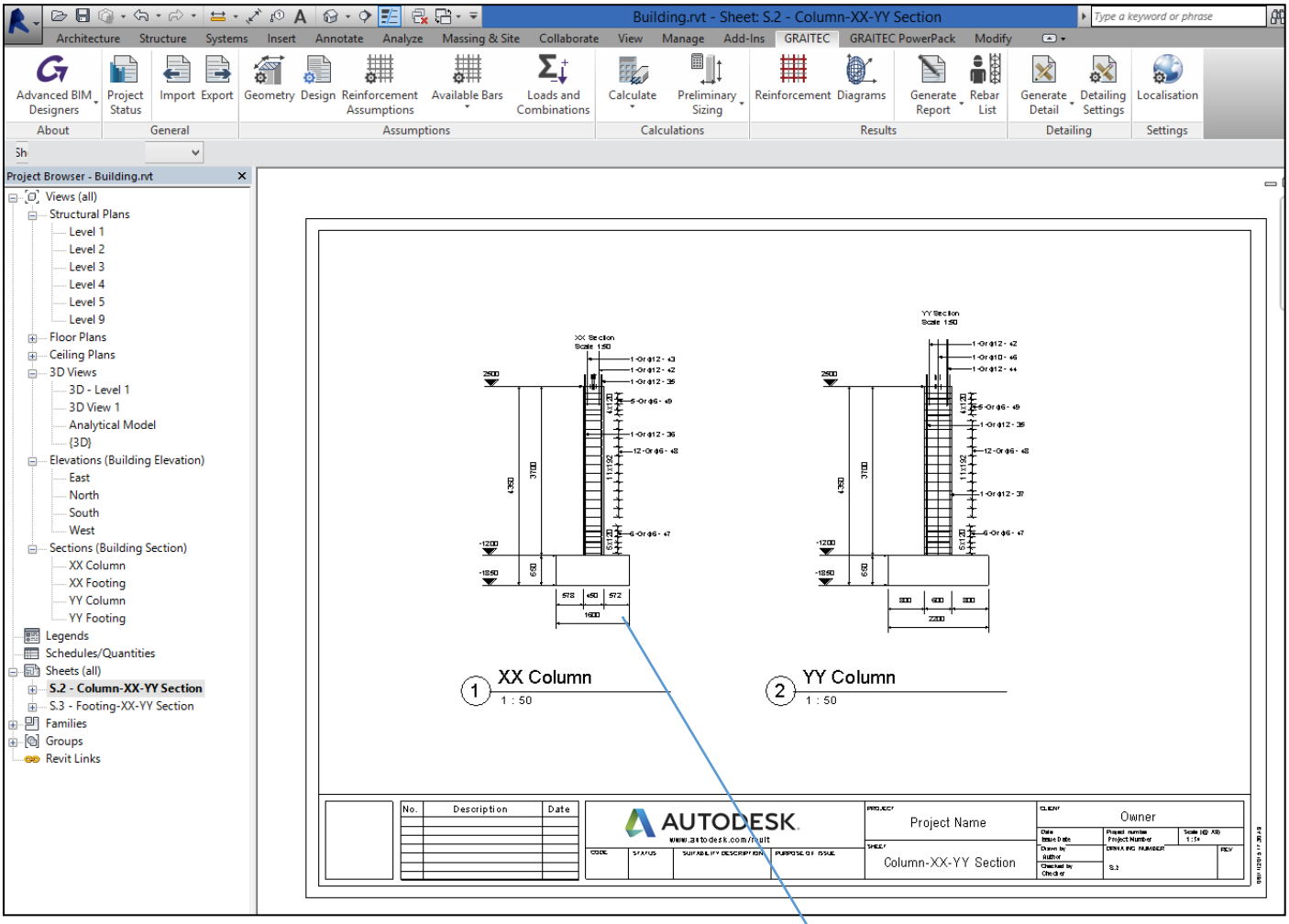


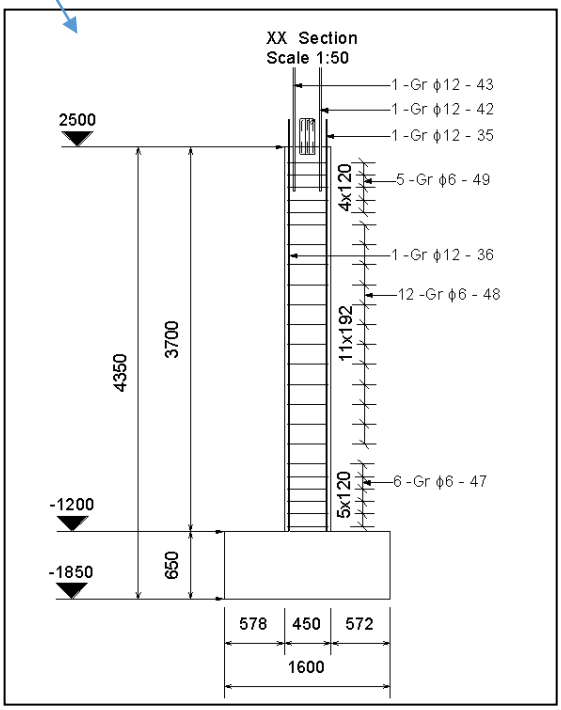
This process uses customized Revit® templates similar to what Revit® uses to manually produce traditional section views. The “Customize Drawings” function presents a dialog where you can define your preferred drawing options:



- The user can apply a drawing template per member and per type
- The user can also select a title block template
- The user can decide to generate a bar schedule on the drawings
- In addition to the views creation, it is also possible to generate the drawing sheets, either one per element, or a single drawing with several selected elements

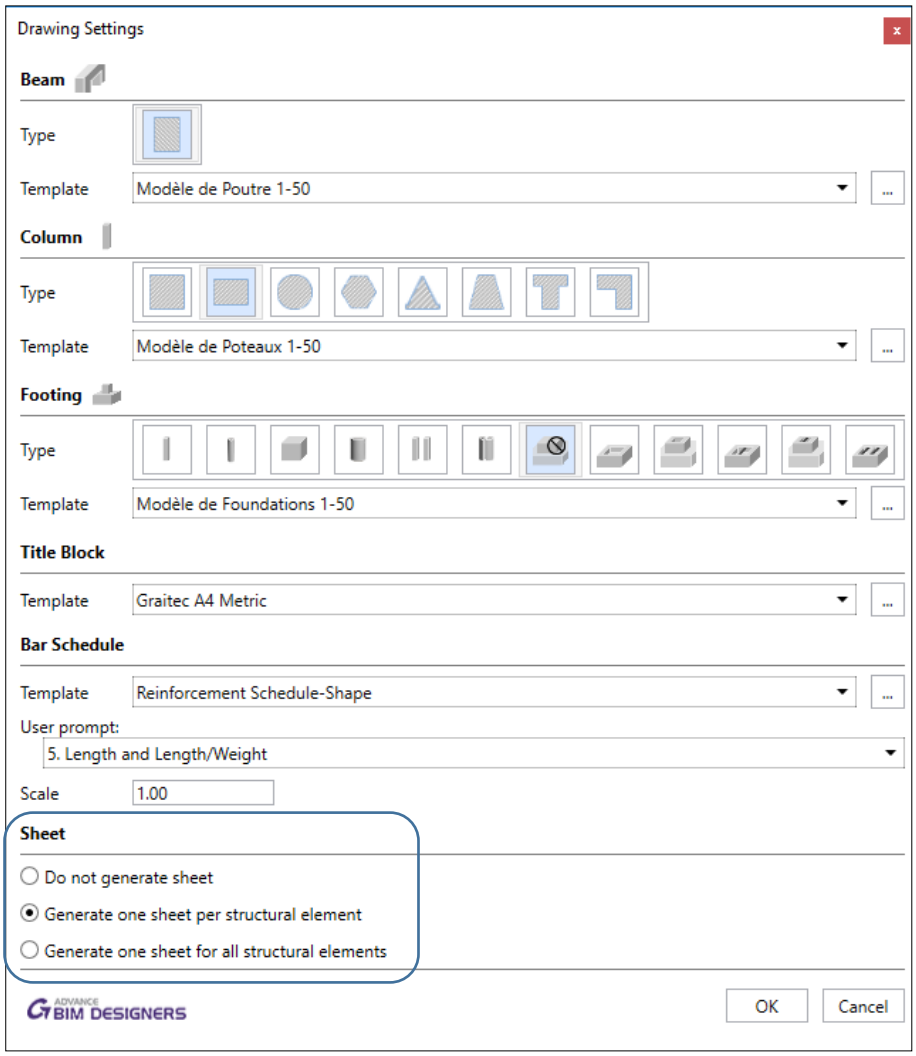
Once your preferred templates have been selected and applied, hit the “Generate Drawings” icon to get the views and drawing sheets of the designed reinforced concrete elements created automatically:





This is a typical section view produced automatically using the Reinforced Concrete BIM Designers. The bar tags and annotations are based on the Revit® template (RVT file) defined in the drawing settings and can be customized to suit.

An additional option is to automate the full process including the drawing sheets, which can be generated per single element or for a multiple selection as shown here:



Check or uncheck the options as required. If you prefer to create your own drawing sheets check the option ‘Do not generate sheet’ and use the Reinforced Concrete BIM Designers to generate the rebar cages and produce all the section and detailed views for each element.

Part 4: Manually modeling rebar in Revit®

Autodesk® Revit® software provides a wide range of tools to manually model reinforced concrete structures in both 2D and 3D. As shown in below image Figure 1.

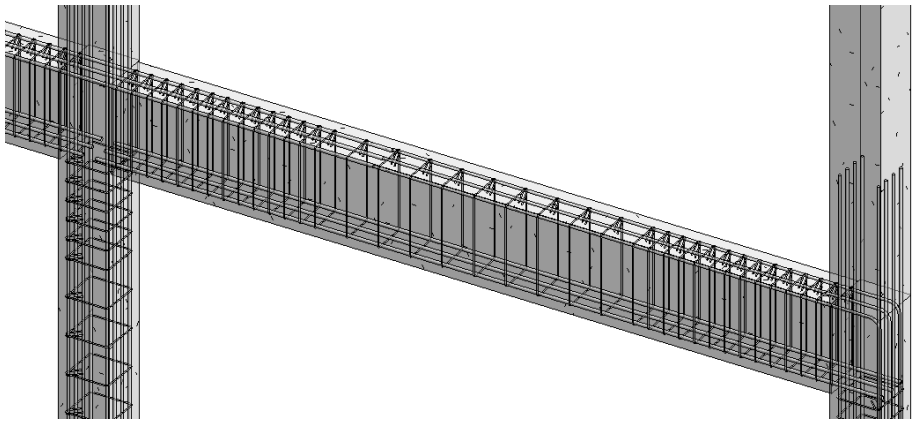
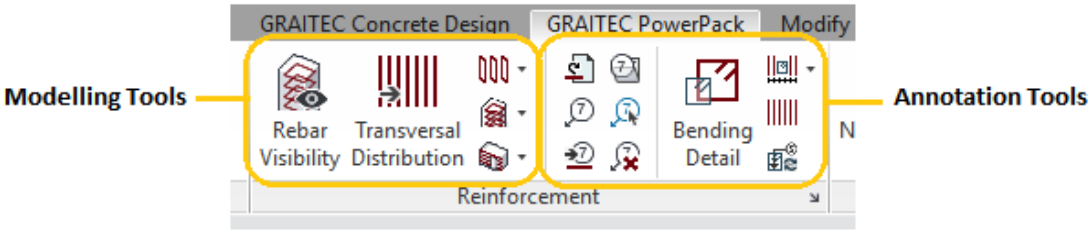


Figure 1 Rebar Example

Advance PowerPack for Revit® is a multi-discipline plugin for Autodesk Revit®, developed by GRAITEC as part of the Autodesk AEC Solution Associate framework, which includes dedicated tools, processes and localized families to enhance and speed up the creation, documentation and annotation of rebar in Autodesk® Revit®.



This tutorial will give insight on how all of these tools can be applied when modelling and detailing reinforced concrete structures. The tutorial is broken into two sections:

SECTION 1 – Modelling

- Rebar in Element - Copying
- Rebar in Element - Deleting
- Rebar visibility
- Transversal distribution
- Rebar sets
- Cutting rebar back to fit an element
- Extending rebar

SECTION 2 – Annotation

- Assign rebar number to sheet
- Browse Reinforcement
- Set Rebar Number
- Select by rebar number
- Renumber reinforcement
- Delete by rebar number
- Bending detail tools

Learning Objectives

- Understand how to speed reinforcement modelling and detailing tasks in Revit®
- Apply learned practices from 2D AutoCAD based tools to transition to BIM working in Revit®

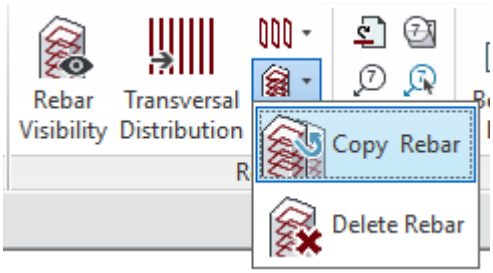
Copying and deleting rebar in elements

The tools in this group are designed to increase productivity whilst working with similar host elements that need to be reinforced or already have reinforcement assigned to them. Unlike default Revit® tools which require you pick individual bars or select host element and filter the selection. These tools work by picking only the host elements, allowing bars to be added or removed from the selection, simplifying and speeding the process.

Exercise 1 - Copying rebar between elements

The **Copy Rebar** tool, allows reinforcement elements to be transferred between rotated and resized columns, rotated and resized beams and rotated footings. Individual bars or the entire reinforcement cage can be copied to one or more elements at a time and assigned to the new element with reinforcement rotated automatically into the position of the new target host if required. Let's get started.

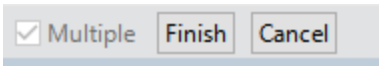
1. Open Revit® sample model {***Graitec_Advance_PowerPack_Revit_Training_v16.02.rvt***} from the training folder. Available to download here.
2. Open the -01 Level (Foundations) Reinforcement view from the project browser under -01 Level Rebar > Structural Plans.
3. On the ribbon select the **GRAITEC PowerPack** tab **> Reinforcement panel > Rebar In Element > Copy Rebar**.



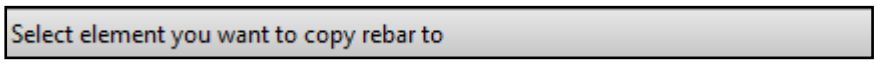
4. Follow the instructions on the Status bar and select the element with rebar, which will be the foundation base on gridline A1.

Note: *If you select an element which is a different size, the reinforcement will adjust to suit.*

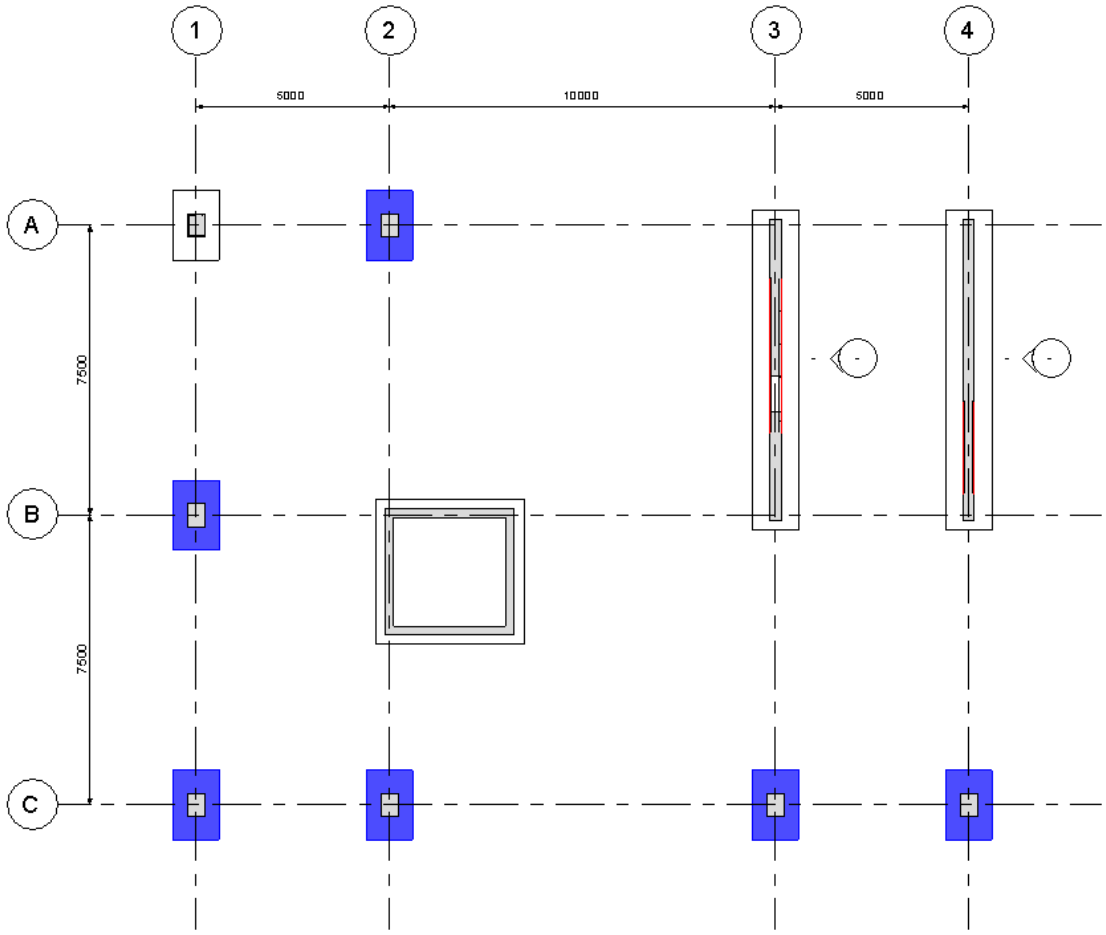
5. Once selected, click the finished icon on the Options bar or hit **Enter/Return** on the keyboard/mouse.



6. Again, follow the instructions from the Status bar and select the element(s) you wish to copy the rebar to.



7. Select the following foundations: A2, B1, C1, C2, C3 and C4.



8. Once you have selected all the elements click the finished icon on the **Options** bar/**Enter**.

9. Investigate the footings that you have just clicked, and check the bars now populated in them. They will match the original bars matched from the A1 footing.

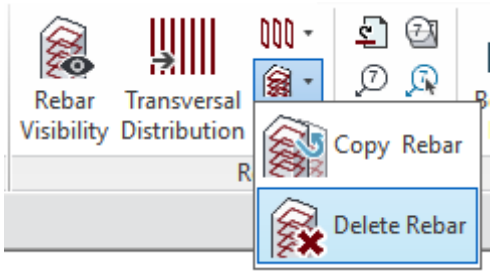
Tip: *If you have selected the wrong element you can simply deselect it by holding down the shift key and left-click on the element in question.*

Exercise 2 - Delete Rebar Elements

The reverse command of Copy Rebar is **Delete Rebar**, which offers the possibility to delete the entire reinforcement of the selected host element or certain parts of it, rather than manually finding each rage or bar and deleting as you would have to with native Revit® commands.

The command is clean and efficient and can be applied to one or more objects at a time (single or multiple selections). It is also possible to exclude one or more bars from the selection that is to be deleted.

1. Remain in the -01 Level (Foundations) Reinforcement view.
2. Zoom in on the foundation bases on gridlines A1 and A2.
3. On the ribbon select the GRAITEC PowerPack tab > Reinforcement panel > Rebar In Element > Delete Rebar.



4. Follow the instructions on the Status bar and select the element with rebar in. Which will be the foundation base on gridline A2.

Note: *You can select multiple elements if you wish during this action.*

5. Once selected click the Finish icon on the Options bar or hit Enter.
6. Again follow the instructions from the Status bar and select reinforcement to exclude from the element(s).

- **All Bars** – To delete all bars in element just select Finish from the options bar. All the reinforcement will be deleted.
- **Select bars** – To delete bars individually click on the bar or bar runs one by one to highlight them. Once you have selected all the bars you require click Finish on the options bar. Just the selected reinforcement will be deleted.

Tip: *If you have selected the wrong element you can simply deselect it by holding down the shift key and left-click on the element in question. To deselect all the bars just click on the screen away from the element.*

Rebar Visibility

Traditionally reinforcement is hidden by default and would need made visible in the *Rebar Element View Visibility States*. This is done by selecting the reinforcement in the view and then adjusting the View Visibility States dialog box. This process can take some time and needs to be repeated each time you want to visibility state of rebar.

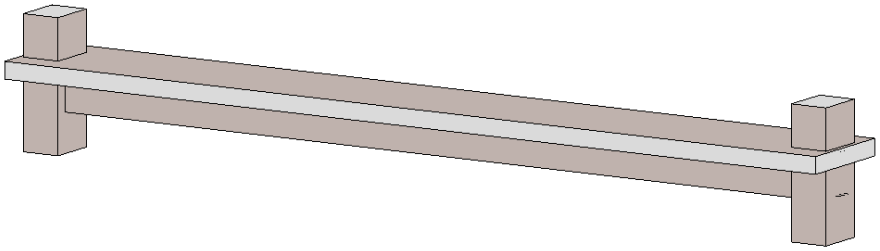
The **Rebar Visibility** tool is a quick way to change the visibility state in order to show/hide reinforcement bars. These settings are applicable for the fine level of detail, and can be used in a very practical way, applied to the active view or for the whole project

Using the **Rebar Visibility** tool is easier and quicker for changing view states.

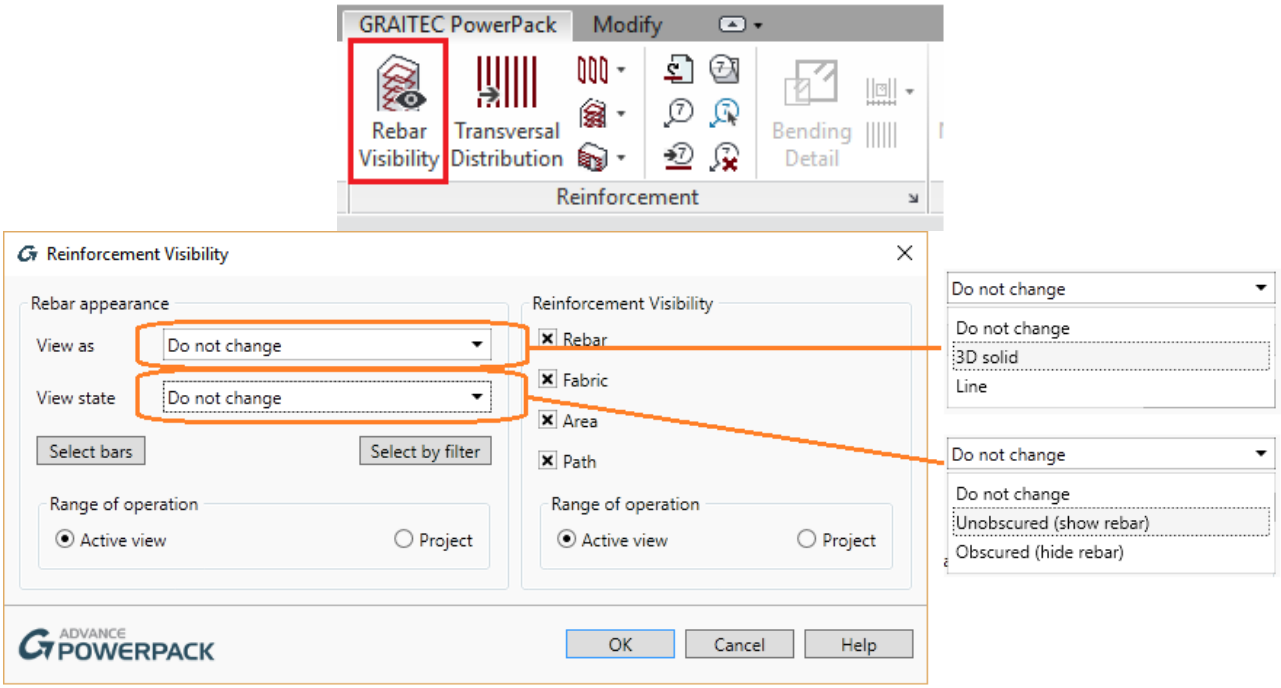
In this exercise we will look at how we can change the Visibility State across multiple views in Revit® of a single bar, the whole element or filtering by partition, rebar shape, bar number and many others.

Exercise 3 - Single Bar (Line Un-obscured)

1. From the project browser open the following view **02 Level Rebar > 3D Views (3D RC View) > 3D Beam GL C Level 2**.
2. All the bars should currently be hidden by the elements (Standard shaded style).



3. On the ribbon select the **GRAITEC PowerPack** tab **> Reinforcement panel > Rebar Visibility**.



4. When the **Reinforcement Visibility** dialog box appears on screen you can change the options to display reinforcement as **line** or **3D solid** and set the view state to **unobscured** or **obscured**. As shown in figure 2.

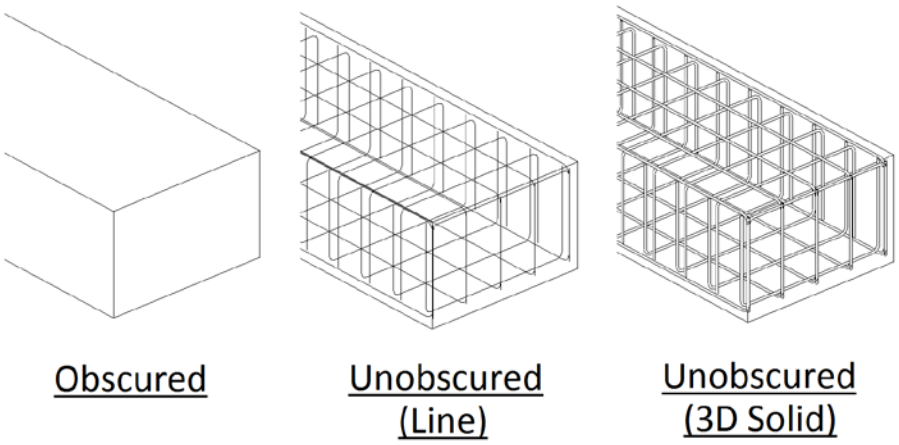
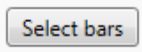


Figure 2 - Rebar Visibility (Hidden line style)

5. In the Reinforcement Visibility dialog box set the following:
   - ✓ View as – **Line**
   - ✓ View State – **Unobscured**

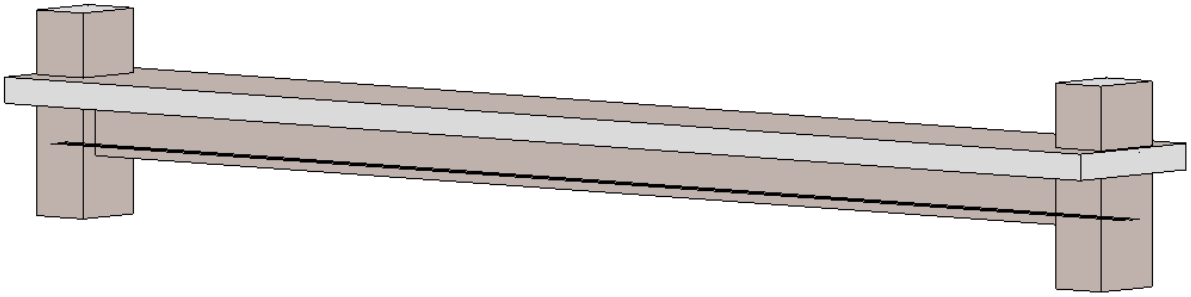
6. Then, click the 

icon.

7. Follow the instructions on the Status bar and select the main bars at the bottom of the beam.

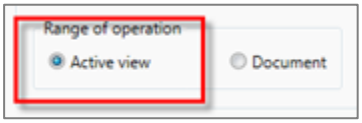
8. Now that the bar(s) have been selected, click 

on the options bar.



9. The Reinforcement Visibility dialog box should appear back on screen. Click **OK** to complete the action.

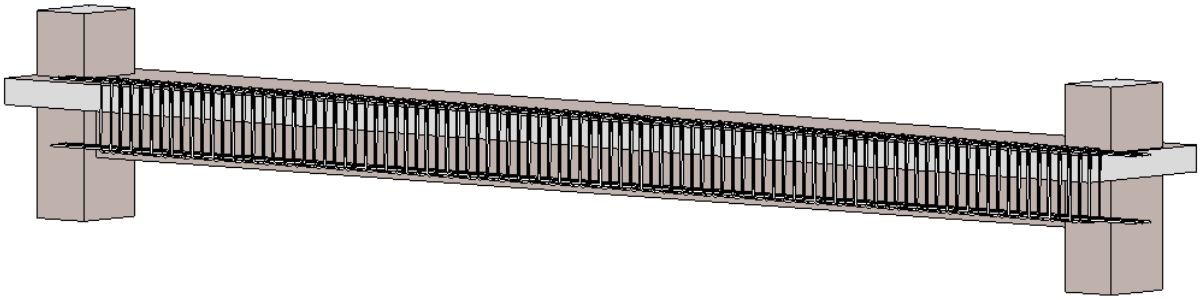
Note: *Make sure you leave the range of operation set to **Active view**, so it will only make reinforcement visible in this view and not the whole model.*



Exercise 4 – Show all bars (3D solid un-obscured)

This time we'll make all the reinforcement visible and solid within the beam.

1. Remain in **3D Beam GL C Level 2** view.
2. On the ribbon select the **GRAITEC PowerPack tab > Reinforcement panel > Rebar Visibility**.
3. When the **Reinforcement Visibility** dialog box opens set the following:
   - ✓ View as – **3D solid**
   - ✓ View State – **Unobscured**
4. Simply click **OK** in the reinforcement visibility dialog box.
5. Without using Select bars or Select by filter all the bars in the view will now be visible as solid.

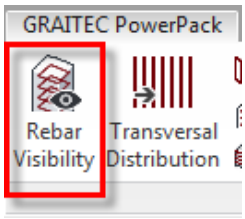


Exercise 5 – Selection filters

You may be wondering what the advantage is over the existing Revit functionality for visibility, other than saving a few clicks changing the Visual Styles in the traditional way. The more advanced features of **Rebar Visibility** tool covered in the next exercise will help clarify its advantages.

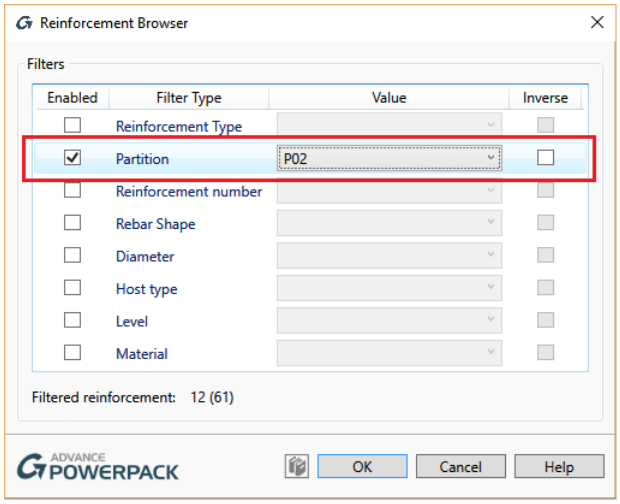
In this exercise we are going look at how we can use filters to display specific rebar.

1. Open the **3D Foundations Rebar** view from the project browser **-01 Level Rebar > 3D Views (3D RC View)**.
2. On the ribbon select the **GRAITEC PowerPack** tab **> Reinforcement panel > Rebar Visibility**.



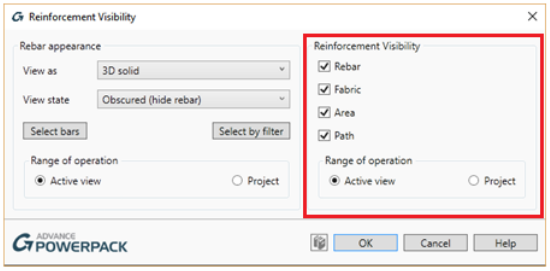
3. When the **Reinforcement Visibility** dialog box opens set the following:
   - ✓ View as – **3D solid**
   - ✓ View State – **Unobscured**
4. Now click Select by filter.

5. Tick **Partition** and then from the dropdown list select **P02**, as shown below.



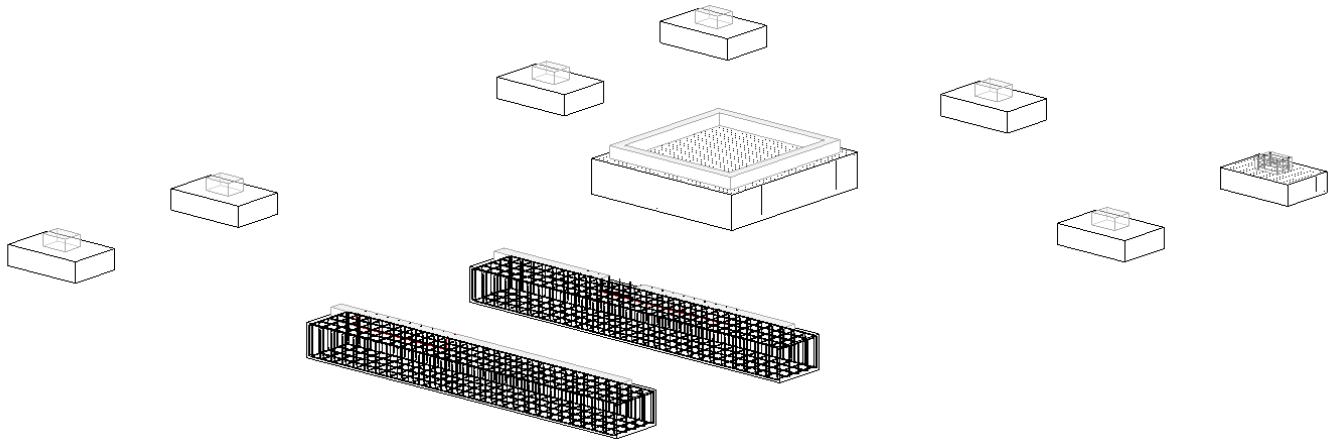
Note: *You can select more than one type if required. Doing this will refine the filter further.*

6. Select **OK** to return to the reinforcement visibility dialog box.



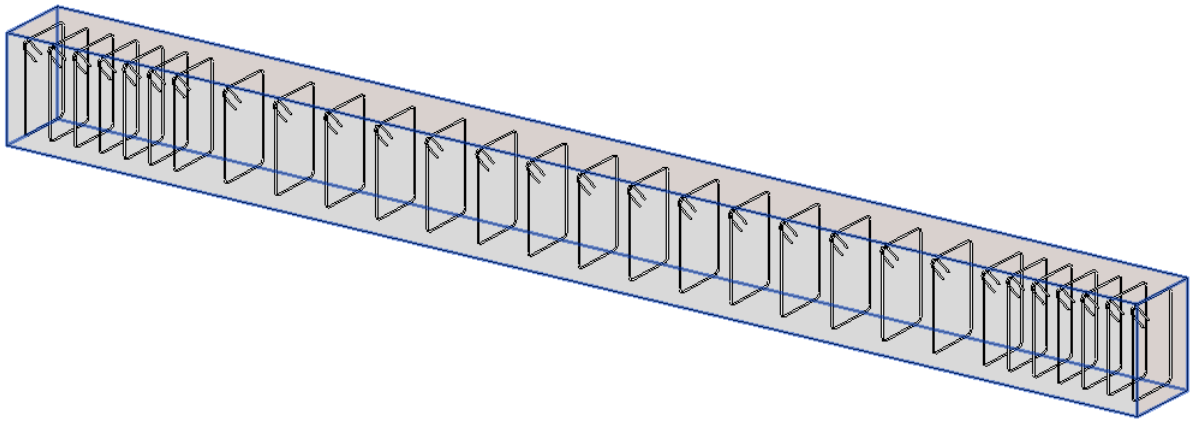
Note: *In the right hand panel you have options to select if the visibility state is applied to rebar, fabric, area or path reinforcement.*

7. Again, make sure you leave the range of operation set to **Active view**, so it will only make reinforcement visible in this view and not the whole model.
8. Now select **OK** to apply settings. Note how only the visibility state of the selected partitions has been affected.

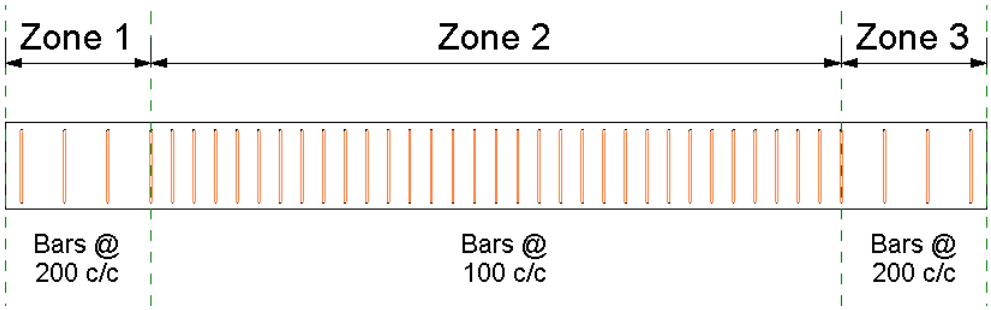


Transversal rebar distribution

This tool enables the automatic generation of transversal rebar sets with multiple spacing for linear elements. From the easy to use interface the user has the option to quickly create multiple transversal reinforcement cage configurations.



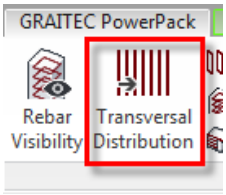
When adding distribution bars to a beam using standard Revit® functionality, bars can either be added by ‘fixed distance’ or by ‘number of bars’. It’s not currently possible to justify rebar by a zone which means in the example below three different rebar sets would need to be added to achieve the distribution required for this beam.



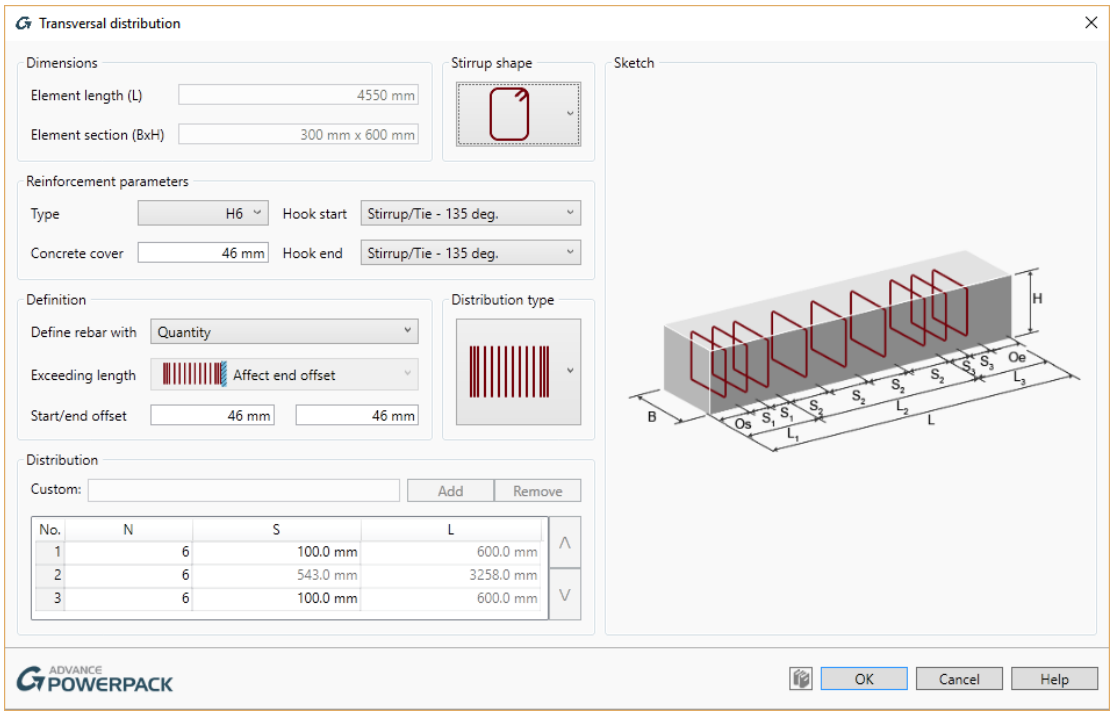
Exercise 6 - Placing traversal distribution bars in beam

In this exercise we will look at how we can distribute bars all at once and create as many zones as required using the GRAITEC PowerPack tool **Transversal Distribution**.

1. Now open the **Elevation B1.11** view from the project browser **01 Level Rebar > Elevations (RC Elevations)**.
2. On the ribbon select the **GRAITEC PowerPack** tab **> Reinforcement panel > Transversal Distribution**.



3. Select beam **B1.10** and the transversal distribution dialog box will open on screen.
   The transversal distribution tool automatically reads the dimensional information from the beam selected, i.e. the beam length, width and height.



Dimensions: Information extracted from selected element.

Stirrup shape: Allows you to choose different stirrup shapes.

Reinforcement parameters:

- Select the bar type/size
- Cover to concrete
- Define the hook at the start or end of stirrup

Definition:

- Define rebar with: How rebar will be spaced
- Exceeding length: define end conditions
- Start and end offset setting out

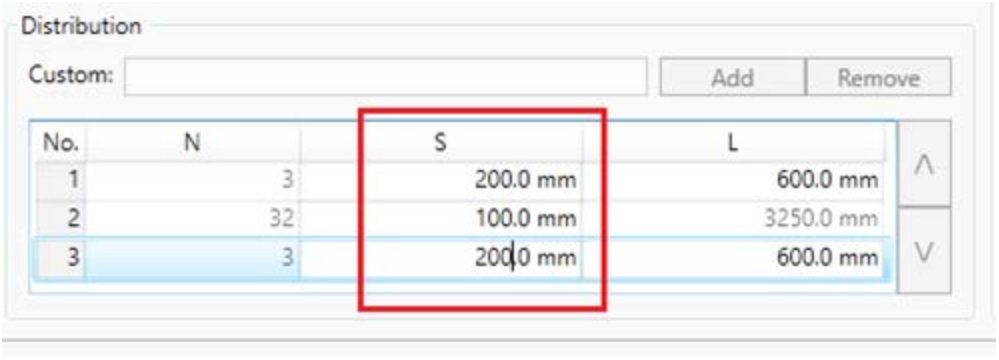
Distribution type: Set zone distribution type

Distribution: Allows you to customize the number of bars or spacing's in each part of the zones selected and add more zones.

4. Leave the **Stirrup Shape** as the default option: rectangular shape.
5. Under **Reinforcement parameters**, change the **Type** to **H10** and the **Concrete cover** to **30mm**.
6. In **Definition**, change the **Define rebar with** to **Spacing and length**, then set the start and end offset to **50** and finally in **Distribution type** select **3 zone distribution**.
7. In the **Distribution** panel, set the spacing to the following:

   Zone 1 = 200mm, Zone 2 = 100mm, Zone 3 = 200mm as shown in below image.

   The number of bar will be automatically calculated.



8. Now select **OK** to finish.

   All the bars should now be added to the beam, but due to the Visibility State they are not visible in this view.
9. Select from the ribbon ***GRAITEC PowerPack tab > Reinforcement panel > Rebar Visibility***. Then simply click **OK**, the tool should remember the settings from the earlier exercise and the bars should appear in beam **B1.10**.

Quick Tip: *Why not isolate this beam in 3D view by using the* ***Auto Section Box*** *tool on the GRAITEC PowerPack Ribbon.*

1. Select beam ***B1.10****, then from the ribbon* ***GRAITEC PowerPack*** *tab* ***> Modelling panel > 3D View > Auto Section Box****.*

2. In the ***Auto Section Box*** *dialog box select a view you wish to use and an offset.*

Note: *You can always duplicate the view to create a new one.*

3. Click ***OK*** *and your beam should now display in a 3D view.*

If you have selected the wrong element you can simply deselect it by holding down the shift key and left-click on the element in question.

Managing rebar sets

Managing rebar sets using standard Revit® tools can be fairly hit and miss as well as labor intensive. As mentioned in the previous exercise it's not possible to justify bars by zone and you need to model each zone separately.

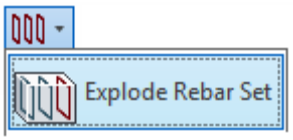
In the next chapter we will take look at the PowerPack tools developed to simplify this process, these are:

- **Explode Rebar Set**: Explodes rebar set to individual bars
- **Split Rebar Set**: Divides a rebar set at a selected point
- **Isolate Rebar Set**: Removes a single bar from a rebar set, leaving behind one or more rebar sets intact
- **Unite Rebar Sets**: Creates a rebar set from a selection of bars

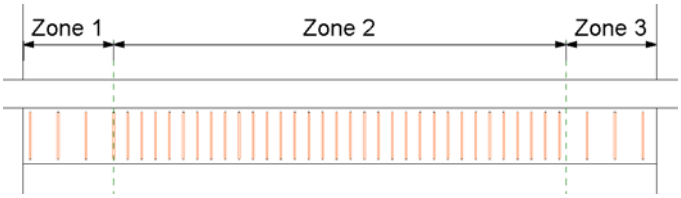
Exercise 7 - Explode rebar set

This tool divides a rebar sets into single reinforcement bars, which is handy for modifying individual bars. The most common modifications are move, copy, rotate, stretch, trim, delete, changing shape, and bar diameter.

1. In Project Browser under **01 Level Rebar > Elevations (RC Elevations)** open the **Elevation B1.11** view.
2. To explode a rebar set you need to select from the ribbon **GRAITEC PowerPack** tab > **Reinforcement** panel > **Rebar Set > Explode Rebar Set**.



3. Next, pick any of the bars in the first zone (on left hand side) within beam **B1.10** between gridline 1 and 2. You will see that all the bars have been removed from the set and are now individual bars.

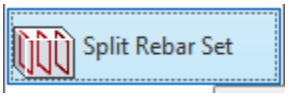


Exercise 8 - Split Rebar Set

An alternative way of editing specific bars of an already existing rebar sets is to divide the set into two sets in order to modify them separately. The **Split Rebar Set** tool divides a rebar set at the user-specified location making this tool handy for quickly creating an unequal stirrup distribution.

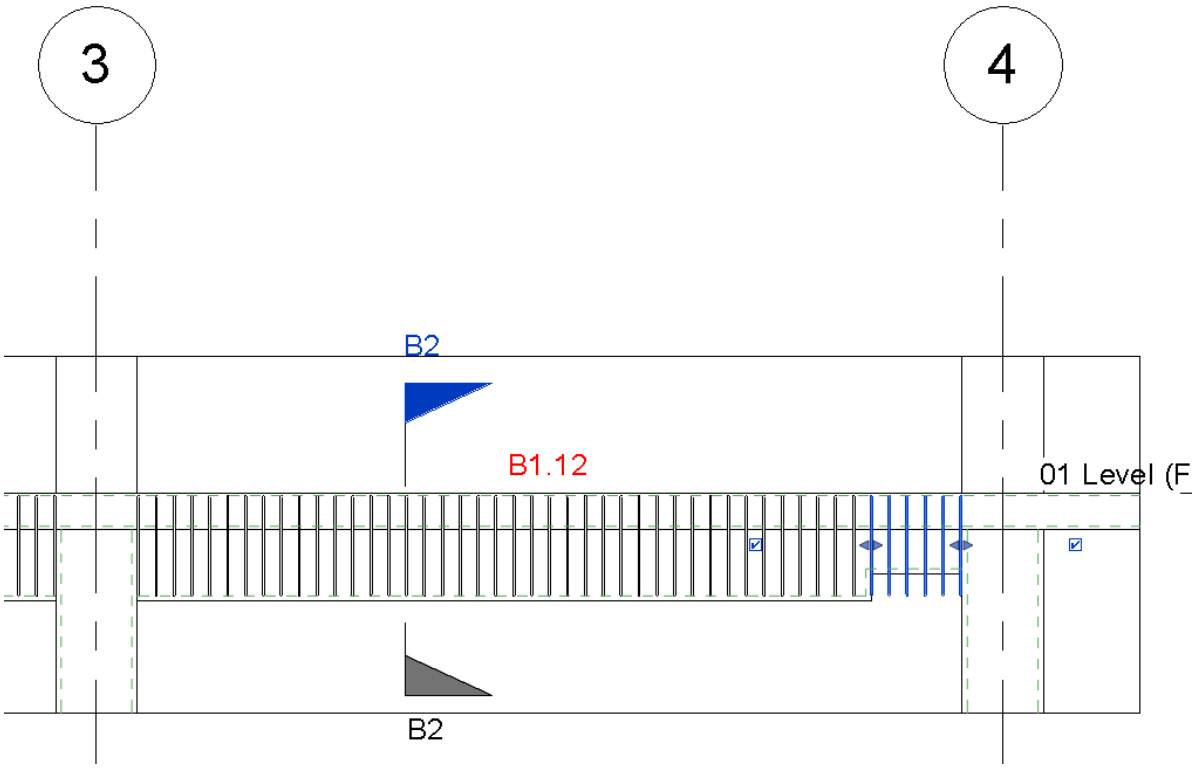
In this exercise we will look at how this works.

1. Remain in the same **Elevation B1.11** view, but move over to the beam **B1.12** between gridlines 3 and 4.
2. This time we are going to split the beam's reinforcement into two zones. From the ribbon select **GRAITEC PowerPack** tab **> Reinforcement panel > Rebar Set > Split Rebar Set**.

1. 

3. Move your curser over the rebar within the beam and click on the reinforcement to select the set.

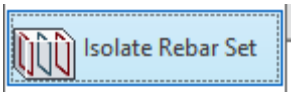
4. Now pick the 6th bar from the right hand side where the beam height changes to split the rebar set at this point - leaving two separate rebar sets for easy editing which we'll come back to this is a later exercise.



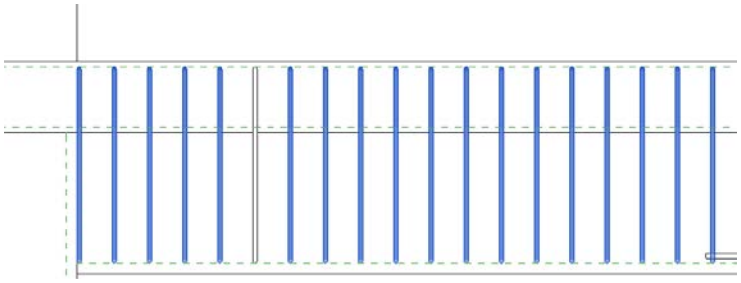
Exercise 9 - Isolate Rebar Set

As suggested this command isolates a bar between two sets at a desired location.

1. Remain in the same **Elevation B1.11** view but move over to the beam **B1.11** between gridlines 2 and 3.
2. This time we are going to isolate a bar from the set, creating two sets either side. From the ribbon select **GRAITEC PowerPack** tab **> Reinforcement panel > Rebar Set > Isolate Rebar Set**.



3. Pick any of the bars to select the whole set, then pick the bar you wish to isolate.

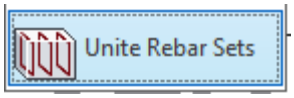


You can see the bar is now isolated with the original split into two sets either side of the isolated bar.

Exercise 10 - Unite Rebar Sets

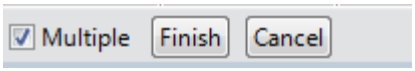
Individual bars or two or more rebar sets can be combined into a single rebar set using the **Unite Rebar Sets** command. The resulting rebar set will adopt the spacing parameters of the larger set selected.

1. Remain in **Elevation B1.11** view and with beam **B1.11** between gridlines 2 and 3.
2. We'll re-join the rebar sets we isolated in previous exercise. Select from the ribbon **GRAITEC PowerPack** tab **> Reinforcement** panel **> Rebar Set > Unite Rebar Set**.



3. Select first bar set on the left, this will select the bar set to join to. Then pick the single bar followed by the bar set to the right.

Note: *The multiple selection is automatically enabled so you can select more than one set.*



5. Click **Finish** on the Options bar, or hit **Enter** to complete the action.
6. Hover over or select the bar set to see they are united as one.

Trim and Extend

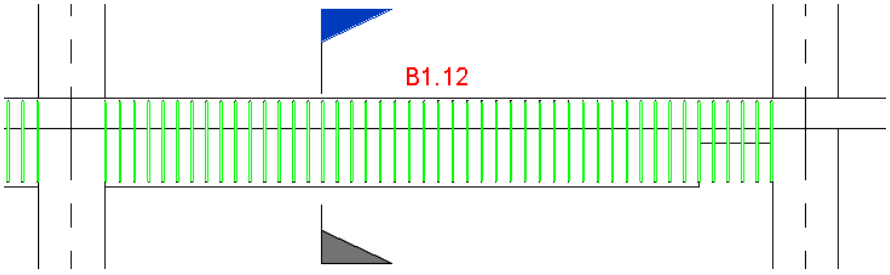
The tools in the Trim/Extend group allow users to adjust reinforcement to suite the shape of the host element. Reinforcement created in hosts with an irregular shape or with depressions or with openings can be adapted to the formwork using one or more of the tools in the following exercises.

Exercise 11 - Rebar to Face

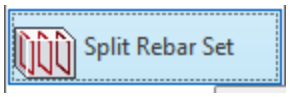
This tool makes it possible to stretch/trim the reinforcement sets to a chosen edge of the concrete element. The side of the rebar closest to this face becomes stretched or trimmed and the face to which the rebar is stretched/trimmed can belong to the same or a different concrete elements (bars can be stretched from a column to the exterior face of a beam supported by the column for example).

The tool can be applied for rebar sets or for individual bars and multiple rebar selection is allowed.

1. Sticking with **Elevation B1.11** view (from the Project Browser **under 01 Level Rebar > Elevations (RC Elevations)** open the **Elevation B1.11** view).
2. Zoom in to beam **B1.12** on the right side. You will recall in an earlier exercise we split the bars at the notch in the beam on right side. If you skipped that part it is repeated here, otherwise jump ahead to step 6.

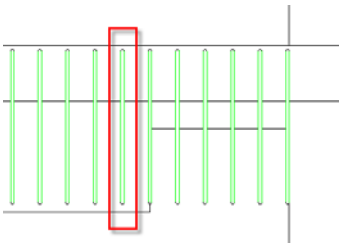


3. From the ribbon select **GRAITEC PowerPack** tab **> Reinforcement** panel **> Rebar Set > Split Rebar Set**.

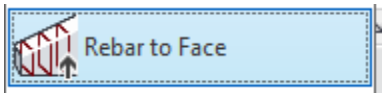


4. Select any of the bars in the rebar set, this will start the action.

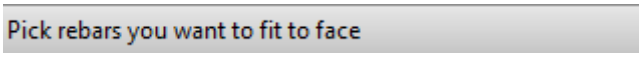
5. Move your curser over the rebar within the beam and click the last bar inside the larger part of the beam. The rebar sets should now be split into two sets.



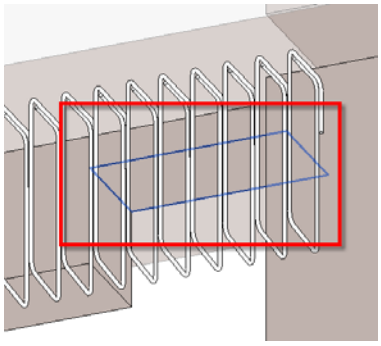
6. Let's switch to a 3D view as it is easier to select a face.
7. In Project Browser under **01 Level Rebar > 3D Views (3D RC View)** open the **3D Beam B1.12 on GL C** view. Adjust the orientation to suit and zoom in.
8. Select from the ribbon **GRAITEC PowerPack** tab **> Reinforcement** panel > **Trim/Extend > Rebar to Face**.

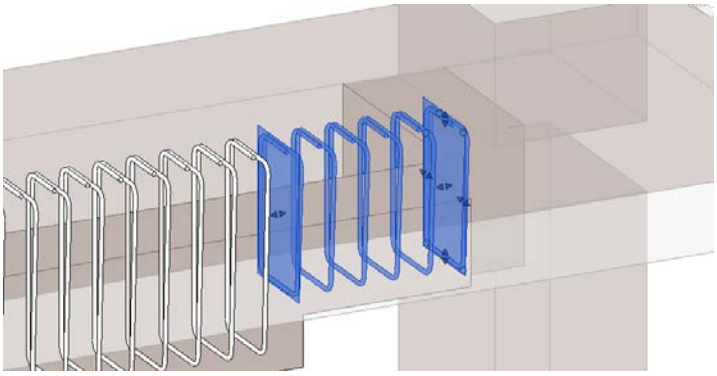


9. Follow the instructions on the Status bar and pick the bars or bar sets you want to adjust.



10. Then, select **Finish** from the options bar. The rebar is now selected.
11. Next, select the face to which the bars should fit to and the bars will adjust (also works on sloped faces).





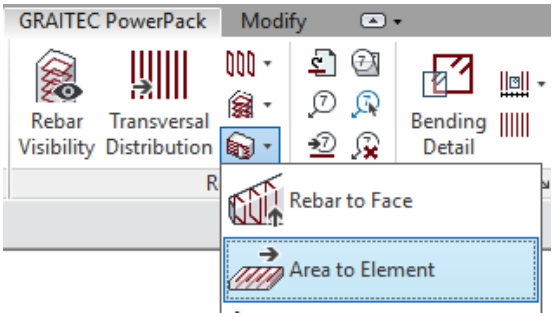
Exercise 12 - Area to Element (Fabric Area)

To stretch the reinforcement to fit the complete dimensions of the host concrete element can take some time. The next command increases productivity whilst working with rectangular or irregular shapes, circular edges, obtuse angles or large number of edges. It can be applied for Structural Area Reinforcement, or Fabric Area Reinforcement.

1. Open **02 Level (Second Floor) Slab** view from Project Browser under **02 Level Rebar > Structural Plans > 02 Level (Second Floor) Floor RC**.

   You should see some Structural Fabric Area has been placed in the top left of the slab.

2. To adjust area reinforcement to shape we are going to use the Area to element from the ribbon **GRAITEC PowerPack** tab **> Reinforcement** panel **> Trim/Extend > Area to Element**.



3. Follow the instructions on the Status bar and select the area reinforcement or fabric area you want wish to extend to face of slab.

4. Hover over the area fabric and the left-click, it should automatically expand to fill full area of the slab.

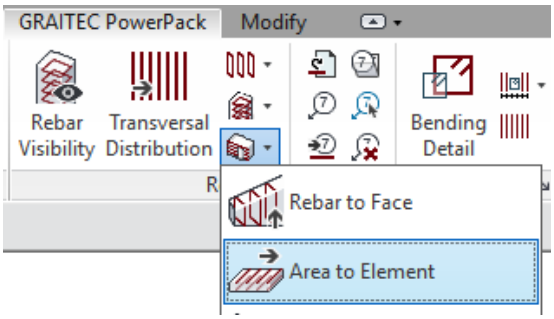
Quick Tip: *Why not use the **Rebar Visibility** tool to show the rebar or combine with the **Auto Section Box** to create a dedicated 3D view.*

Exercise 13 – Area to Element (Area Reinforcement)

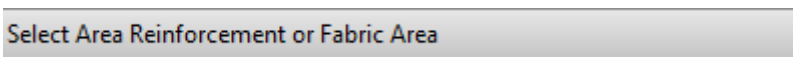
1. Open **Elevation on Wall GL 4** view from Project Browser under **00 Level Rebar > Elevations (RC Elevations)**.

   You should see some Structural Area reinforcement has been placed towards the left side of the wall.

2. To adjust area reinforcement to fit the area we are again going to use the **Area to element** from the ribbon **GRAITEC PowerPack** tab **> Reinforcement** panel **> Trim/Extend > Area to Element**.



3. Follow the instructions on the Status bar and select the area reinforcement or fabric area you want wish to extend.



4. Simply hover over the area reinforcement and the left-click to expand the reinforcement to the extents of the wall. If you open **3D Wall on GL 4** view from Project Browser under **00 Level Rebar > 3D Views (3D RC View),** you should see the bar now extend to the full extents of the wall.

Exercise 14 - Cut Openings in Rebar set

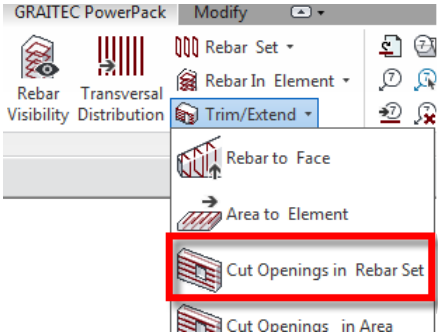
Now we have created rebar, let's take a look at how it can be trimmed around openings without having to delete and recreate the reinforcement. Reinforcement bars that intersect the opening will be detected and split bars around the opening. The newly-created rebar above and below the opening will receive new rebar numbers and the ones that do not intersect the opening will keep their original rebar number.

Rebar sets can be split around openings at once. The cut operation will take into account all the openings located in the host element.

1. Open **Elevation on Wall GL 4 (1st – 2nd)** view from Project Browser under **00 Level Rebar > Elevations (RC Elevations)**.

   You should see some Structural Area reinforcement has been placed on the left face of the wall.

2. To adjust area reinforcement around the opening we are going to use the **Cut Openings in Rebar Set** from the ribbon **GRAITEC PowerPack** tab **> Reinforcement** panel **> Trim/Extend > Cut Opening in Rebar Set**.



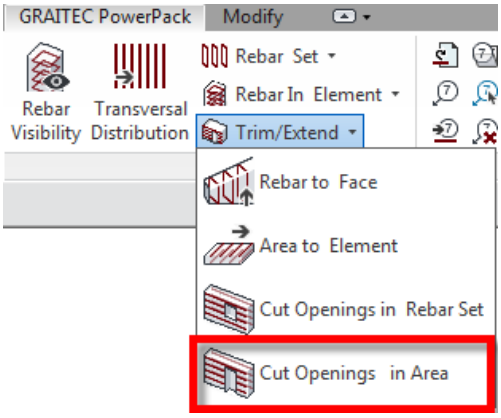
3. Hover your curser over the reinforcement and the left-click the bars will be cut around the hole in the wall.

Exercise 15 - Cut Openings in Area

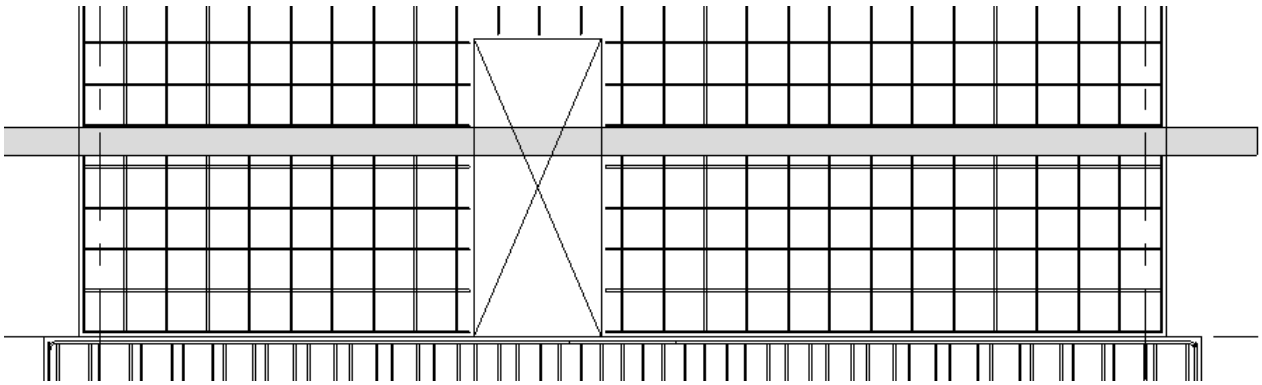
Adjusts the reinforcement of a wall or a floor when an opening is created in the host element that modifies its external geometry. The most common situation is a door or window opening in a wall. The command can be applied for both Structural Area Reinforcement and Fabric Area Reinforcement.

Note: *The cut tool can be applied to all types of structural openings and to any shape that has had the external geometry of the host element altered.*

1. Open **Elevation on Wall GL 3** view from Project Browser under **00 Level Rebar > Elevations (RC Elevations)**. You should see some Structural Area reinforcement has been placed in the wall covering the door opening.
2. To trim the area reinforcement around the door we are going to use the Area to element from the ribbon **GRAITEC PowerPack** tab **> Reinforcement** panel **> Trim/Extend > Cut Openings in Area**.



3. Hover your cursor over the area reinforcement and the left-click on the area reinforcement. The reinforcement should be cut accordingly and it will also automatically extend the bars to the extents of the wall.



Use the **Rebar Visibility** tool to show the rebar.

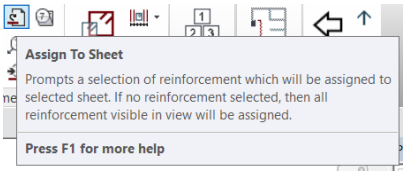
Part 5 – Rebar Annotation in Revit®

To efficiently document the model, the PowerPack provides a series of useful features, to smooth out some of the operations required to get your design to the printed page, such as enhancing the numbering so that it becomes a more useful way to control your rebar, produce details automatically, and also speed dimensioning. This chapter looks at some of these tools.

Exercise 6 – Assign to Sheet

This tool is used for assigning reinforcement to a specific sheet useful for associating the rebar to the drawing number or name.

1. In Project Browser under **01 Level Rebar > Elevations (RC Elevation)** open the **Elevation B1.11** view.
2. Select from the ribbon **GRAITEC PowerPack** tab **> Reinforcement** panel **> Assign to Sheet**.



The selection of reinforcement can be done in two different ways:

- **Select reinforcement** – allows the user to perform single or multiple selection of the rebar;
- **Select by filter** – allows the user to choose a certain category of rebar based on one or several criteria at a time. In the dialog that appears, enable the desired filters to select the rebar you want assigned.

Note: *If no reinforcement elements are selected, the Assign to Sheet tool will apply to all visible reinforcement in the view.*

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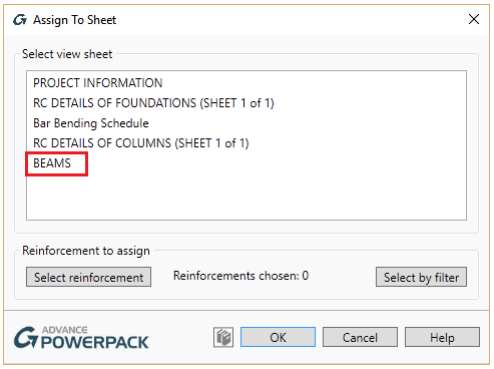
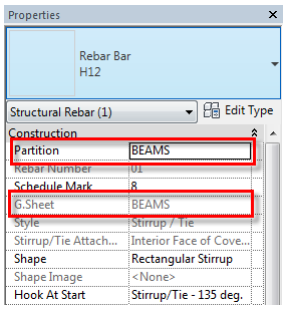
3. To pick the reinforcement click on Select reinforcement, then click on the bars within beam **B1.10**.
4. Once you have selected all the bars, click Finish from the Options bar.
5. Select **BEAMS** from the sheet list and click **OK**.



After completing the selection, the reinforcement can be identified as assigned to one sheet through a unique *G.Sheet* parameter value in the properties panel.



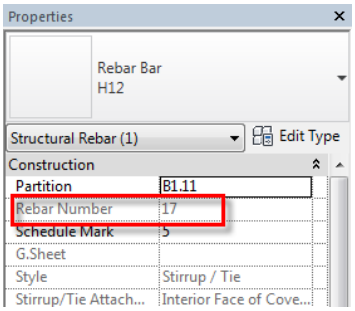
Exercise 7 – Set Rebar Number

This tool allows the user to manually change the rebar number of a selected bar.

1. In Project Browser under **01 Level Rebar > Elevations (RC Elevation)** open the **Elevation B1.11** view.

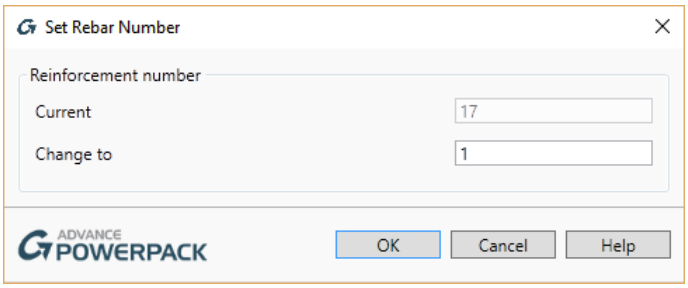
   Let's check to see what the bar mark number is from the link/stirrup bars within beam **B1.11**.

2. Move your curser over the bars and *left-click* to highlight the bars. Then from the properties window you should see the Rebar number is currently set to **17** unless you have changed it during one of the previous exercises.



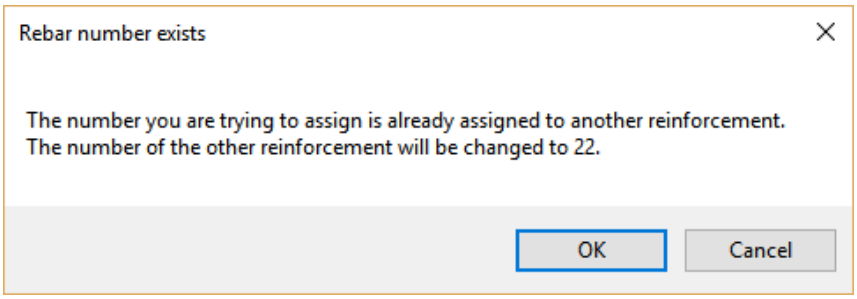
3. To set a rebar number select from the ribbon **GRAITEC PowerPack** tab **> Reinforcement panel > Set Rebar Number**

4. Select the link/stirrup bars in beam **B1.11**. The **Set Rebar Number** dialog box will appear on screen.



Note: *If you change the number in the 'Change to' field, it will change the reinforcement bar mark number. Alternatively, if you just leave it, it will be set to **1**.*

5. Let's change the bar mark number to **18**. The following message should appear on your screen.



If the chosen number is already assigned to another bar, a message is displayed to inform of the situation automatically detecting, and proposing to assign, the next available number in the sequence to the other bar. Click 'Cancel' to abort the change or 'OK' to change the selected bar as specified updating both bar numbers.

Exercise 8 – Renumber Reinforcement

The 'Renumber Reinforcement' tool automatically changes the numbers for all reinforcement in order to eliminate any gaps that may appear in numbering sequence, or to create a uniform count starting from a specific number.

The numbers assigned to the rebar may be further used to filter rebar.

This operation will detect identical reinforcement considering rebar shapes, dimensions, materials, bar diameters.

Depending on the selected mode of operation, the command behaves in two different ways:

- **Per sheet: This affects a single sheet** – in which case two rebar assigned to different sheets can receive the same rebar number.
- **Per Project: This affects the entire project** – in which case the first option is disabled and the reinforcement assigned to sheets is reset.

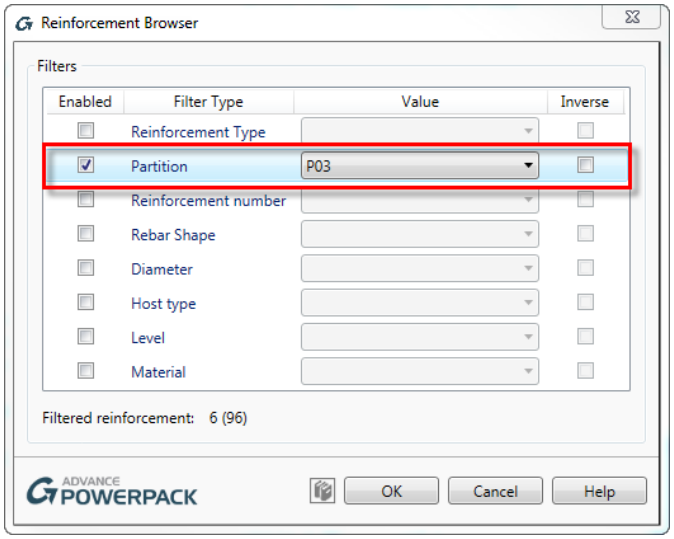
Exercise 9 – Browse Reinforcement

As it suggests the 'Browse Reinforcement' highlights rebar or fabric sheet based on a filter and highlights all instances in the corresponding view.

Note: *The user can navigate (rotate, move, zoom) through the view, while the dialog is open.*

The tool allows the user to choose a certain category of rebar, based on one or more criteria at a time.

1. Open **Rebar – 3D view** from Project Browser under **3D Rebar > 3D Views**.
2. To browser reinforcement select from the ribbon **GRAITEC PowerPack** tab **> Reinforcement** panel **> Browse Reinforcement**.
3. In the reinforcement browser enable Partition and select value **P03**. As shown in below image.



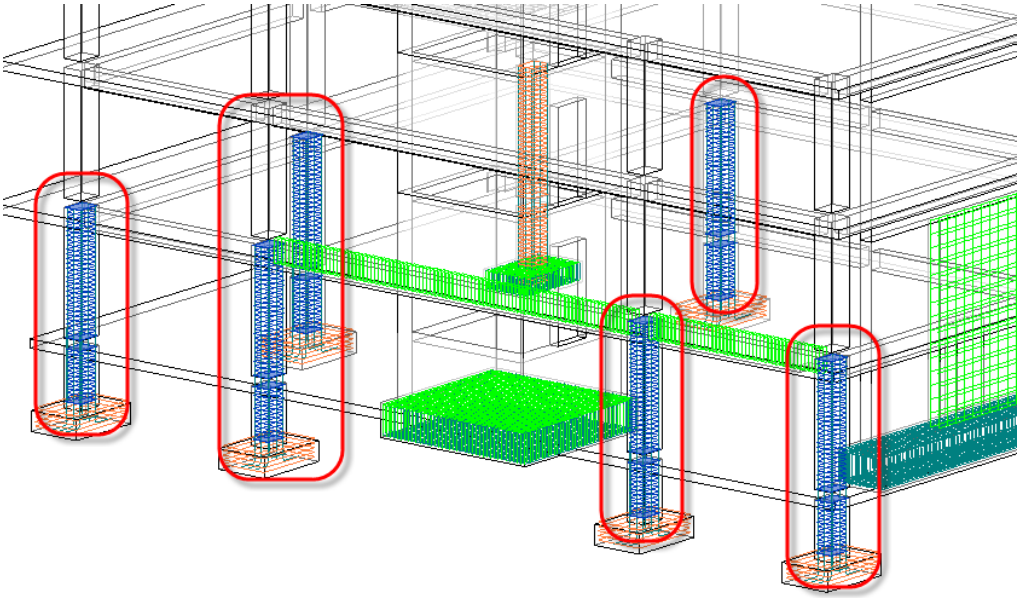
The view should have zoomed into the area where **P03** is located. Spend a few moments trying out some of the other powerful filters.

Exercise 10 – Select by Rebar Number

This tool allows the selection of all instances of a rebar or fabric sheet by 'Mark' making it easy to edit common the properties in one go (such as diameter, hooks, rebar shape, etc.) Simply by selecting one rebar or rebar set from the project, all instances with the same Mark number will be automatically included in the selection.

1. Remain in **Rebar – 3D** view from Project Browser under **3D Rebar > 3D Views**.
2. Then on the ribbon choose **GRAITEC PowerPack** tab **> Reinforcement** panel **> Select By Rebar Number**.
3. Follow the instructions on the Status bar and pick the reinforcement type you wish to select in your project.

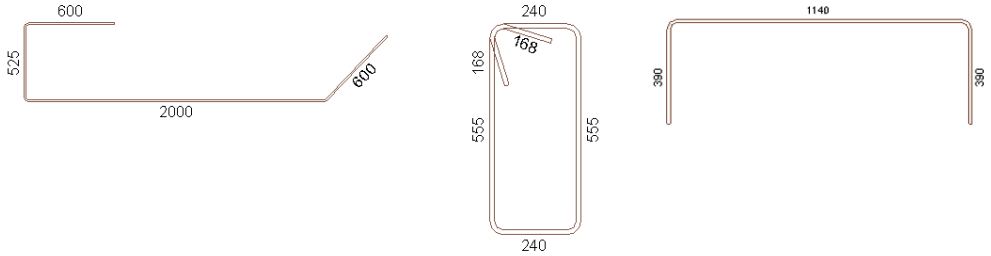
If you select a bar which has been placed multiple times all of these bars will be highlighted in the view.



Exercise 11 – Bending Detail

The Bending Detail tool 

is a great time saver as it automatically creates rebar shape details with tags and dimensions for one or multiple rebar, regardless of their shape or quantity.

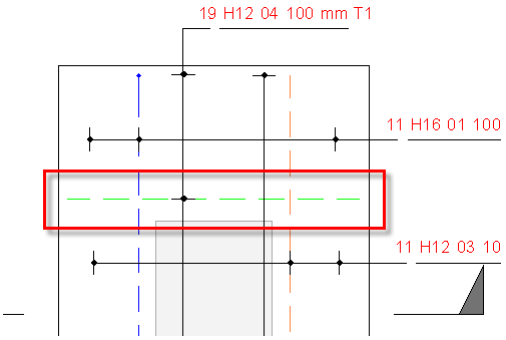


1. Open **-01 Level (Foundations) Reinforcement - P01** view from Project Browser under **-01 Level Rebar > Structural Plans**.

2. On the ribbon select the **GRAITEC PowerPack** tab **> Reinforcement** panel **> Bending Detail** 

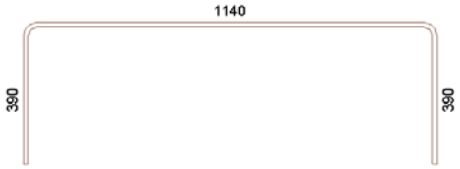
.

3. In the view select bar mark **04**, as shown highlighted in below image.



4. Now select 

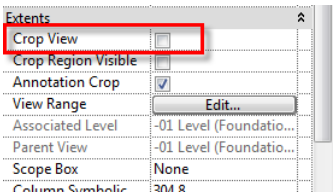
from the options bar or hit Enter on your keyboard. A detail view of the bar shape with associated tag and lengths should appear, as shown in the below image.



Note: *Please make sure that the following visibility is set so the shape diagram will appear on screen.*

*1. In the **Visibility/Graphics** dialog box under **Model Categories > Lines > G.DetailLineSytle**. Also under **Annotation Categories > Text Notes**.*

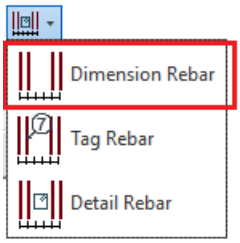
*2. You may need to untick **Crop View** from the view properties window.*



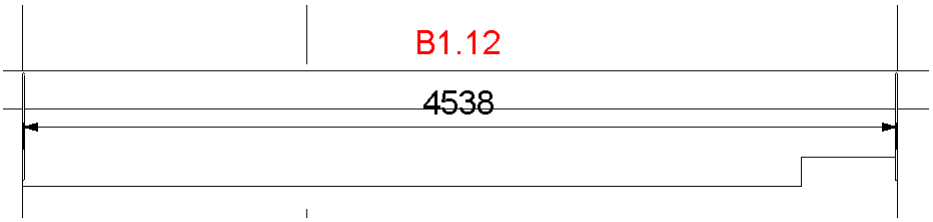
Exercise 12 – Symbols & Dimensions (Dimension Rebar)

To add extra dimensioning control, the PowerPack provides configurable detailing tools to help communicate your design effectively where differing styles and standards exist across the globe.

1. Go to view **Elevation B1.11** in the **01 Level Rebar > Elevations** browser
2. Focus on the bars between grids 3&4, and select **Dimension Rebar** from the drop down menu



3. Select the bars in the beam **B1.12** and press enter. The dimension inserted should overlay the bars, leaving the two bars at each extent, like this

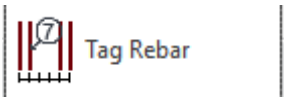


4. Move the dimension line up away from the beam for a clearer view.

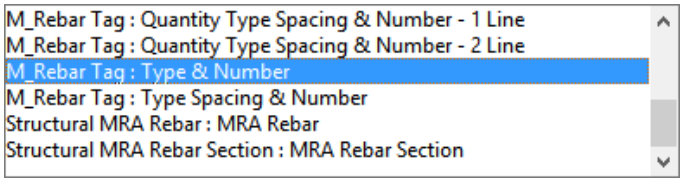
Exercise 12 – Symbols & Dimensions (Tag Rebar)

Adding extra detail to your annotation is easy with the next tool, which adds a Tag family to display the bar information.

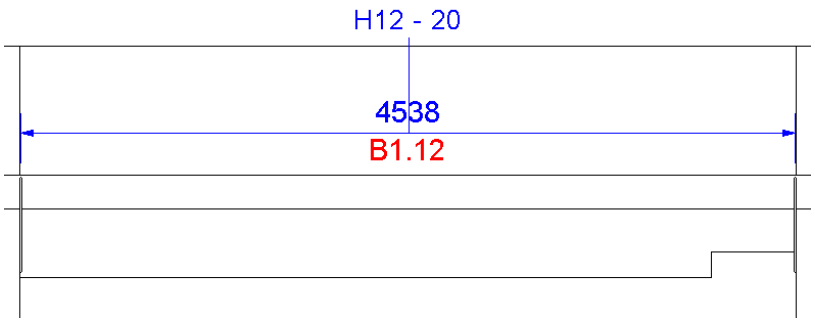
1. Select the **Tag Rebar** tool:



2. Select the bar range as before in **B1.12** and press enter to apply the dimension.
3. Now select the dimension and in the properties browser click **Edit Type**.
4. In the **Graphics** area of the panel, select from the **Tag Family** drop down list.



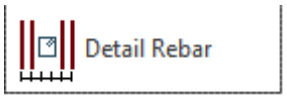
5. Click **OK** and the dimension is appended with extra information based on the Family selected. The drop down list includes Families installed with the PowerPack and are customizible if desired.



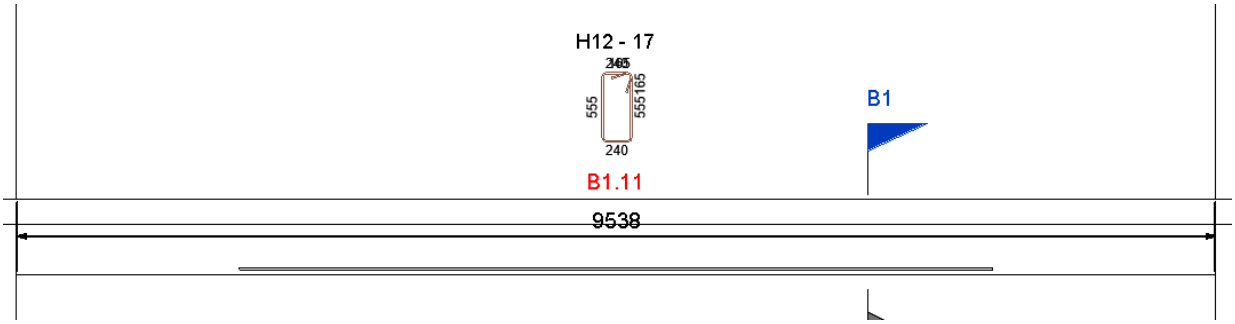
Exercise 13 – Symbols & Dimensions (Detail Rebar)

Similar to the Bending Detail feature, this quick draw method will allow you to place a dimension, tag, and detail in a single move.

1. Select the tool from the drop down list.



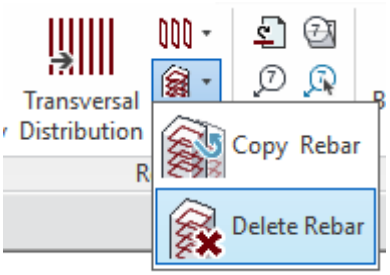
2. Using the same beam **B1.11** select the rebar range to detail, and press enter and the view is updated like this:



Exercise 13 – Clean and Refresh Rebar

Keeping all your details current is simplified with the **Clean and Refresh** tool, which assess any changes you have made which affect the details produced using the above tools and updates them, it also deletes any details that are unnecessary as a result of deleted rebar sets.

1. Staying with the view on **B1.11** as exercise 12, using the **Delete Rebar** tool:

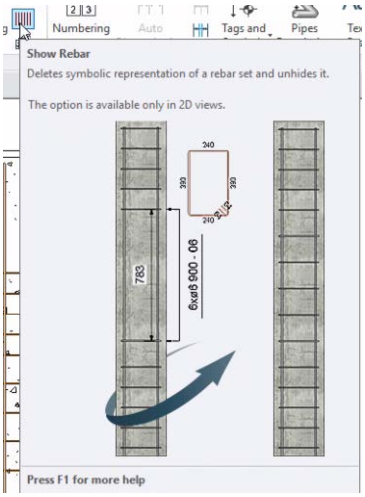


select the beam and click **Finish** to delete the bars.

2. The diagram produced will still be seen above the beam. Click the **Clean and Refresh** Icon and the diagram is removed as it is no longer required.

Exercise 14 – Show Rebar

To reset the details and annotations you have inserted using the previous tools, simply use the **Show Rebar** tool. This will remove the bending details and dimensions drawn, and return the view to the original rebar style.



1. Move to the beam displayed between grids 3 & 4 **B1.12**. Using the methods learned in the previous exercises, produce a detail diagram above the beam.
2. Click the **Show Rebar** tool and select the annotation overriding the reinforcement range, and press enter. The rebar returns to its original plain display style.

The details and annotations are ready to tweak according to your draughting style, and to import into schedules and drawings as you would with standard Revit views giving you swift process to rely on.

Useful links and information

We hoped you enjoyed this tutorial. We welcome all feedback and new/improvement suggestions.

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