



ProtaStructure Design Guide

Subbasement Members

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Publisher



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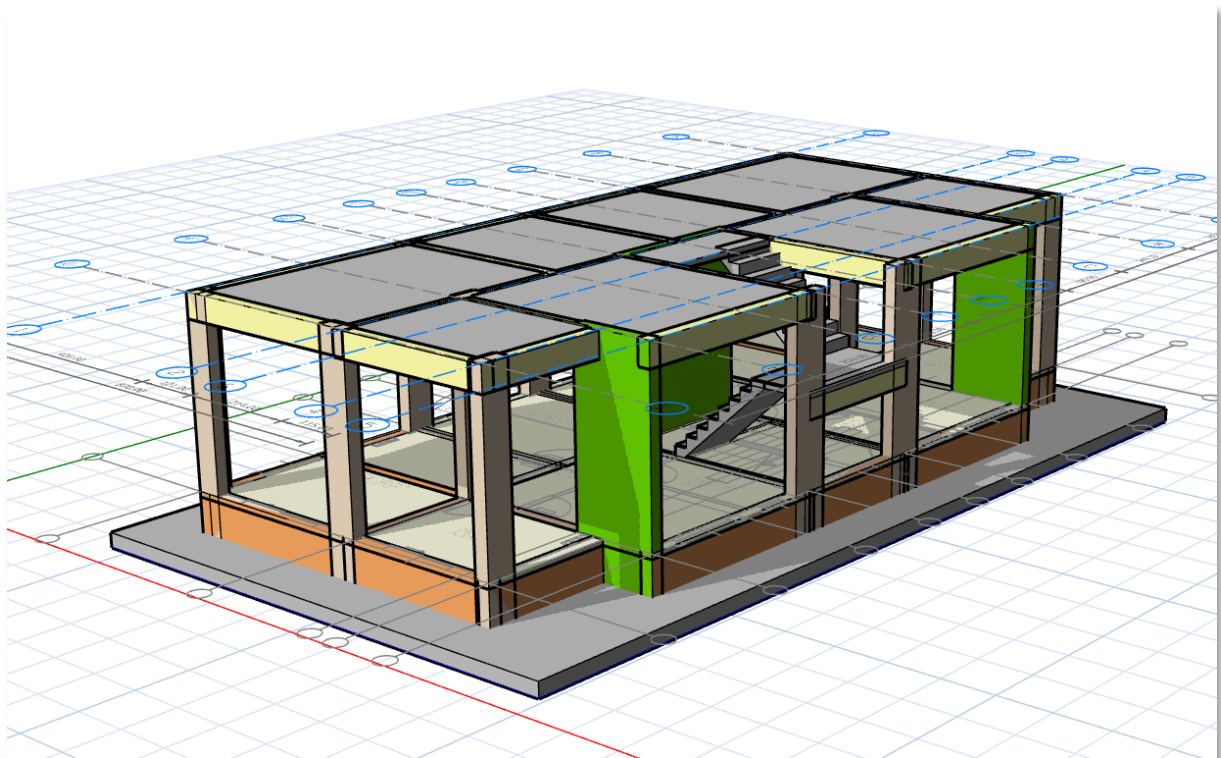
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Subbasement Walls, Beams and Slabs

Subbasement walls are usually considered as a part of the foundation and provide support for the infills on the ground storey and contains the fill on the foundation. ProtaStructure 2026 enables the users to model these walls on foundation level and optionally consider them in the analysis. Previously it was harder to model these walls, requiring additional storeys or deep beams.

Like subbasement walls, subbasement beams and slabs are also considered as a part of the foundation. They are usually built on top of the fill contained by subbasement walls. Subbasement slabs are reinforced by mesh reinforcement. ProtaStructure now enables you to model these beams and slabs as a part of the foundation and mesh them compatibly with neighboring members. Previously it was not possible to insert and mesh these slabs on top of mat foundation slab (at different elevations).



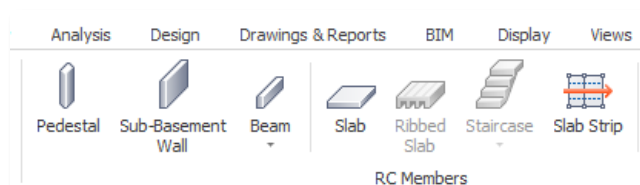
Subbasement Walls

Modeling

To insert a subbasement wall click **Subbasement Wall** command on the **Modeling > RC Members** ribbon tab.

Important Note:

The foundation floor must be activated before modeling. You can not model subbasement walls in upper storeys.



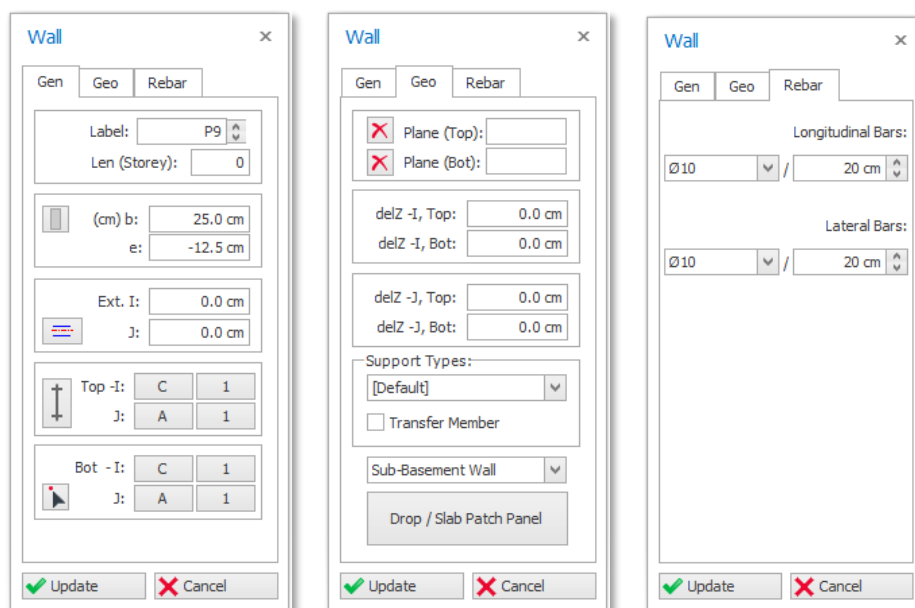
The insertion of subbasement walls is identical to regular walls. Pick two axis intersections on the screen to place them. You can adjust the following properties:

Wall Label: ProtaStructure will automatically assign a label to the wall. You can update it to suit your requirements.

Wall Extensions: You can specify extensions beyond insertions just like the regular walls. This is a practical feature to change the dimension of the wall without changing its insertion points and analytical representation.

DelZ Top and Bottom Values: You can change the relative elevation of subbasement wall's top edge. This is handy if subbasement wall is supporting a ramp or a similar component.

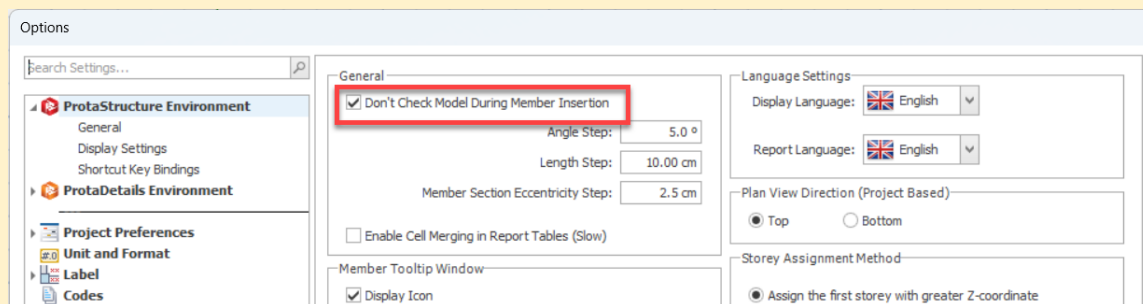
Reinforcement: Since the subbasement wall reinforcement design is not done automatically, you have to manually enter the reinforcement information.



Important Note:

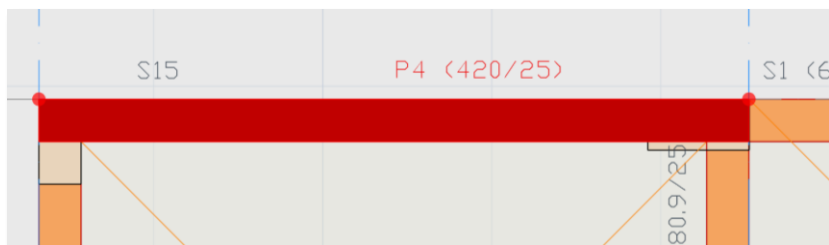
If you intend to design a raft foundation, make sure that you insert the raft foundation slab first, before modeling any subbasement members. Otherwise, you will not be able to insert raft foundation when subbasement members are present. ProtaStructure will issue an “**overlapping member**” message and will not insert the raft foundation slab.

If you want to insert raft foundation slabs after subbasement members, then navigate to **Options > ProtaStructure Environment** and activate “**Don’t Check Model During Member Insertion**” option. This will allow you to insert raft foundation slabs after you inserted subbasement members without any overlap warning.



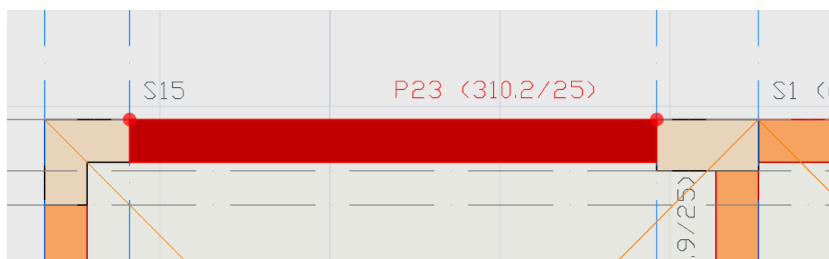
Inserting Subbasement Walls at the Column Nodes

You can pick the column nodes for inserting the subbasement walls. This will create an FE mesh compatible with the columns. The subbasement wall and the column will be connected at the common nodes and there will be a force transfer between the wall and the column depending on their stiffness characteristics.



Inserting Subbasement Walls at Column Faces

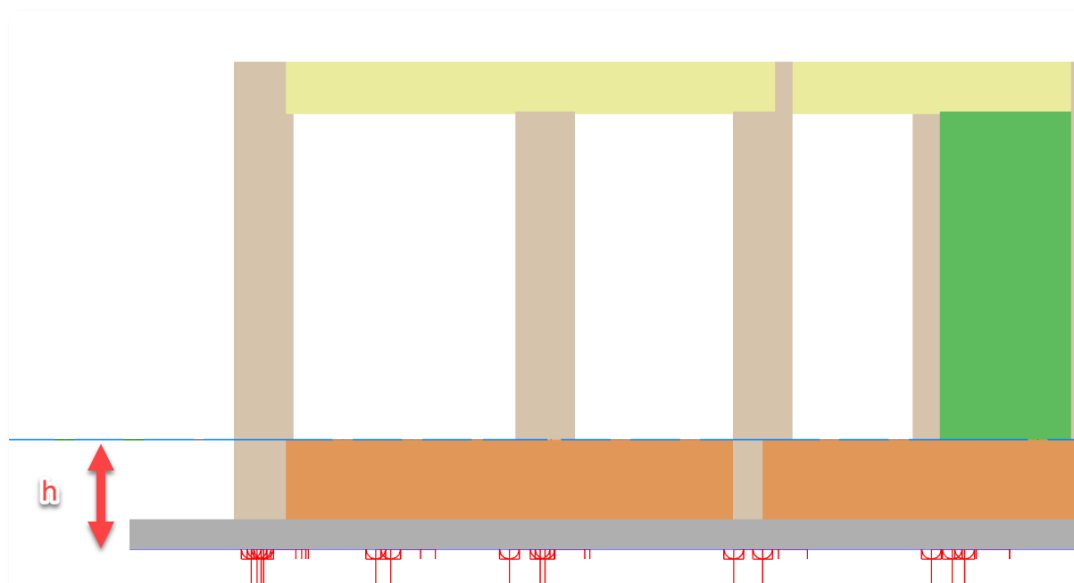
If you want to include the subbasement walls in the analysis model but do not want them to participate in a force transfer with the columns, you can insert them at column faces. To achieve this, you can create an offsetted axis at the column face and insert the wall using this axis. In this way, the wall will not be meshed compatibly with the column and there will be no internal force transfer.



Subbasement Wall Height

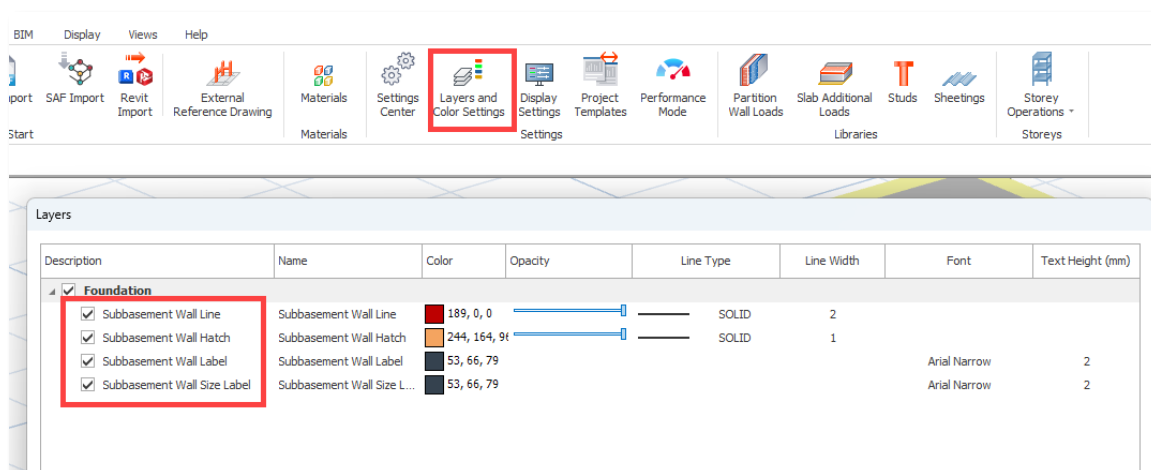
Subbasement walls will automatically have the same height with **Foundation Depth** specified in “**Edit Storey**” window. This is because, the subbasement walls are intended to be used only at the foundation level. You can still assign **DelZ Top** values to the subbasement walls to adapt to your specific project requirements.

Effective Top Storey No:	1	1st Storey Bottom Level:	0.0 cm
No. of Rigid Basements:	0	Foundation Depth:	110.0 cm
		Footing Label:	F
		Footing Description:	



Visibility and Colors

Subbasement walls are automatically assigned a **different layer** and they are colored differently than regular shearwall, basement walls or retrofit walls. You can turn on/off the visibility of subbasement walls using the **Layer and Color Settings** window.

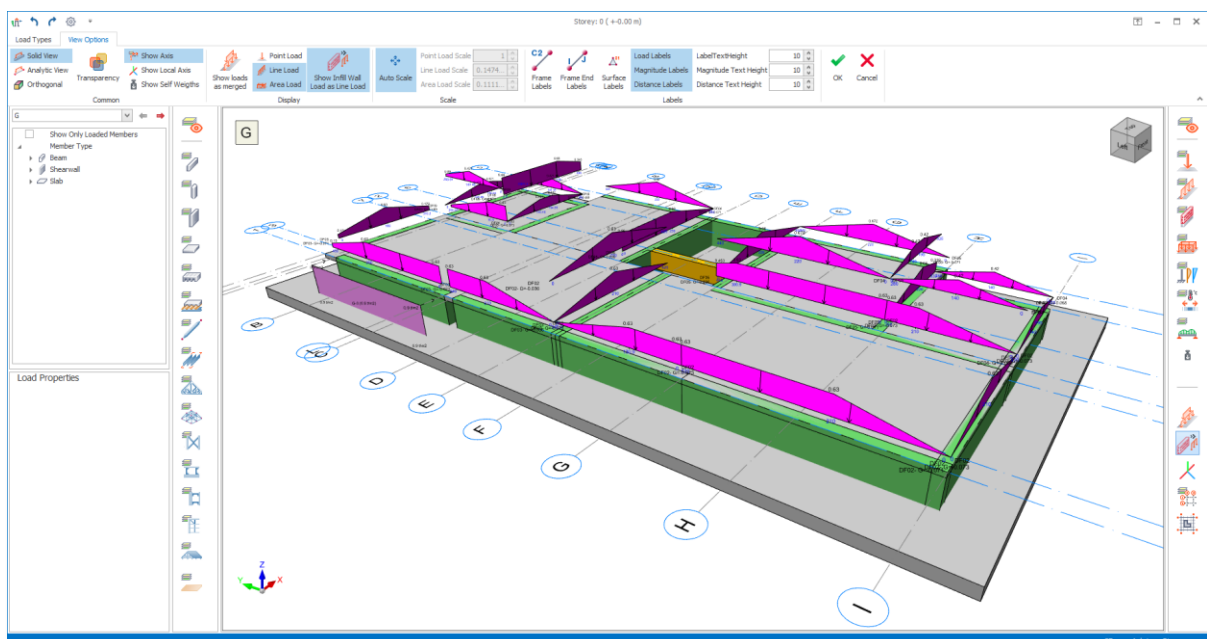
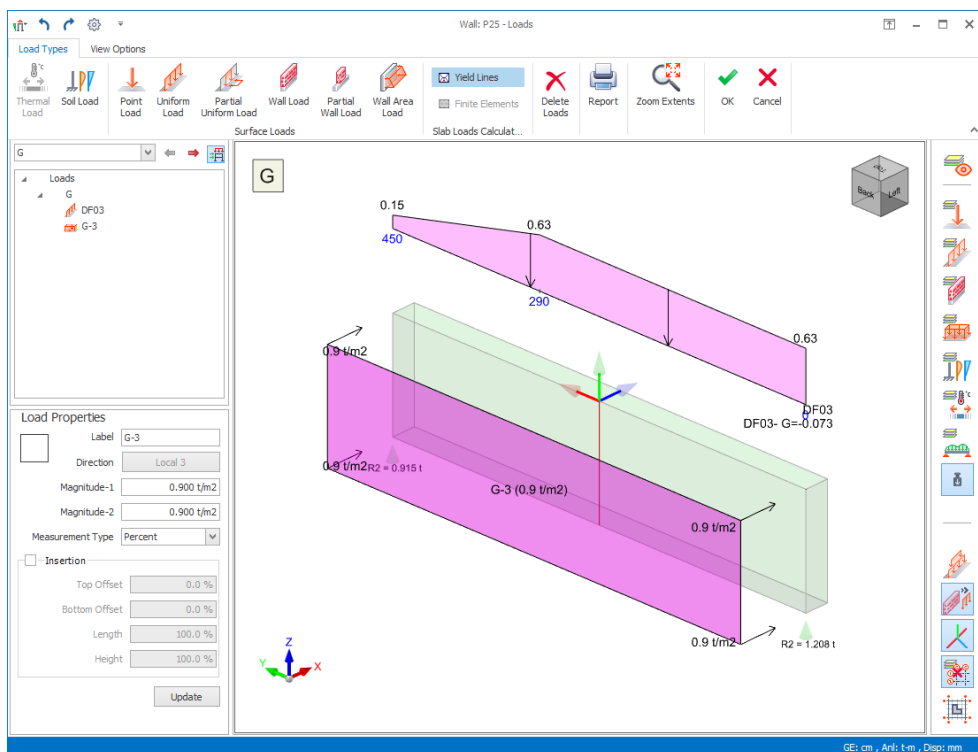


Loads on Subbasement Walls

Once inserted in the model, you can assign loads on the subbasement walls like any other member including infill walls, distributed loads, point loads, etc. Moreover, subbasement walls can indirectly support loads from connected subbasement slabs, subbasement beams, staircases, columns and other members.

Note:

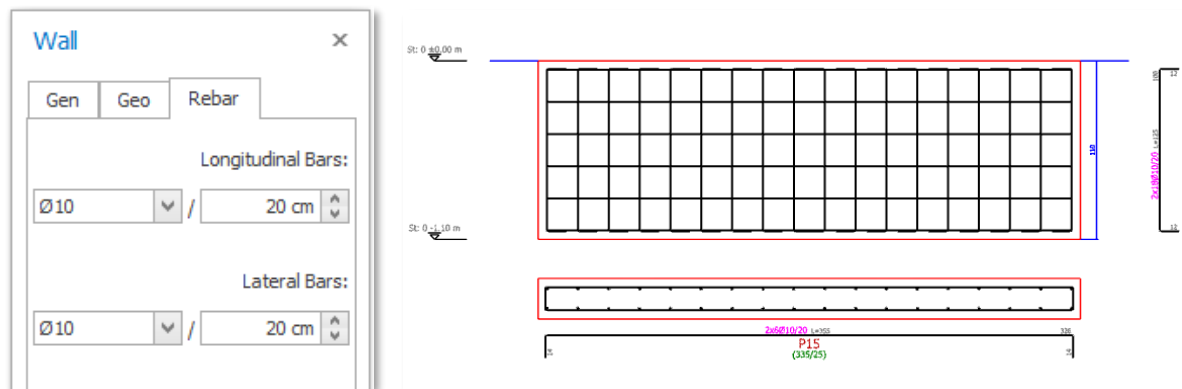
Previously, there was no way of assigning infill wall loads on the ground storey floor for buildings without basements. With the introduction of subbasement walls and beams you can now assign infill wall loads (and any other loads) on the ground storey floor.



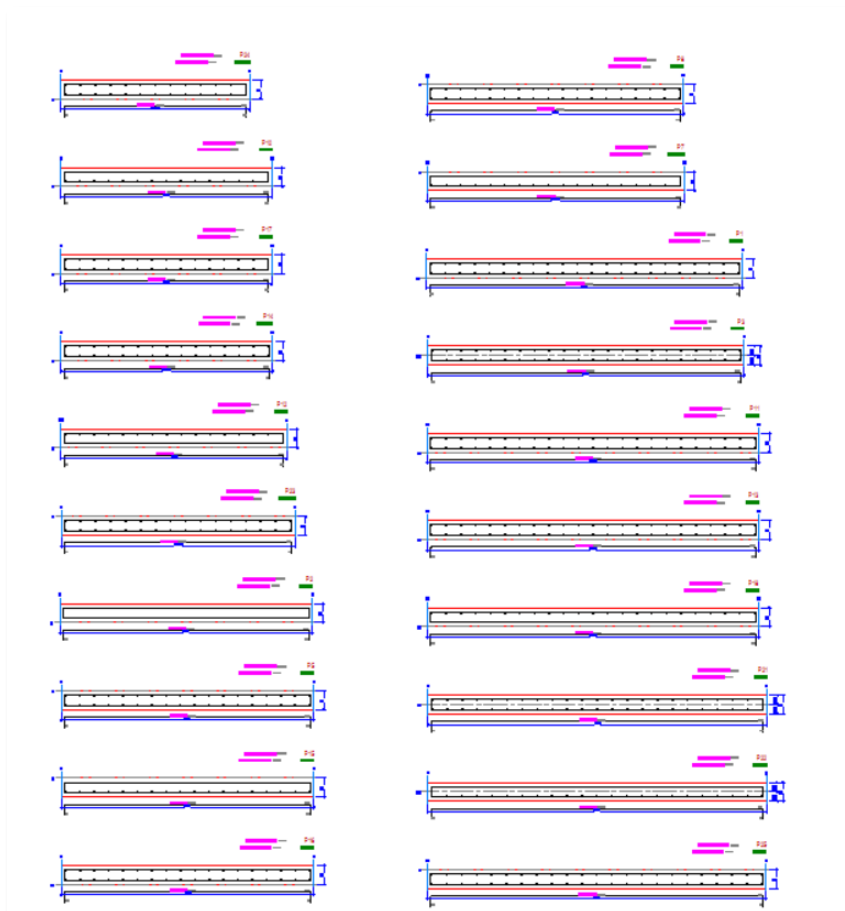
Subbasement Wall Reinforcement Design and Detailing

Subbasement wall reinforcement design IS NOT performed by ProtaStructure. We expect the user to enter longitudinal and horizontal reinforcement information. Detail drawings are created accordingly.

Rebar information for the subbasement walls can be introduced using the **Rebar** tab on the **Wall** Property window.



You can generate subbasement wall details using **Shearwall Elevations** and **Shearwall Schedules** or **Column Application** commands in ProtaDetails. Foundation Storey was added to these categories to draw the subbasement wall details.



Subbasement Slabs

Modeling

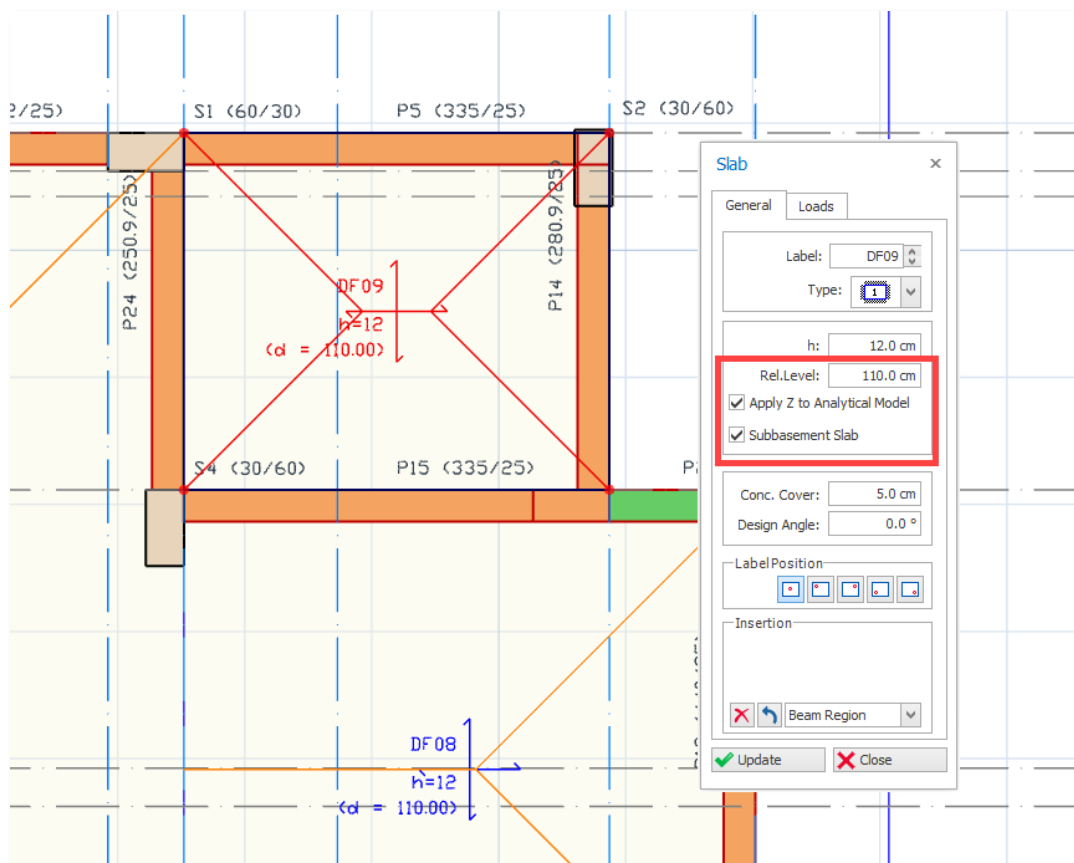
Insertion of subbasement slabs are similar to the regular slabs. You can use one of “Beam Region”, “Axis Region”, “Pick Closed Edge”, “Pick Points” or “Pick Axes” methods.

Important Note:

The foundation floor must be activated before modeling. You can not model subbasement slabs in upper storeys.

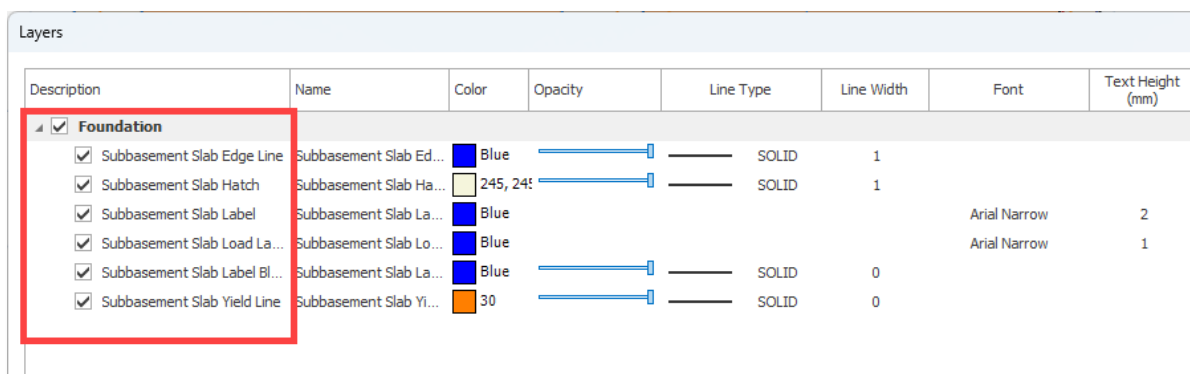
To insert a subbasement slab:

1. Click **Slab** command on **Modeling > RC Members** ribbon tab.
2. Check “**Subbasement Slab**” option on the Slab Property window.
3. **Z-Offset** value will be automatically set the **Foundation Depth** value and the top surface of the slab will be flush with the ground storey level.



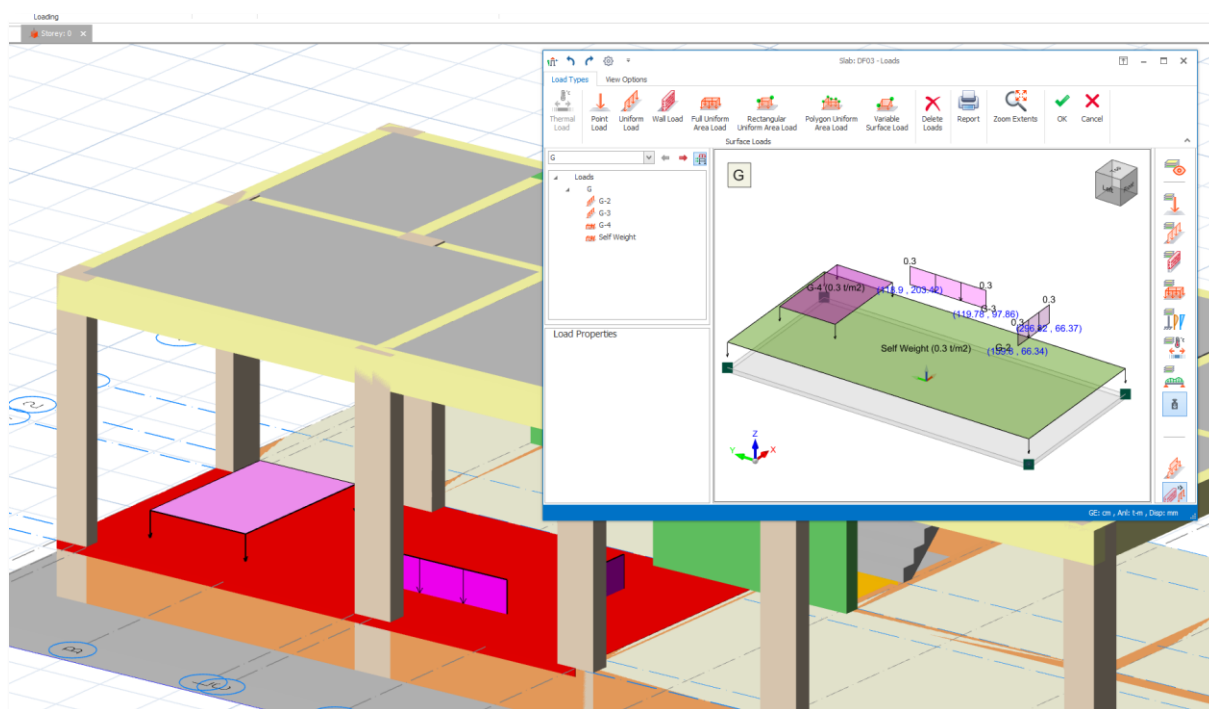
Visibility and Colors

Subbasement slabs are automatically assigned a **different layer** and they are colored differently than regular slabs. In the foundation plan view, subbasement slabs and raft foundation slabs will be drawn on top of each other and the view can easily be congested. You can turn on/off the visibility of subbasement slabs using the **Layer and Color Settings** window.



Loads on Subbasement Slabs

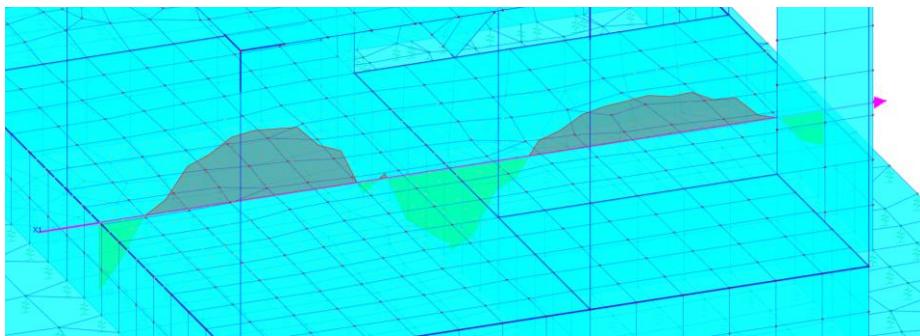
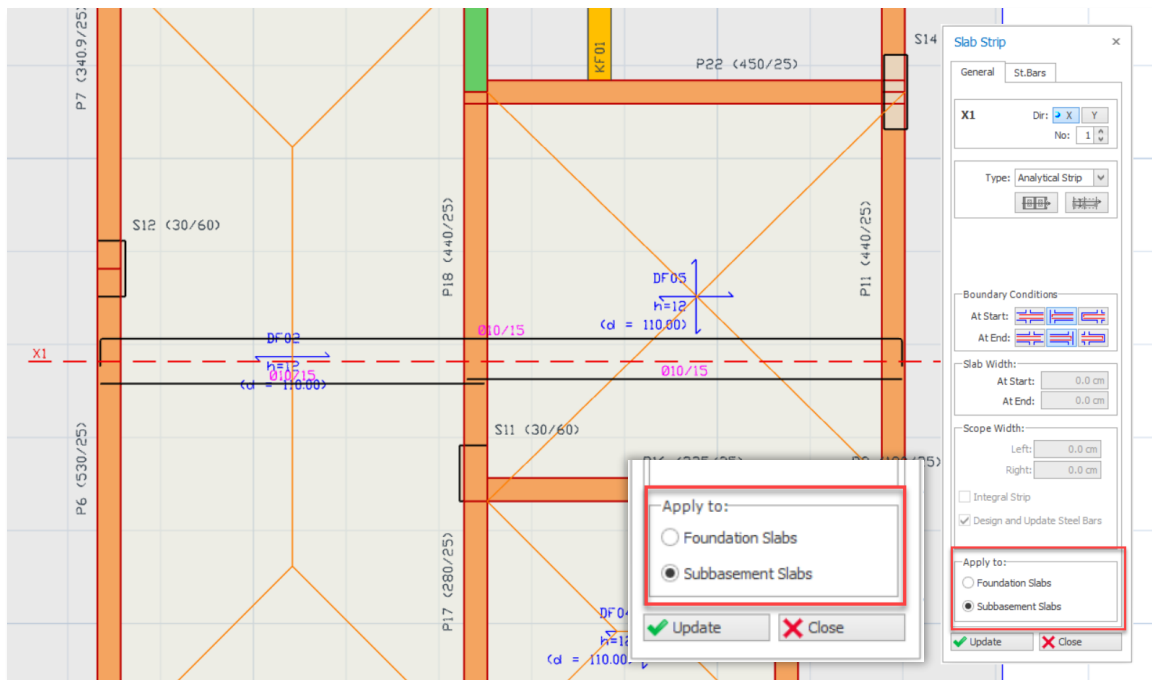
Once inserted in the model, you can assign loads on the subbasement slabs like any other member including distributed area loads, point loads, line loads etc.



Subbasement Slabs Rebar Design and Detailing

You can design subbasement slabs using slab strips just like any other slab in ProtaStructure.

1. Switch to foundation storey. You will see subbasement slabs and raft foundation slabs drawn on top of each other on the screen.
2. You may find the view complicated because the entities are drawn on top of each other. If you want to focus on subbasement slabs, you can only turn on the subbasement slab layer visibility. This is already covered in **Visibility and Color** section.
3. Pick the **Slab Strip** member from the **Model** ribbon tab.
4. You can design the subbasement slabs using one of **Finite Element Method** or **Moment-Coefficient Methods**.
5. Select “**Analytical Strip**” if you want to use Moment-Coefficient Method. Alternatively, select “**FE Strip**” if you want to use finite element analysis results.
6. Select “**Subbasement Slabs**” option in the “**Apply to**” section.



Subbasement Beams

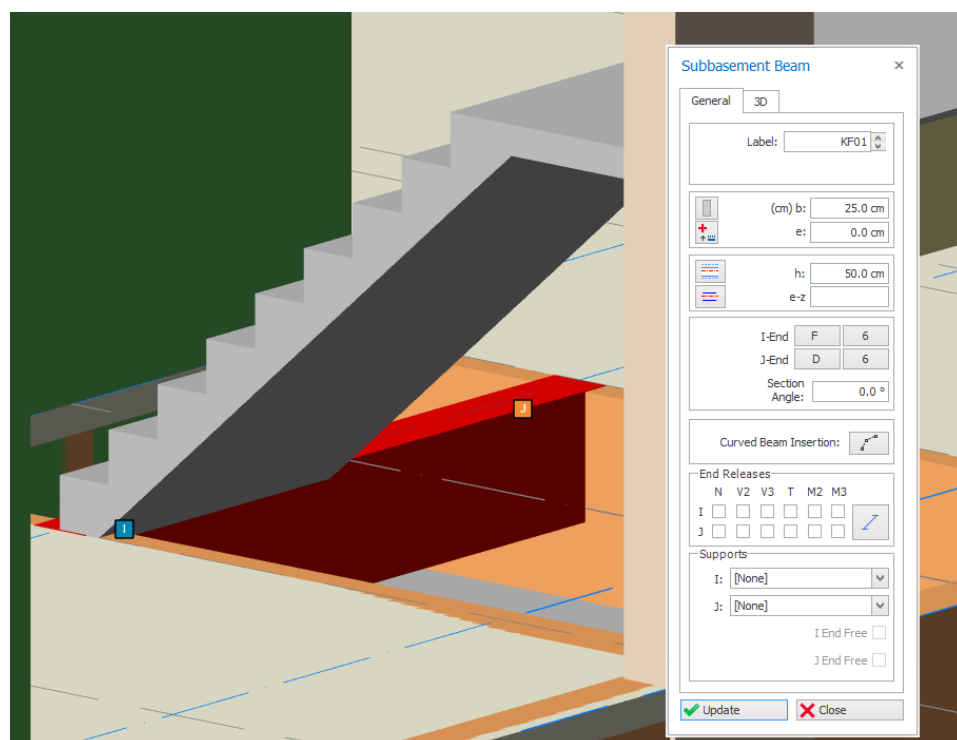
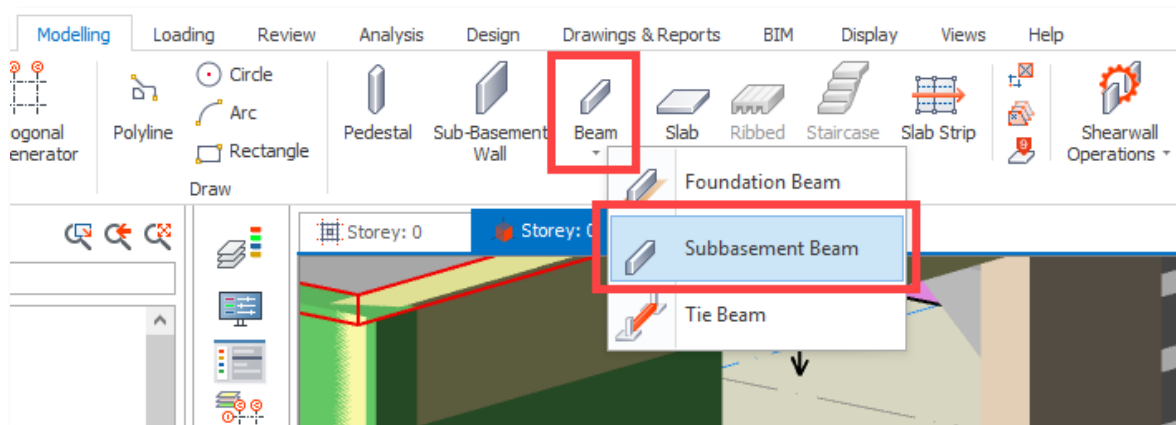
Modeling

Insertion of subbasement beams are similar to the regular beams.

Important Note:

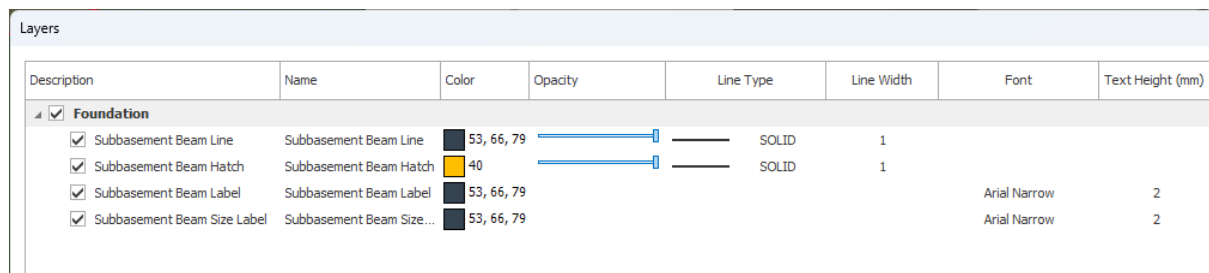
The foundation floor must be activated before modeling. You can not model subbasement slabs in upper storeys.

1. Click **Subbasement Beam** command on **Modeling > RC Members > Beams** ribbon tab.
2. Pick two axis intersections on the screen to insert a subbasement beam.
3. The beam will be placed on top of the **Foundation Depth** automatically



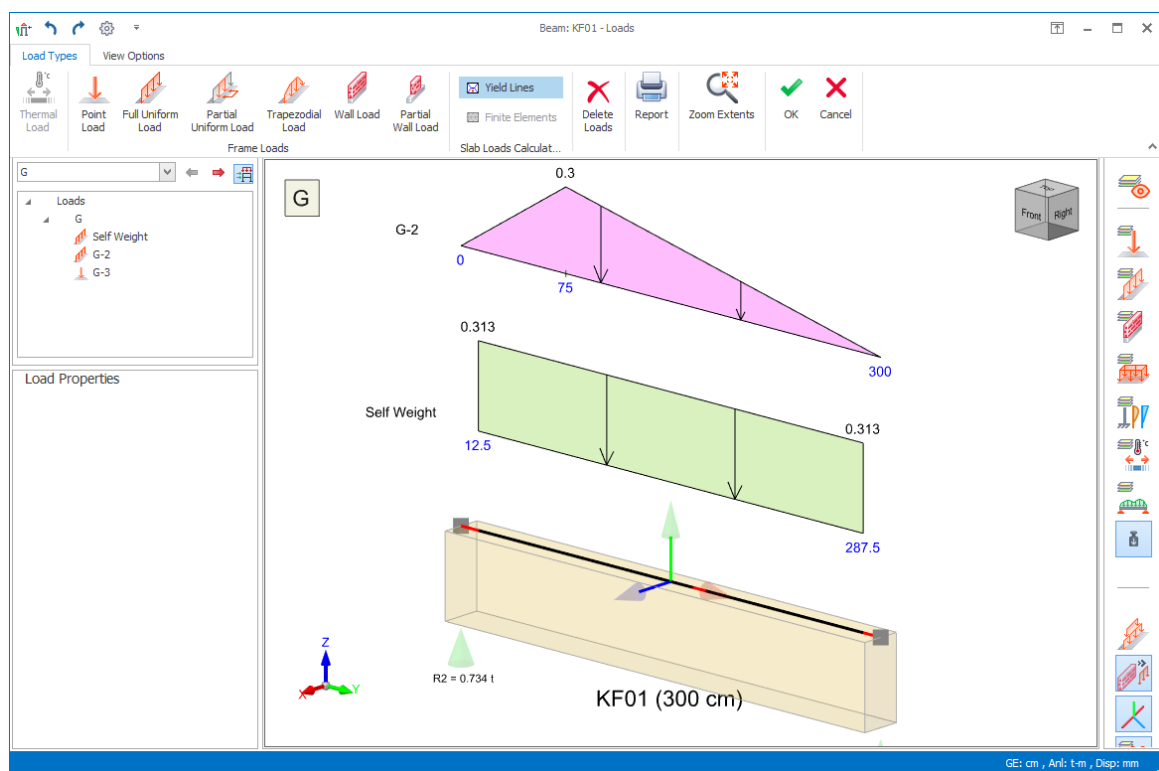
Visibility and Colors

Subbasement beams are automatically assigned a **different layer** and they are colored differently than regular beams. In the foundation plan view, subbasement beams, raft foundations slabs, regular foundation beams and subbasement slabs will be drawn on top of each other and the view can easily be congested. You can turn on/off the visibility of subbasement beams using the **Layer and Color Settings** window.



Loads on Subbasement Beams

Once inserted in the model, you can assign loads on the subbasement beams like any other member including distributed loads, point loads, infill wall loads, etc.



Subbasement Beam Rebar Design and Detailing

Subbasement beam reinforcement design and detailing IS NOT currently performed by ProtaStructure.

Analytical Model

Usually, in the practice, subbasement walls, slabs and beams are excluded from the analysis model since they are a part of the foundation and have limited effect on superstructure members. ProtaStructure now offers an option to include these members in the physical model and building analysis model. Once included, their stiffness and mass characteristics will play a role in building and foundation behaviour.

Important Note:

Subbasement walls are always modelled with FE shell elements.

If they are **inserted at the column nodes**, then the columns will be meshed compatibly with the subbasement walls and will share the internal forces with the columns.

If the subbasement walls are inserted at column faces, they will not be meshed with the columns. In this case, there won't be any force distribution between columns and subbasement walls.

There are two main analytical modeling options for building analysis:

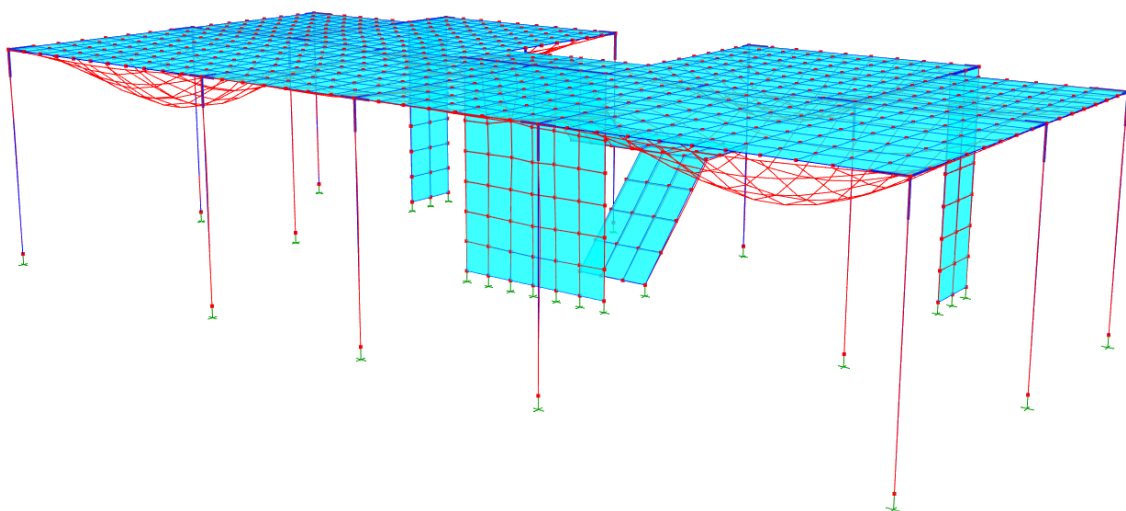
1. Analysis with User-Defined Supports
2. Analysis with Integrated Foundation Model.
3. FE Foundation Analysis (Separate from the building)

Analysis with User-Defined Supports

In this analysis option, the foundation floor is completely ignored (except for pedestals) and the supports (restraints) that the user has assigned are used under the members. In this method subbasement walls, beams and slabs have no effect on the analysis model. They are simply excluded.

Important Note:

Subbasement members are never included in the FE analysis model in this analysis option.



Building analysis model created with "User-Defined Supports" option

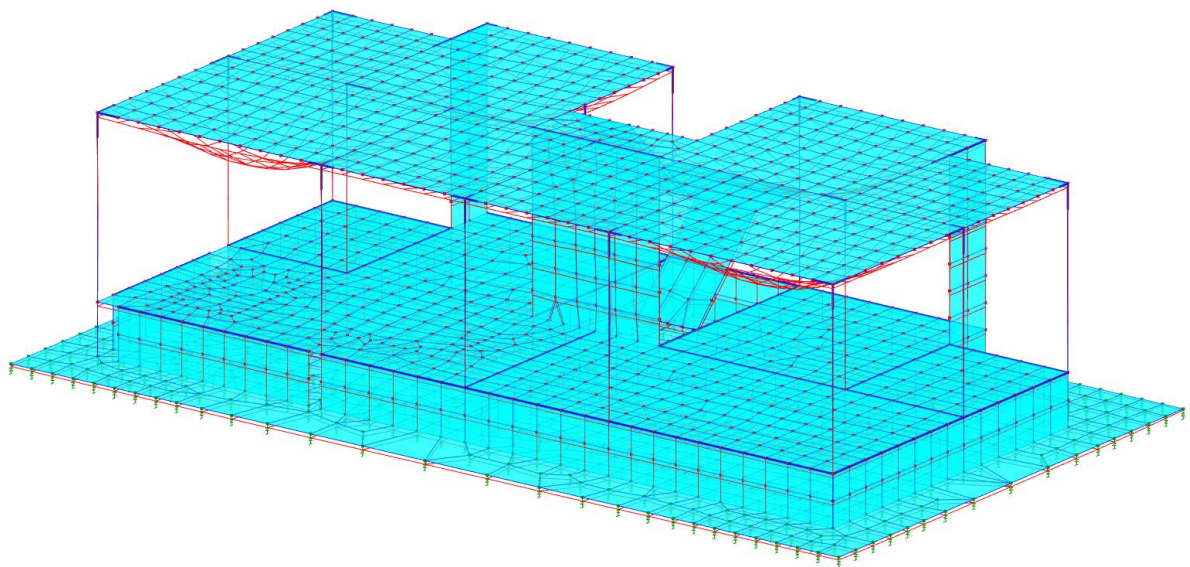
Analysis with Integrated Foundation Model

In this analysis option, the members in the foundation level, including pad footings, strip footings, pile caps, piles, raft foundations, subbasement walls, subbasement slabs and subbasement beams are considered in the building analysis model together with the loads assigned on them.

User-defined supports are ignored and soil springs are used to support the structure. These soil springs are calculated using the coefficient of subgrade reaction. Piles are also modeled with vertical axial springs and the spring stiffness values are assigned by users.

Important Note:

Subbasement members can be excluded from the FE model in this analysis option.



Building analysis model created with "Merged Foundation Model" option

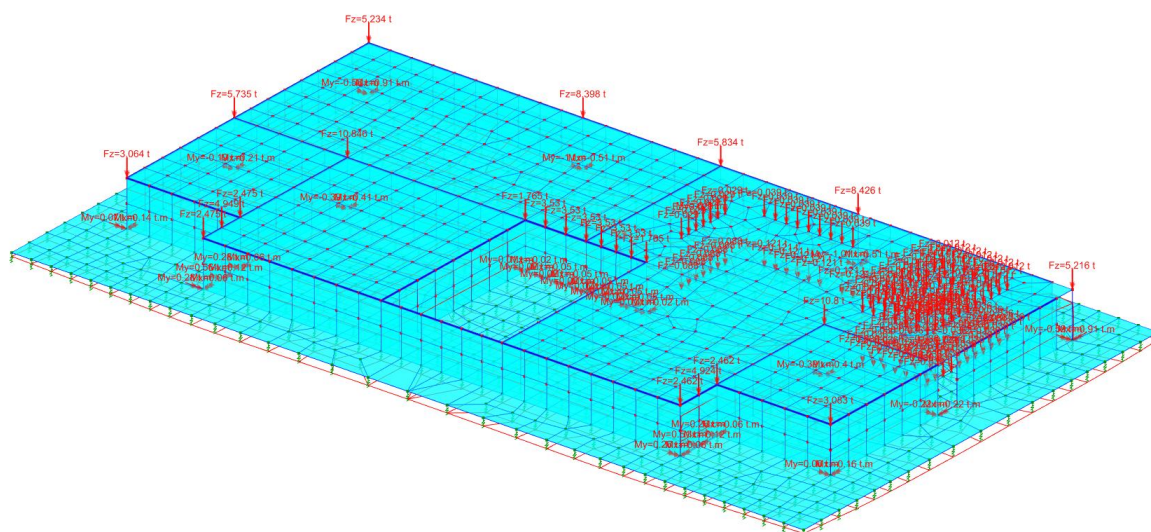
FE Foundation Analysis (Separate From the Building)

In this analysis option, only the foundation members are included in the FE analysis model. The reactions from the superstructure is applied on the members in the foundation for each combination. Details of this model is not in the scope of this document.

Subbasement members may have a significant effect on the rigidity of the foundation and hence the soil pressure. The existence of subbasement members will definitely introduce a somewhat rigid box effect on the foundation, also helping to distribute the column and wall axial loads from the upper structure. You can exclude the subbasement members from the analysis if you do not want to incorporate their effects.

Remark:

Subbasement members can be excluded from the FE model in this analysis option.



FE Foundation analysis model with "Subbasement Member Included"

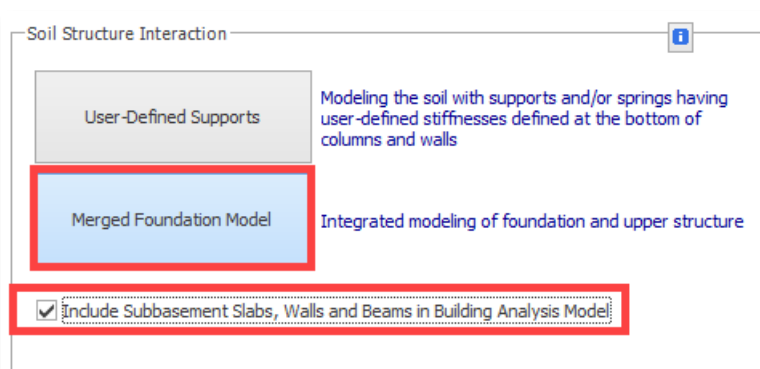
Excluding Subbasement Members from the Analysis

Although you may have modelled the subbasement walls, slabs and beams in the physical model, you can still exclude them from Integrated Foundation Model and FE Foundation Analysis model. Two separate options were introduced for this purpose.

Excluding from Integrated Building Analysis Model

To exclude the subbasement members from the integrated building analysis model:

1. Open the **Building Analysis** window
2. Navigate to **Model Options > Slab Model**
3. Uncheck **“Include Subbasement Members in the Model”** option

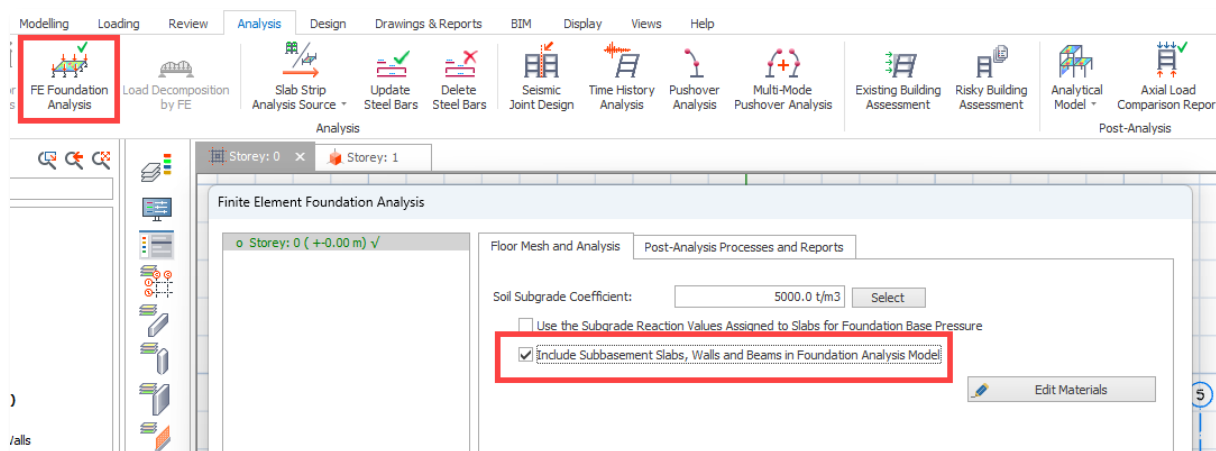


Building Analysis > Model Options window with “Merged Foundation Model” and “Include Subbasement Slabs, Walls and Beams in Building Analysis Model” option.

Excluding FE Raft Foundation Analysis Model

To exclude the subbasement members from the FE raft foundation analysis model:

1. Open the **FE Foundation Analysis** window
2. Uncheck **“Include Subbasement Slabs, Walls and Beams in Foundation Analysis Model”** option



FE Foundation Analysis Window with “Include Subbasement Members...” option.



Conclusion

ProtaStructure 2026 provides a powerful and flexible feature by allowing users to introduce subbasement members in the integrated building analysis and FE raft foundation analysis models. This helps to deal with project scenarios more accurately.

Flexible analytical modeling options allow users to control the structural behaviour according to their expectations and expertise.

Subbasement wall and beam design is not automated and users are expected to enter the reinforcement manually. On the other hand, subbasement slabs can be designed using slab strips. Subbasement wall detail drawings are automatically generated in ProtaDetails using the manually entered reinforcement information.



Thank You...

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