

# ProtaStructure Design Guide

## ProtaStructure Revit Integration Guide

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## Overview of Integration

When considering the integration between ProtaStructure and Revit, it is crucial to understand that the information transferred is essentially the physical information associated with the structure - e.g., geometry, section sizes, grade and slab thicknesses, etc. by using Revit families.

ProtaStructure is a code-based modeling, analysis, design, and detailing tool to enable Structural Engineers to establish a code-compliant design of the structure (for example, EC2, BS8110, ACI). Autodesk Revit is a physical modeling tool for producing drawings, material lists, and BIM coordination. As Revit does not hold 'code' specific data, it is essential to understand that all the design/code data is held within ProtaStructure at all times.

In a typical design office, the Technicians are responsible for drawing production, while the Engineers' responsibilities include code-compliant design. It is, therefore, typical for the Engineer to be the predominant user of ProtaStructure and the Technician to be the predominant user of Revit. This workflow varies from company to company, where the role of the Technician and the Engineer merge. However, the principles remain the same.

## ProtaBIM Installation

The latest & previous versions of ProtaBIM can be obtained here: [Downloads](#)

### Installation

1. Double-click to run the downloaded ProtaBIM setup file.
2. Choose default options for the installation.
3. When you first start Revit after installing ProtaBIM, you may be prompted a security warning about the ProtaBIM plugin. It is a standard warning issued by Revit. Select the "Always Load" option to confirm.

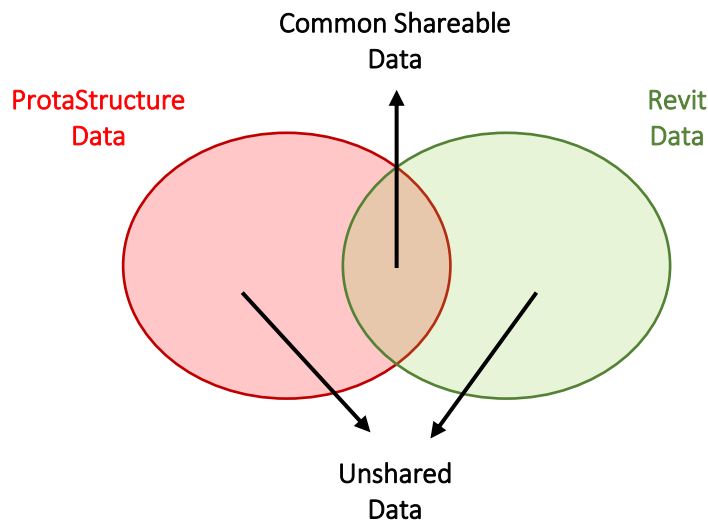
When you install ProtaBIM, it automatically registers itself for Revit. DLL files are default installed on "C:\Program Files(x86)\Prota\ProtaBIMXX".

The manifest file with the ".addin" extension is created under "C:\ProgramData\Autodesk\Revit\Addins\<Year>".

## Merging Models and Round Tripping

The main steps of model merging between Revit and ProtaStructure are Model Creation, Model Transfer, and Model Merging. This complete set of operations is called round-tripping. The building model is created either in Revit or ProtaStructure. Then, the model is transferred to the other program whenever necessary.

Both programs work with different data and data structures once you compare them. However, there are common data that can be shared between these two programs. The transferred model contains this shared data.



**Figure 1:** Common data

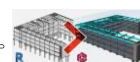
The data transfer between ProtaStructure and Revit consists of only physical information. Properties such as geometry, sections, materials, and slab thicknesses can be transferred.

## Essential Points to Consider While Creating a Model in Revit

Autodesk's programming interface (API) enables developers to query and modify models created in Revit. It also means that the communication between Revit and other software depends on the capabilities and limitations of this API. The preferred data the API allows access to is Revit's analysis model data. ProtaStructure uses this Revit's analytical model data when importing this model into its structure. However, incompatibilities and difficulties might occur during the import/export processes. These difficulties and incompatibilities can be minimized by paying attention to some critical points and developing good practices when creating the Revit model.

We recommend that our users start creating models using Prota Structure at first, and then the export and import process can be done seamlessly between Revit and Prota Structure.

You can find the video for the suggested workflow by clicking on this icon. 



If the Revit model has been created from scratch for importing to the ProtaStructure, the following suggestions must be considered during the modeling phase in Revit.

- "ProtaStructure\_Metric\_2022.rte" under C:\Users\ user\ Documents\ ProtaLib\ Templates should be used before starting your Revit model.

- Add a "Level" in Revit for each floor in your project. Use proper names and abbreviations for the lower and foundation levels of the first floor. These names can be "BASIC", "TML", "FOUNDATION", "FOOTING", or "FTG" for foundations. For below the first floor (the last basement if there is a basement), "GROUND", "ENTRY", "ENTER", "ENTRANCE", "TOF", "BASE", "BASEMENT", "TOB", "GRO", "GROU", "GROUND".
- When creating a model in Revit, be sure to define an axis. Even if there are no axes, ProtaStructure will create its axes. However, at least defining the main axes that run through columns, shears, and beams in Revit will make model transfer incredibly easy and smoother. In addition, modeling rules of Prota Structure must be applied in Revit as follows:
  - Users should create members at the intersection of axes,
  - Defining storeys and all members' top and base levels must be assigned to the relevant storeys.
  - Beams must be split on the column nodes
- Where possible, use the standard Revit families for beams and columns.
- Where possible, allow Revit to automatically clean up the joins between beams, columns, walls, and slabs.
- Design differences between Columns and Shearwalls, such as modeling the elements with a height/width ratio greater than 4 (may vary regarding the selected code) as a structural wall and modeling the elements with a column size as a structural column, should be taken into account.
- When a shearwall is modeled as a Column in Revit, the export will notify the user. The user needs to take note of this and correct it in the model transferred to ProtaStructure, and you can cancel the export process and make the necessary correction in Revit.
- Columns should be modeled between levels. Suppose you need to model slabs at different levels with little elevation difference in different building parts instead of defining a separate "Level" for them. In that case, you can use "Vertical Offset" to ensure that the columns fit into their correct places. Remember that each "Level" you define is transferred to Prota Structure as a new storey. Therefore, avoid defining a large number of levels at small heights.

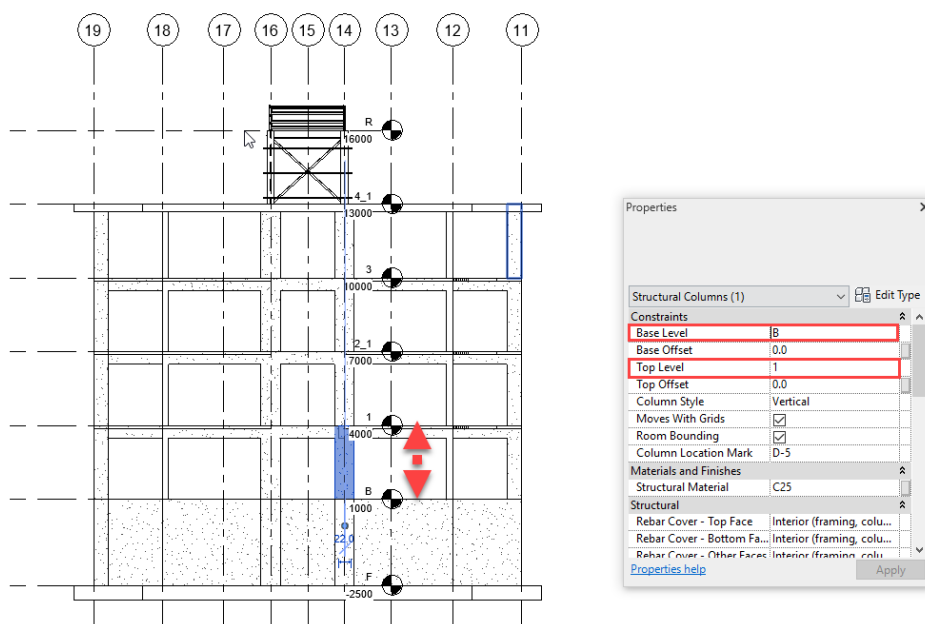
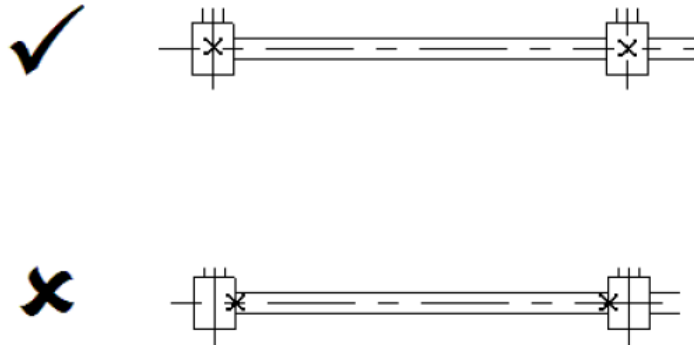


Figure 2: Standard Column Definition – From "Level" to "Level",

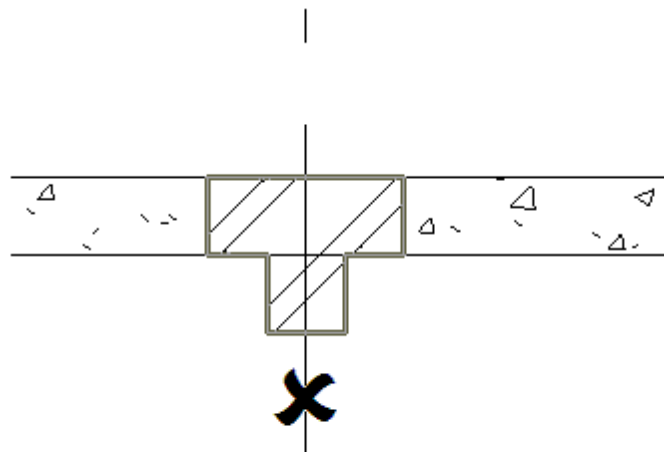
For beams:

- Define beams from node to node instead of defining from column's edge to column's edge.



**Figure 3:** Beam insertion in Revit

- Define the level by using the "Level" parameter in the Element Properties.
- Use the full depth of the rectangular section when defining the beam depths (Do not consider the depth of the part under the floor as the depth of the beam).
- "z-Direction Justification" should be selected as "Other".
- Flange lengths of beams can be considered automatically in the design by ProtaStructure. Hence, It's not recommended to be modeled in Revit with flanged sections.



**Figure 4:** Unsupported beam section in Revit



## ProtaStructure into Revit

### Creation of the ProtaStructure Model

The Engineer has several options available to him when creating a ProtaStructure model.

#### Create a model from scratch.

- ProtaStructure includes specific modeling tools to create grids, columns, beams, walls, floors, etc. More importantly, each element is modeled as a physical object which can be positioned accurately with their correct architectural eccentricities and locations.
- When synchronized with Revit, the spatial position is communicated along with items such as section size and grade.
- For further information on creating ProtaStructure models, please see our [knowledge base](#).

#### Import 2D Drawings

- In the early phases of a project, it is a common practice to have several 2D architectural drawings outlining the scheme. ProtaStructure has the facility to import 2D DXF drawings.
- The Engineer can use these drawings as external reference layouts (XRef) in the background to aid in setting out or importing grids, columns, and walls.
- If a grid system is used in the project, it is logical to import it into ProtaStructure to ensure the structure is set in the correct position.
- When importing grids, it is also advisable to check the geometry of the grid thoroughly against almost-orthogonality or large coordinate values.

### Importing the ProtaStructure model into Revit

When you run Revit, you should create a new project using one of these template files:

"ProtaStructure\_Metric\_2023.rte" (using Revit 2023, ProtaBIM2022 & ProtaStructure 2022) OR  
"ProtaStructure\_Metric\_2021.rte" (using Revit 2021, ProtaBIM2021 & ProtaStructure 2021) OR  
"ProtaStructure\_Metric\_2020.rte" (For ProtaBIM2019 & ProtaStructure 2019) OR  
"ProtaStructure\_Metric\_2019.rte" (For ProtaBIM2019 & ProtaStructure 2019) OR  
"ProtaStructure\_Metric\_2018.rte" (For ProtaBIM2018 & ProtaStructure 2018) OR  
"ProtaStructure\_Metric.rte". (For ProtaBIM2015/ ProtaBIM2016 versions & ProtaStructure 2015/2016.

All necessary loadable families are already pre-loaded in the templates. The template files are located under "My Documents\ProtaLib\Templates".

If you start with the recommended template, ProtaStructure sections will be automatically mapped to existing families in the Revit project. Otherwise, ProtaBIM may have difficulty mapping ProtaStructure sections to Revit families. Fortunately, ProtaBIM has a "Family Mapping" functionality that lets you manually map ProtaStructure sections to Revit families to use your existing family files.

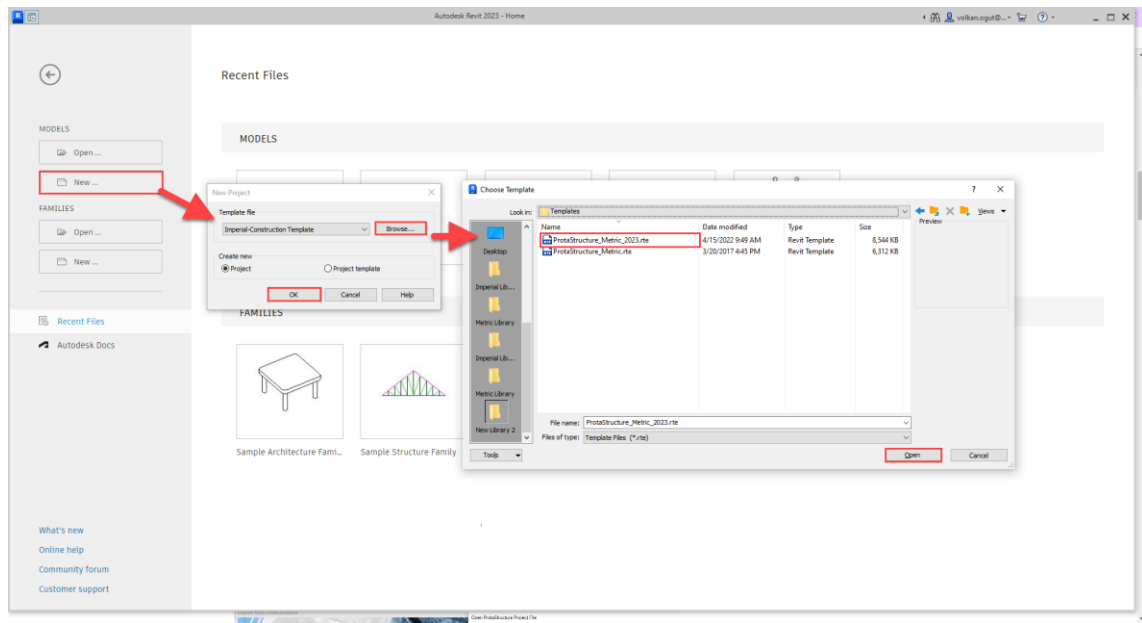


Figure 5: Creating a new file in Revit

- Switch to the “ProtaBIM” Ribbon tab on the Revit toolbar > Select the “Import from ProtaStructure” command.

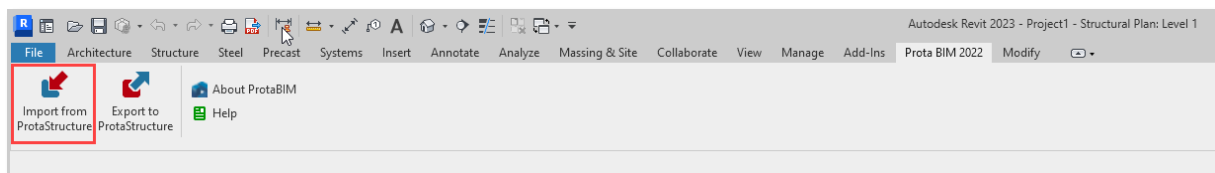


Figure 6: Starting the import process in Revit

- Select a ProtaStructure project by clicking "..." and browse to the desired Project Folder > Select the “.prota” file of the Project Folder > Open.

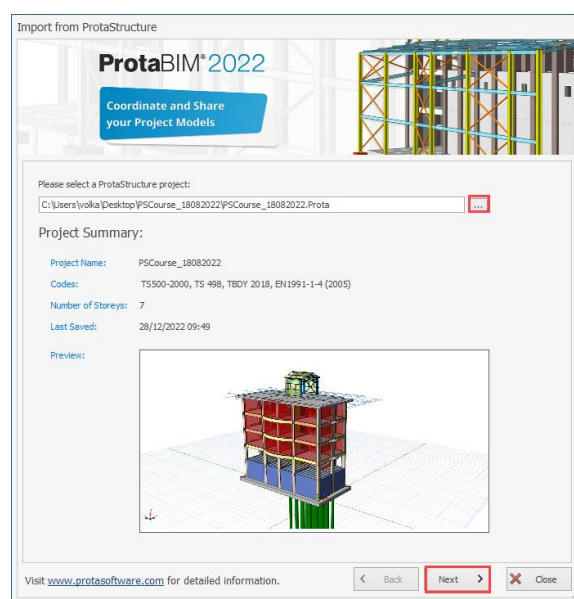
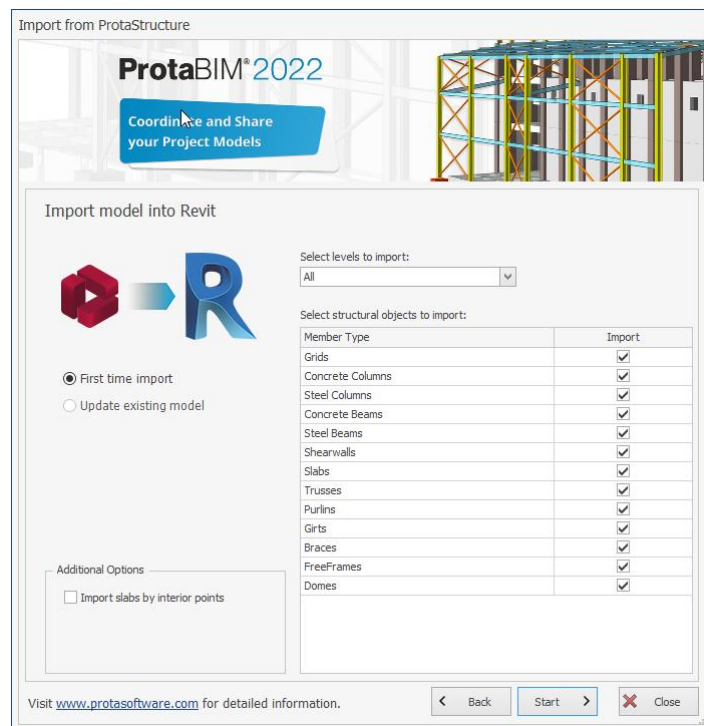


Figure 7: Selecting the ProtaStructure model

- A preview of the model will be shown. Click the “Next” button. If it is the first import, the “First-time import” option will be auto-selected. If it is your second or subsequent import, the “Update existing model” option will be automatically selected.



**Figure 8: Import options**

- Checking the “**Import slabs by interior points**” option will avoid slab trimming and overlapping with other member issues. Use this option only if the first import is unsatisfactory.

Guidelines on using this option:

- Always uncheck this option once you import the model from ProtaStructure to Revit.
- Consider using this option if you find issues like slabs overlapping beams and columns.

The “**Import slabs by interior points**” option may cause the unintentional deletion of some slabs when you export back to ProtaStructure. If you are sure that slabs are not deleted, you can ignore those erroneous warnings during the import process.

- You can choose which structural elements will be imported into Revit. By default, all elements will be imported. To start the import process, specify the structural object types on the provided table and click **Start**.

During the import process, ProtaStructure objects will be converted to Revit objects. This process requires mapping the ProtaStructure column, beam, and frame sections to “**Loadable Revit Families**”.

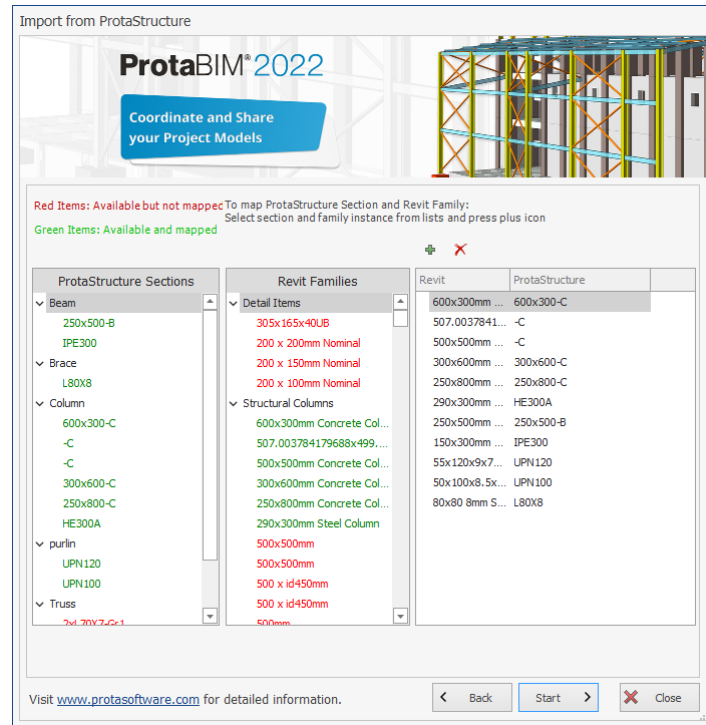
If you start with the recommended template, ProtaStructure sections will be automatically mapped to existing families in the Revit project. Otherwise, ProtaBIM may have difficulty mapping ProtaStructure sections to Revit families. Fortunately, ProtaBIM has a “**Family Mapping**” functionality that lets you manually map ProtaStructure sections to Revit families to use your existing family files.

In the mapping dialog, ProtaStructure Sections (Left pane) will be automatically mapped to the available Revit Family Instances (Middle pane) in the Revit project you are importing into. A **Mapping**

List will be presented on the right pane if suitable Revit family instances are found and successfully mapped. You can always change the mapping and use loadable families of your preference.

**Red items:** Available but not mapped

**Green items:** Available and mapped



**Figure 9:** Mapping ProtaStructure sections with Revit families

- Red items listed under ProtaStructure Sections (Left pane) indicate that the particular section could not be mapped to a suitable Revit family. Hence it should be mapped in the following way:
  - Select a section under ProtaStructure Sections pane.
  - Select a family instance under Revit Families (listed according to Revit Family Instance Name)
  - Click the "+" symbol (Add to Mapping List), and the selected ProtaStructure section will be mapped to the selected family instance. The new mapping will be added to the mapping list on the right.
- If a mapped section is wrong and you would like to change it:
  - Select the already mapped section under Mapping List (right pane),
  - Click the "X" symbol (Remove from Mapping List),
  - Remap the section as described above.
- Click the **Start** button to start the import process. Upon completion, **Model Import Summary** will appear, listing elements successfully imported.
- Close the dialog to return to the Revit working environment.

Please note that if ProtaBIM cannot automatically match the Revit families and ProtaStructure sections, it must be done manually by the user. This possibility usually occurs if the recommended templates are not used.

After the dialog is closed, Revit continues to generate members. This process may take time, depending on the model size.

**Important Note:**

Unlike columns, beams, and frames, slabs and shearwalls are “**System Families**”. These system families must exist in the Revit project. Otherwise, slabs and columns will not be imported.

Additionally, slab and wall system families must contain at least one “**Structural Layer**” with a “**Structural Material**” association.

## Importing Revit Model into ProtaStructure

- In Revit, navigate to the **ProtaBIM** ribbon tab > select **Export to ProtaStructure**.

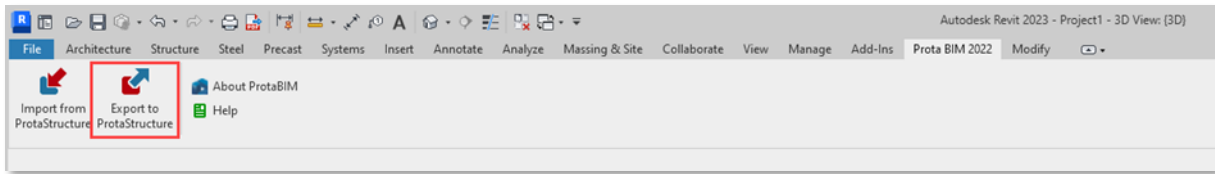


Figure 10: Exporting to ProtaStructure

- In the “Open Project” dialog, choose the “Data Folder” and then select the same project name (which was used in import) > click OK.

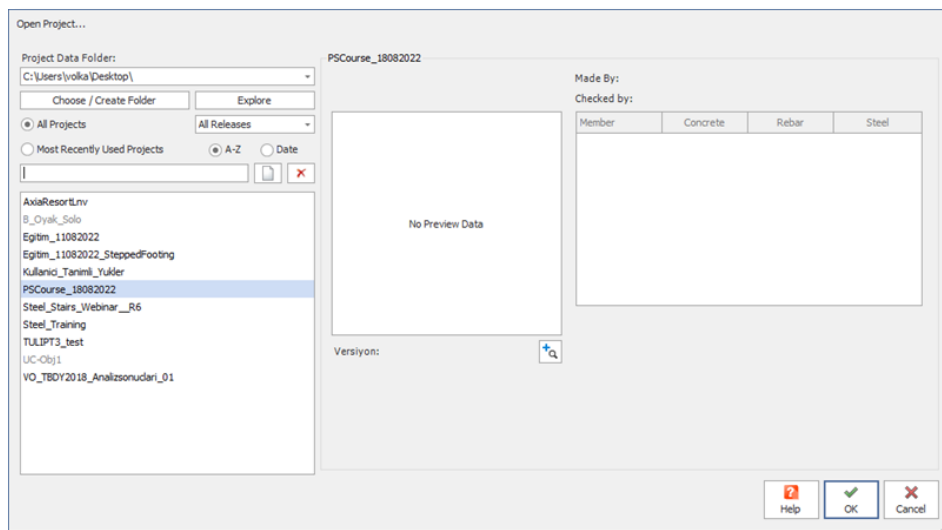


Figure 11: Selecting the ProtaStructure model

- The “Map Sections” window will appear. Revit Families (left pane) are automatically mapped to ProtaStructure Sections (middle pane) and shown in Mapping List (right pane).

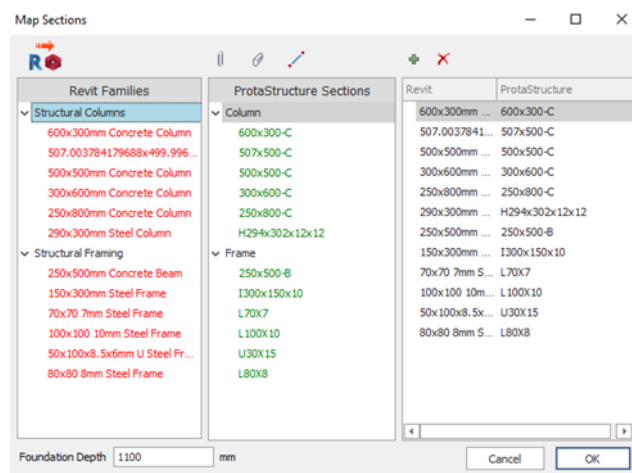


Figure 12: Mapping sections


**Red items:** Available but not mapped

**Green items:** Available and mapped

The red sections under Revit Families (left pane) indicate that the section cannot be mapped. Hence it should be mapped manually by :

- Select a section under Revit Families
- Select a section under ProtaStructure Sections

If the sections listed are not available, you can create new ProtaStructure sections:

- Click on Column / Beam / Frame Section symbol  > **ProtaStructure Section Manager** will be launched.

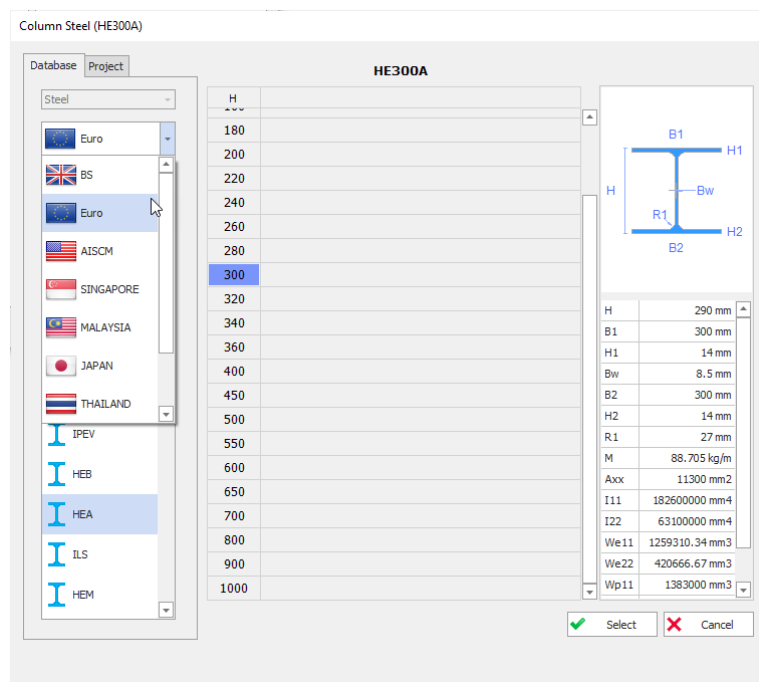


Figure 13: ProtaStructure section manager

- Select the correct country section Database > Pick the Section > Select > OK
- The selected section will now be added to the list under ProtaStructure Sections (the newly added section will be in red).
- Select the newly added section.
- Click the "+" symbol (Add to Mapping List), and it will be added under **Mapping List** (right pane).

If a mapped section is wrong and you would like to change it:

- Select the already mapped section under Mapping List (right pane)
- Click the "X" symbol (Remove from Mapping List)
- Remap the section as described above
- Click OK > The dialog will close automatically to return to the Revit environment.

- A subfolder called "RevitData" will be created in the ProtaStructure project folder of the same project. Once the model is exported in Revit, you can open the same project in ProtaStructure (if it is not already opened).
- Go to ProtaStructure > Ensure the same project is opened (i.e., the same project chosen in Revit in "Export to ProtaStructure" above).
- Go to the BIM ribbon, and choose **Revit Import**.

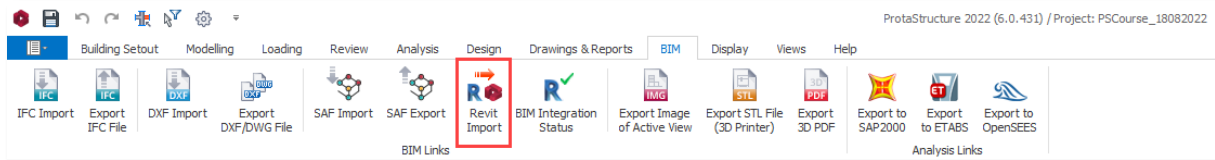


Figure 14: Revit import button in ProtaStructure,

- In the **Import** menu, Pick structural objects to import > click the "Import" button.

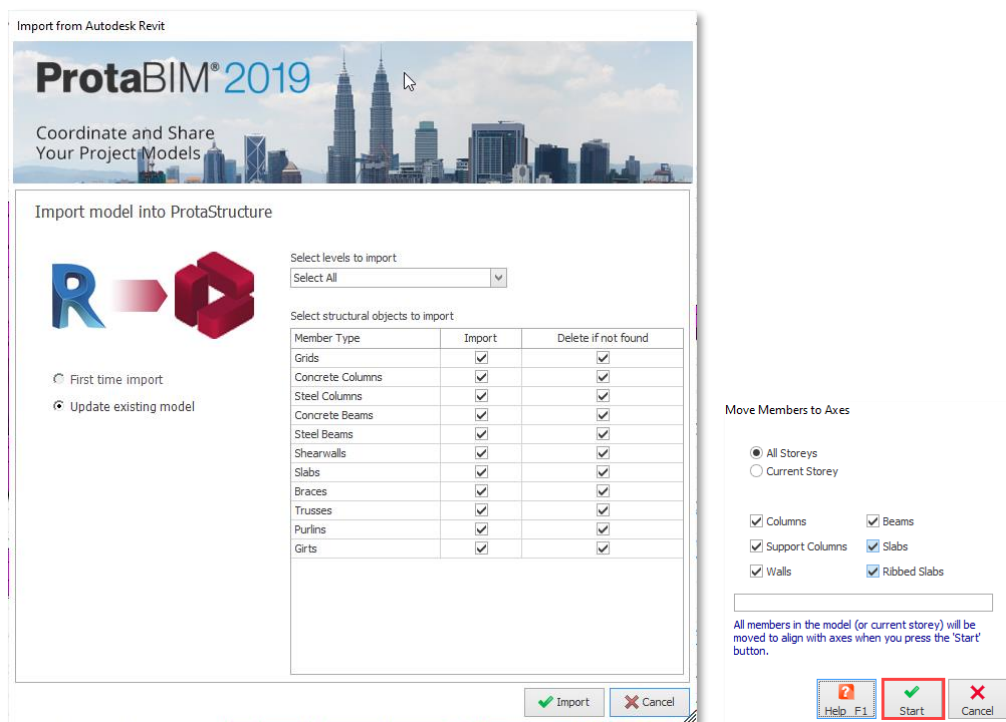
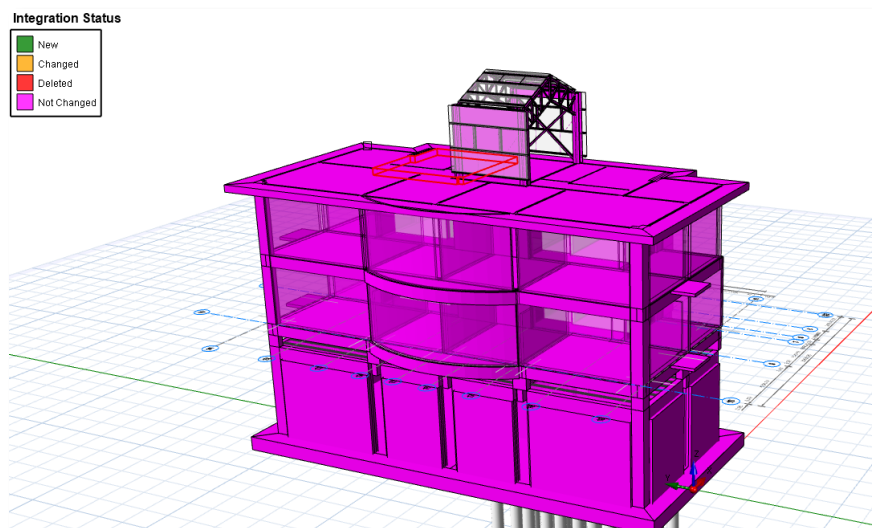


Figure 15: Updating existing model in ProtaStructure

After a successful import, the "Move Member to Axis" window, followed by the "Building Model Check" window, will appear. Select the "Start" button and close the window if you want to run it.

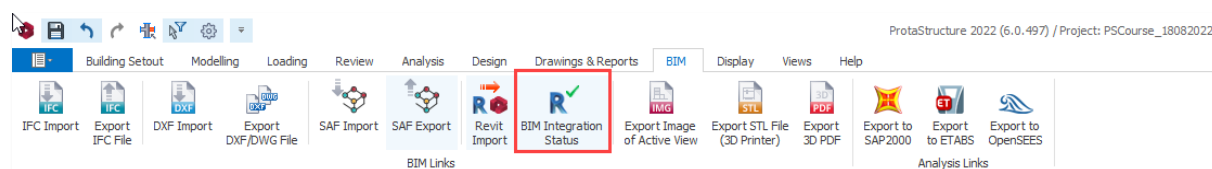
The view will automatically switch to a 3D view with the **BIM Integration Status** color coding switched on, showing which members are new, updated, deleted, or unchanged.





**Figure 16:** Integration status in ProtaStructure

The ON/OFF toggle of BIM Integration Status is located under the BIM tab, as shown in the Figure below.



**Figure 17:** BIM Integration status button

## Appendix A: API - Application Program Interface

### API - Application Program Interface

The Revit API facilitates the transfer between ProtaStructure and Revit. It was developed and released by Autodesk. ProtaBIM is a Revit plugin developed by Prota Software using the Revit API.

Revit API is the governing factor in the BIM link between Revit and ProtaStructure, and it controls which objects can be communicated between them.

## Appendix B: Information Transferred

### From Revit to ProtaStructure

#### Information Transferred

The following information is transferred from Revit to the ProtaStructure environment:

- All grid lines in Revit are imported.
- A level in Revit where data exists is imported as a storey.
- There is no suitable mapping between Boundary Conditions in Revit and Supports in ProtaStructure, so by default, supports are created at the bottom of every column.
- All selected Revit beams, columns, and walls are imported, provided they are within the scope of geometric limitations that apply within ProtaStructure (i.e., only vertical columns and walls, only horizontal beams). Their orientation, section size, and member releases will be maintained.

Please note that members flagged as "not for analysis" are not considered in the Export from Revit. Due to Revit's current limitations, specific items, including curved beams and slanting columns, may have to be modeled as "In-place families". Unfortunately, these items may be flagged as non-structural, in which case the export process will not consider them, or some required data will be missing, which will be exported but with a warning.

#### Limitations

The following limitations exist in the current release: -

- No loads,
- No Rebar objects,
- No openings in walls - these must be manually modeled in ProtaStructure,
- Only rectangular walls are handled - bounding rectangles will be applied where necessary.
- No curved members or walls,
- No pre-cast concrete beams or columns,
- If Revit Material is set to "By Category", there is a Revit API limitation meaning that we cannot determine the material. To avoid this issue, please ensure materials are set for Structural Column, Structural Framing, Wall, and Floor categories (Object Styles dialog).

## From ProtaStructure to Revit

### Information Transferred

The following information is transferred from ProtaStructure to Revit:

- All grid lines in ProtaStructure are exported - Exported grids all appear in Revit with the default style (i.e., the settings for bubbles are ignored),
- All storeys are exported, including a level for the Base and Foundations,
- All Columns are exported; all rotations are exported,
- All Beams are exported; all rotations and end releases are exported,
- All Slabs are exported,
- All Shear Walls are exported.

### Limitations

The following limitations exist in the current release:

- Loads are not exported,
- Due to current limitations in the Revit API, ProtaBIM may not detect the correct section for some polyline columns or columns with skewed outlines. However, you can manually map the sections by the family mapping feature. If you continue without mapping, a rectangular section with the same bounding rectangle size is created in such a case.

## Thank You...

Thank you for choosing the ProtaStructure Suite product family.

Our top priority is to make your experience excellent with our software technology solutions.

Should you have any technical support requests or questions, please do not hesitate to contact us at all times through [globalsupport@protasoftware.com](mailto:globalsupport@protasoftware.com) and [asiasupport@protasoftware.com](mailto:asiasupport@protasoftware.com)

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