AUTODESK UNIVERSITY 2014

Precast Concrete Industry Extensions for Revit® Structure Suite 2015

Reinhard Lackner – IDAT

FB5656

This class shows how extensions to Revit Structure Suite software can dramatically speed up creation of precast elements. We will look at different precast elements, such as solid and sandwich walls, solid and hollow core slabs, and columns and beams. You will learn how to split walls and floors into producible panels. We will show how to create different connections, such as anchor plates, connection loops, grout tubes, dowels, column shoes, and so on. We will also discuss the automatic creation of reinforcement and the placing of lifting anchors, and we will go through the automatic creation of shop drawings and data for the production in the precast factory. By defining the transport stacks and the production line, we will see the full workflow from design to production of different precast elements inside of Revit Structure Suite software.

Learning Objectives

At the end of this class, you will be able to:

- Learn how to split walls and floors into producible precast elements
- Learn how to create different connections for the precast elements
- Learn how to reinforce the precast elements with predefined reinforcement types
- Learn how to create shop drawings and machine data for the production of the elements

About the Speaker

Reinhard is from Austria and studied computer science at the Technical University Vienna. He has been the general manager for the company IDAT (www.idat.de) since 1990. His technical know-how is in the precast industry.

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1. Introduction

What are the Revit Precast Tools?

The Revit Precast Tools are Extensions to and around Revit to support the workflow from design to fabrication for the Precast Concrete Industry. These tools are developed by the company IDAT (www.idat.de) in cooperation with Autodesk.

Who is IDAT?

IDAT is German based company developing software for the Building Industry since 1981. The main product is a full developed software solution for the Precast Concrete Industry based on AutoCAD Architecture. This software is used by clients in more than 40 countries worldwide.

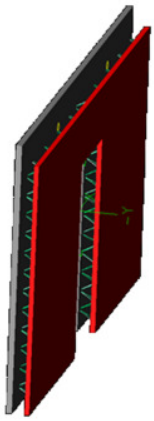
The following modules are currently available for AutoCAD Architecture:

<table>
<tr>
<td>Walls:

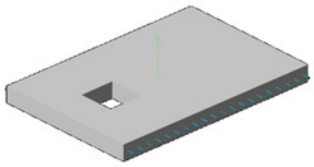
Solid/Sandwich

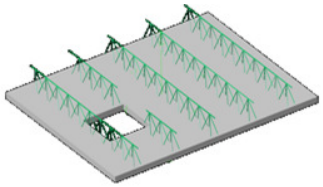
Double

  </td>
<td>Slabs:

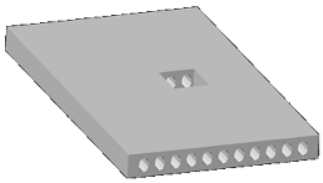
Solid

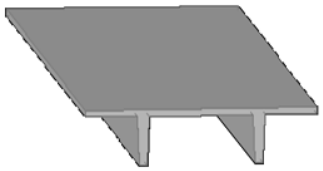
Girder

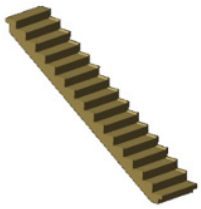
Hollow core

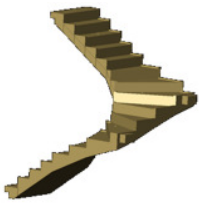
TT

  </td>
<td>Stairs:

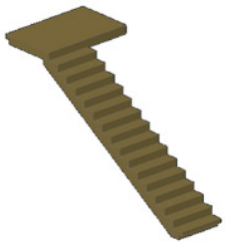
Straight

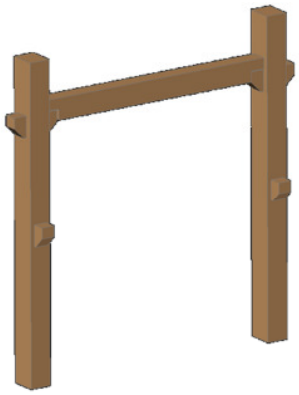
 

Winding

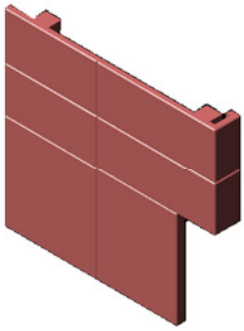
 

Podest

  </td>
<td>Colums/Beams:

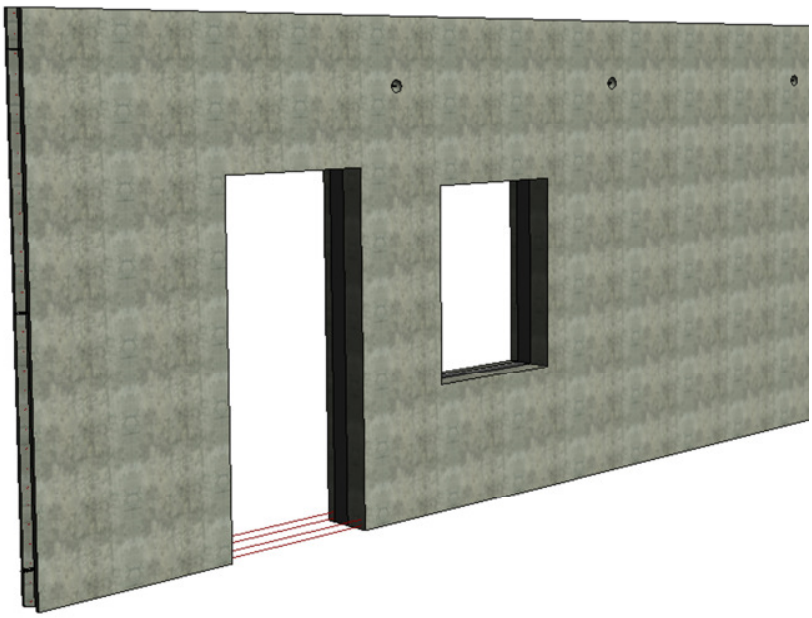
Facades:

  </td>
</tr>
</table>

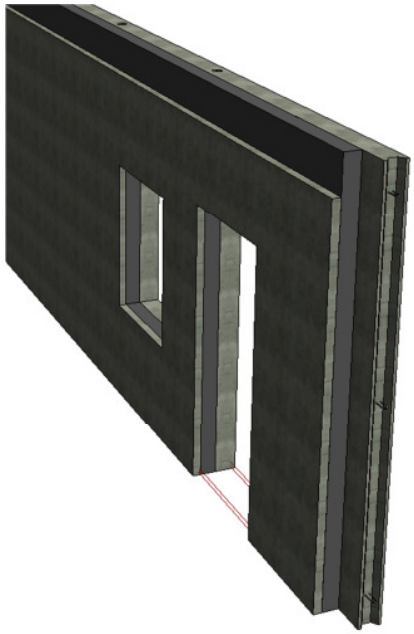
Revit Precast Tools for Autodesk Revit Structure

Each module from the AutoCAD version will be redeveloped on Revit. At the moment there are the following modules available:

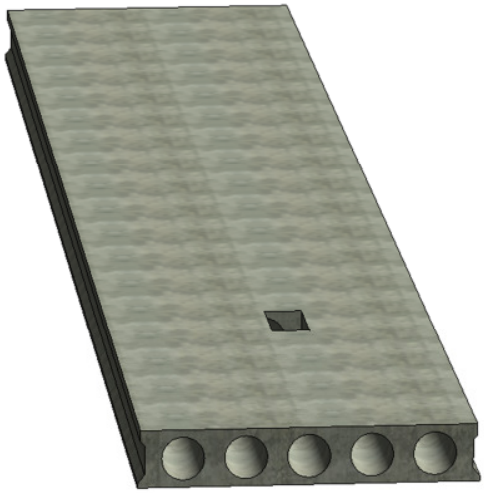
Solid Walls:



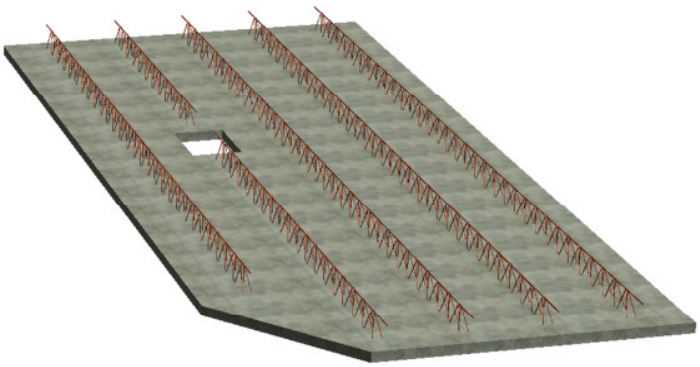
Sandwich Walls:



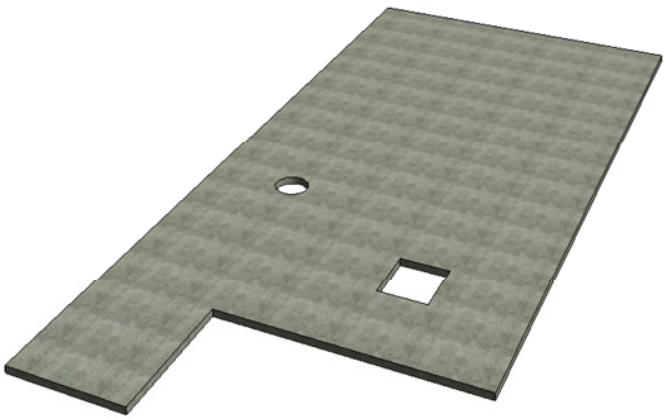
Hollowcore Slabs:



Girder Slabs:

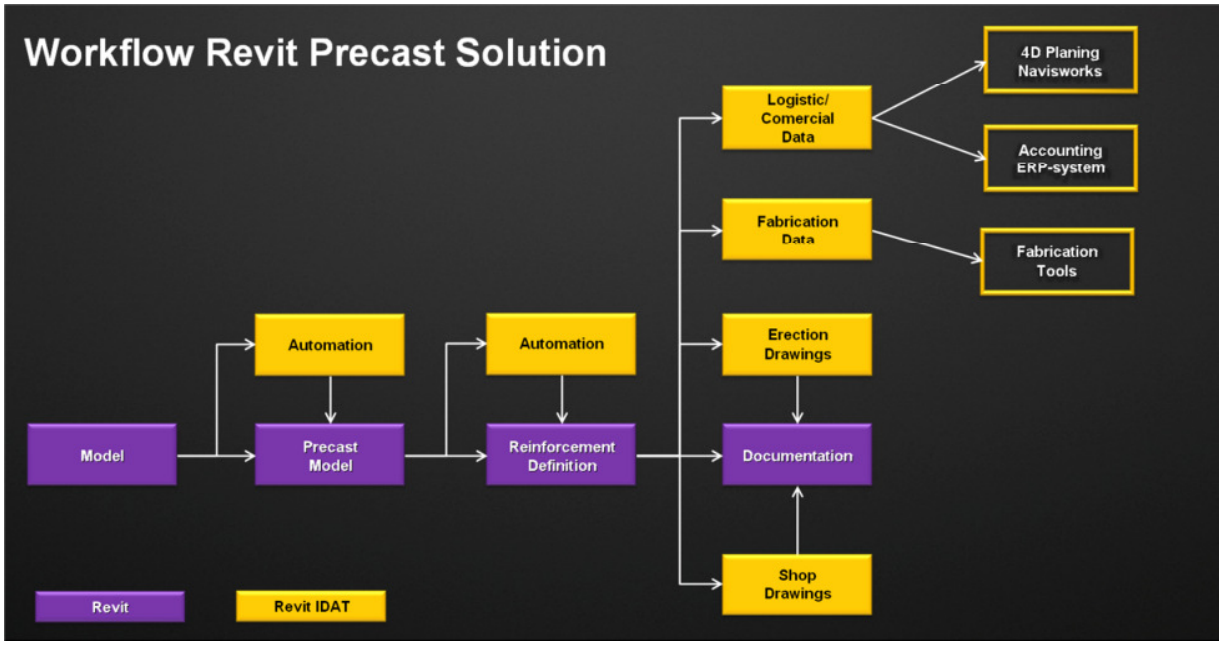


Solid Slabs:



Workflow of the Revit Precast Solution:

The workflow of the Revit Precast Solution from design to the fabrication is the following:



2. Installation

File locations

When installing the software, a path for the template and family files can be set. The default value is

"C:\ProgramData\IDAT\Revit Precast Tools 2015"

The templates and families for the different modules are installed in the following folders with several subfolders in it:

Solid Walls:

"C:\ProgramData\IDAT\Revit Precast Tools 2015\IDATFamilies\en-US\Solid Wall"

Sandwich Walls:

"C:\ProgramData\IDAT\Revit Precast Tools 2015\IDATFamilies\en-US\Sandwich Wall"

Hollowcore Slabs:

"C:\ProgramData\IDAT\Revit Precast Tools 2015\IDATFamilies\en-US\Hollow Core Slab"

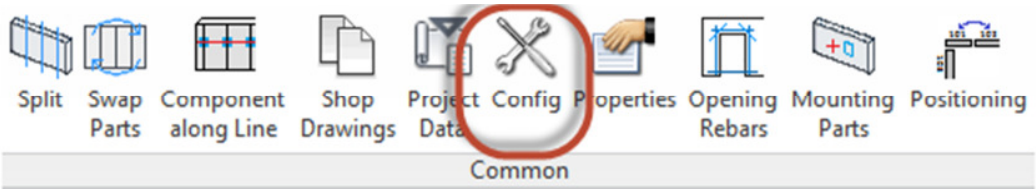
Girder Slabs:

"C:\ProgramData\IDAT\Revit Precast Tools 2015\IDATFamilies\en-US\Girder Slab"

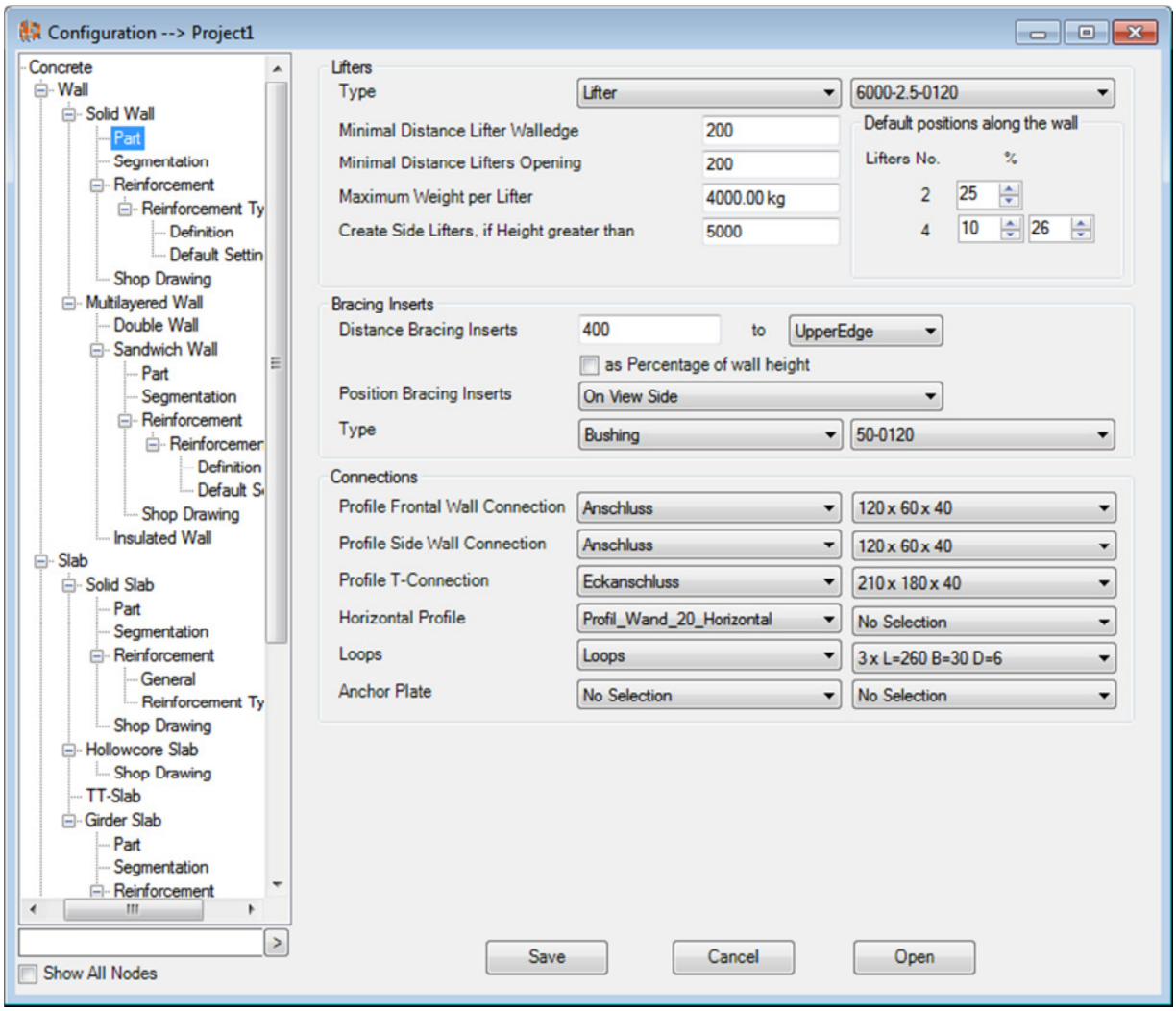
Solid Slabs:

"C:\ProgramData\IDAT\Revit Precast Tools 2015\IDATFamilies\en-US\Solid Slab"

3. Configuration



With the command “Config” you can open the dialog to change different settings:



The settings are described later in the document. With the button “Save” all the changes are saved into the settings of the project.

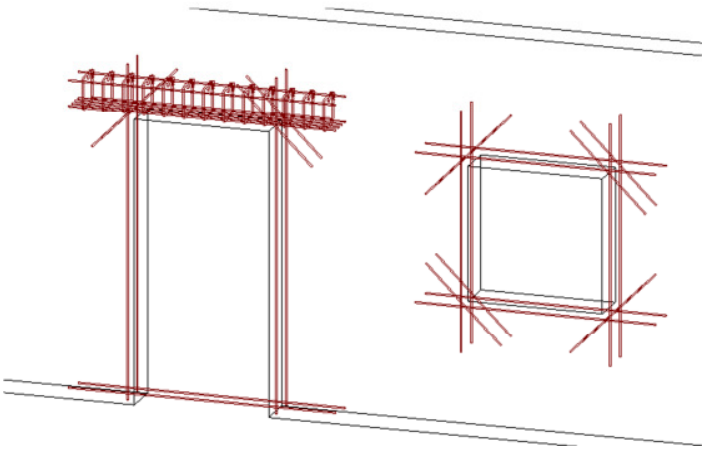
If you use the button “Open” you can open an external XML file with different settings. To create such an external configuration file you have to make a right mouse click in the tree on the left side and choose the

“Export” option. Thereby you can export only some parts or the full tree. So you have the possibility to create different configurations for different factories or other situations. These configurations can be loaded into projects individually.

Remark: If you create a new project or you open a project which has never been saved with the Revit Precast Tools installed, the XML file “IdatCfg.xml” from the folder “C:\ProgramData\IDAT\Revit Precast Tools 2015\Config” will automatically be loaded and saved in the project.

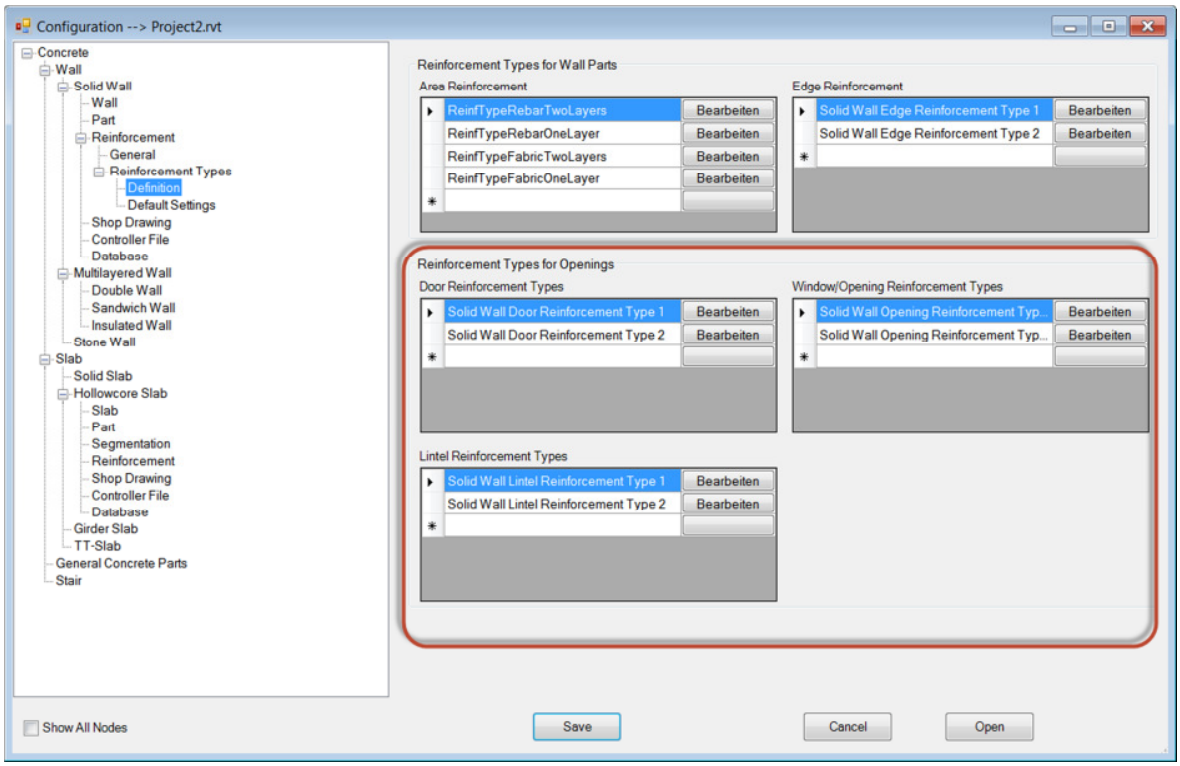
4. Reinforcement for openings

Depending on the configuration the Revit Precast Tools automatically inserts reinforcement around openings when they are inserted. This can be reinforcement around doors, windows and openings with optional lintel reinforcement:



Configuration of the reinforcement for openings

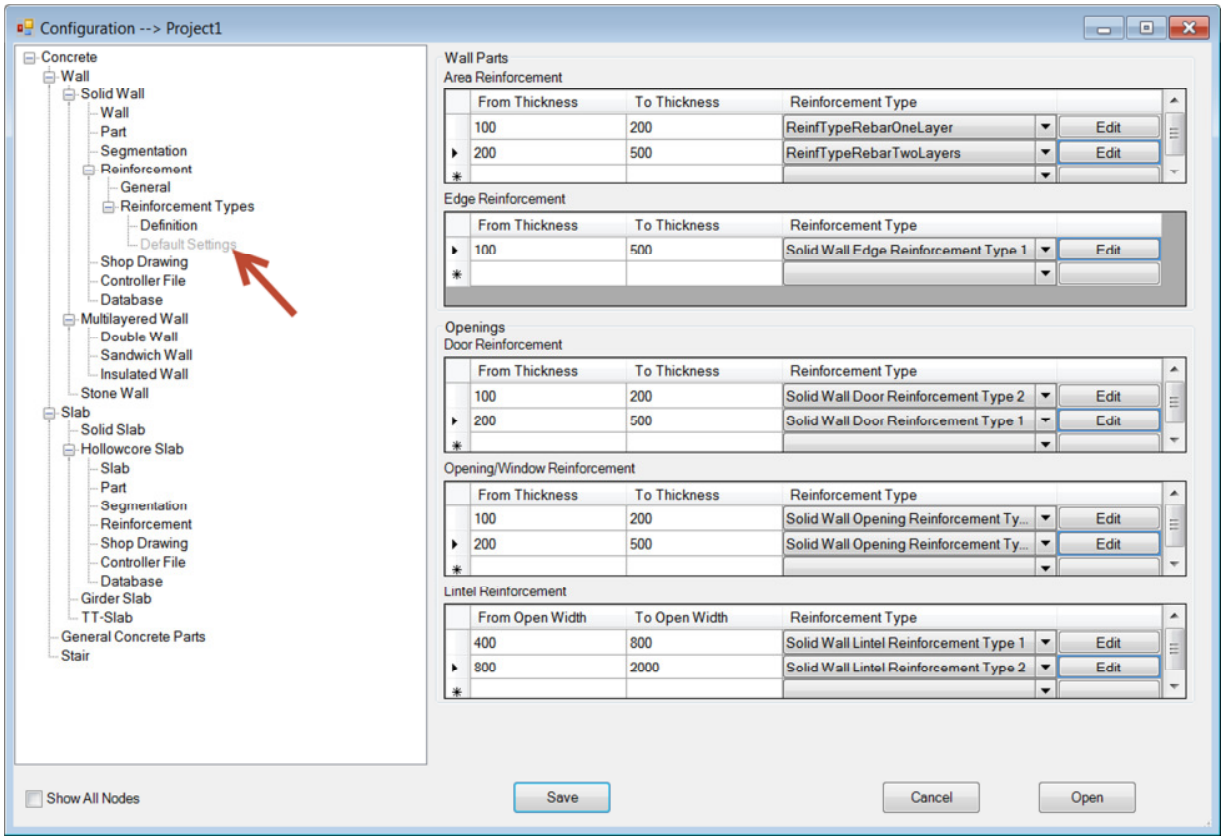
The opening reinforcement can be defined in the configuration with the following dialog:



You can define as many reinforcement types for Doors, Windows/Openings and Lintel Reinforcement as you want.

Reinforcement default settings

In the following dialog you can define in which situation which reinforcement type should be used:

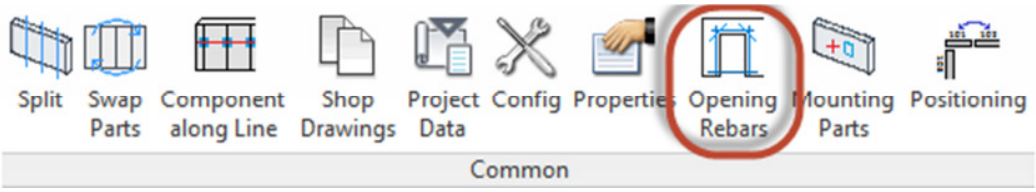


For the wall parts, the edge reinforcement and the opening reinforcement you can define different intervals of wall thicknesses and choose the desired reinforcement type for it.

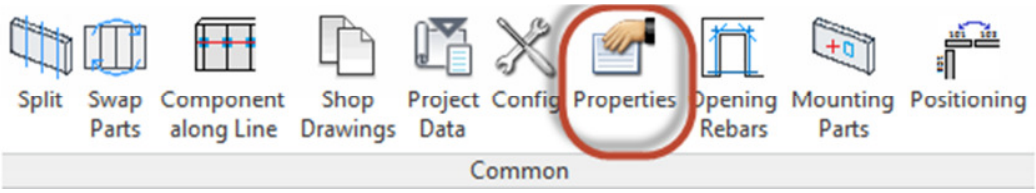
For the lintel reinforcement you can define different intervals of opening widths and choose the desired lintel reinforcement type for it.

Use of the opening reinforcement command for the walls

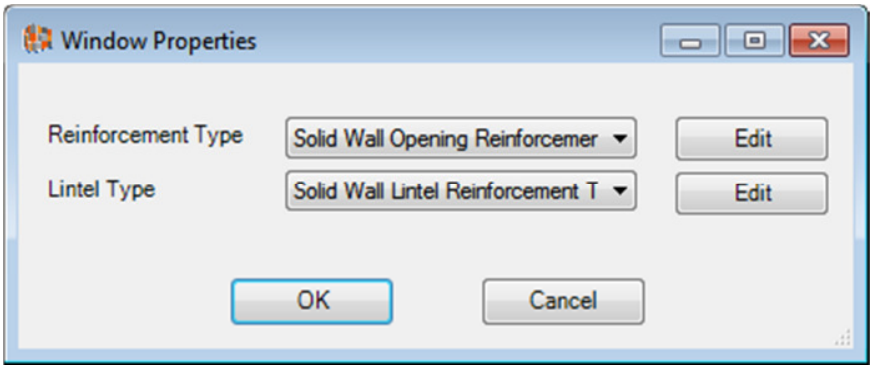
If you insert a wall opening in the project the opening reinforcement is automatically created. If you open a project where openings are already inserted without the Revit Precast Tools you can select the openings and start the command “Opening Rebars”:



This command inserts the defined reinforcement for all selected openings. If you want to change the reinforcement or the reinforcement type of an opening, you can select the opening and call the command “Properties”:



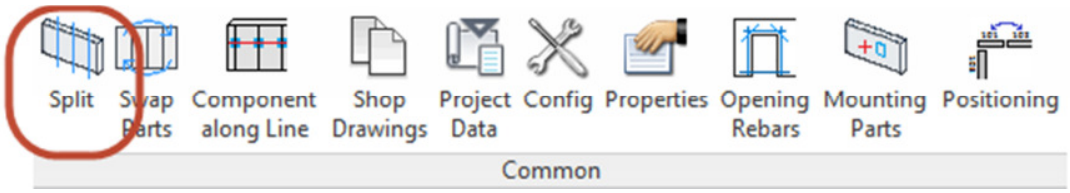
This opens a dialog where you can choose a different reinforcement and/or lintel type or edit the type directly with the edit command.



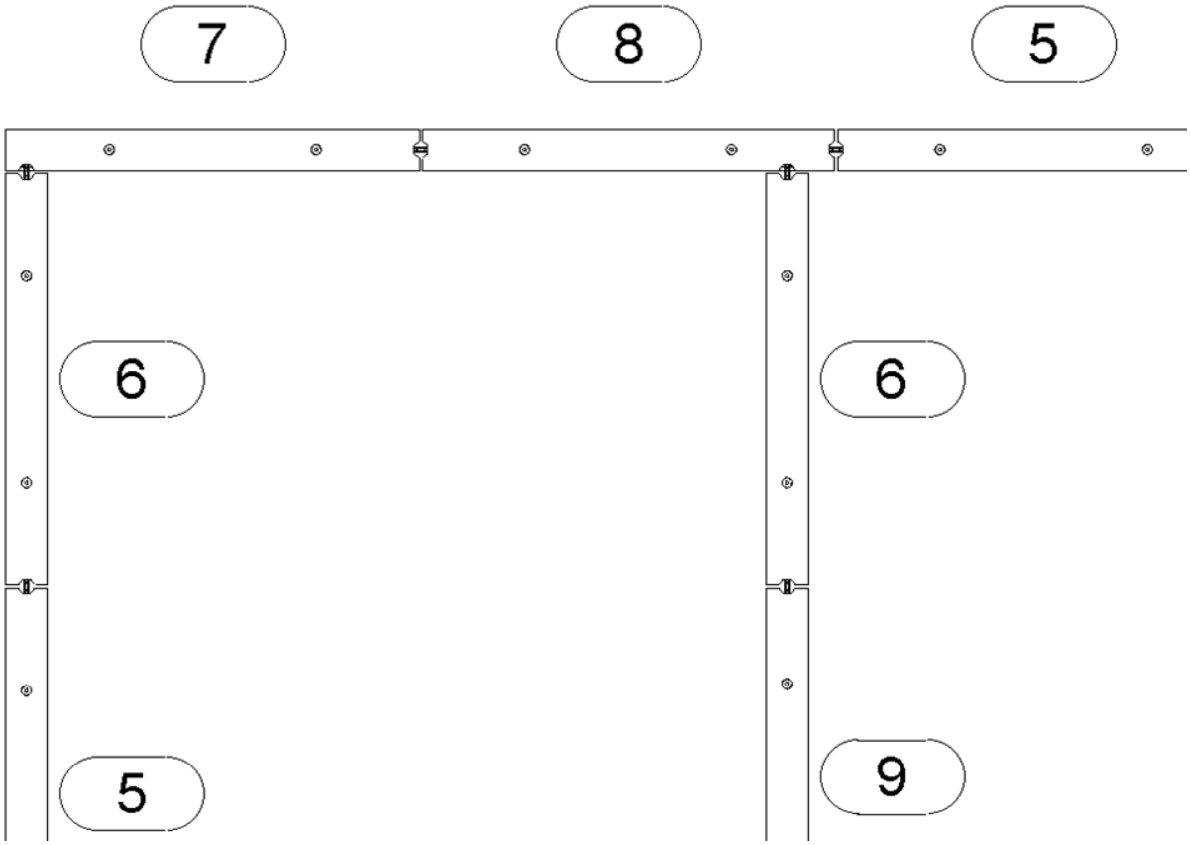
The change in this dialog will automatically replace the old reinforcement with the new type.

5. Dividing of walls or slabs

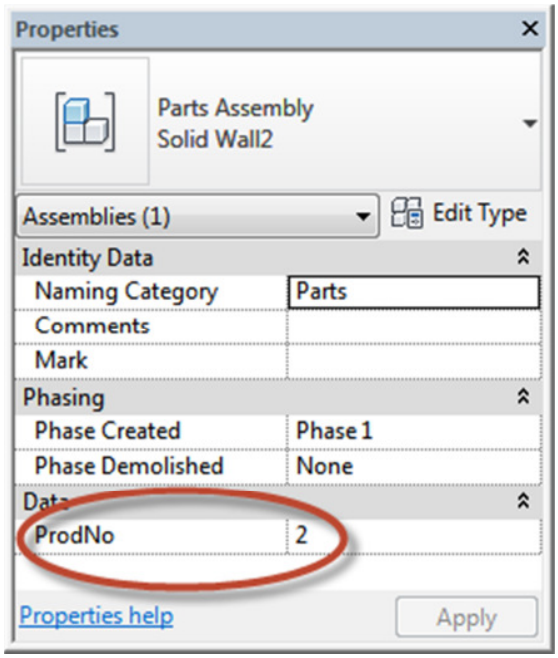
To divide walls or slabs into producible panels you can select one or more walls and/or slabs and call the command “Split” from the Revit Precast Tools:



This command will first create parts out of the walls or slab and divide the parts with the Revit divide command into producible parts. After that the program creates lifters, connections and reinforcement and adds all together with eventually manually inserted components to an assembly:

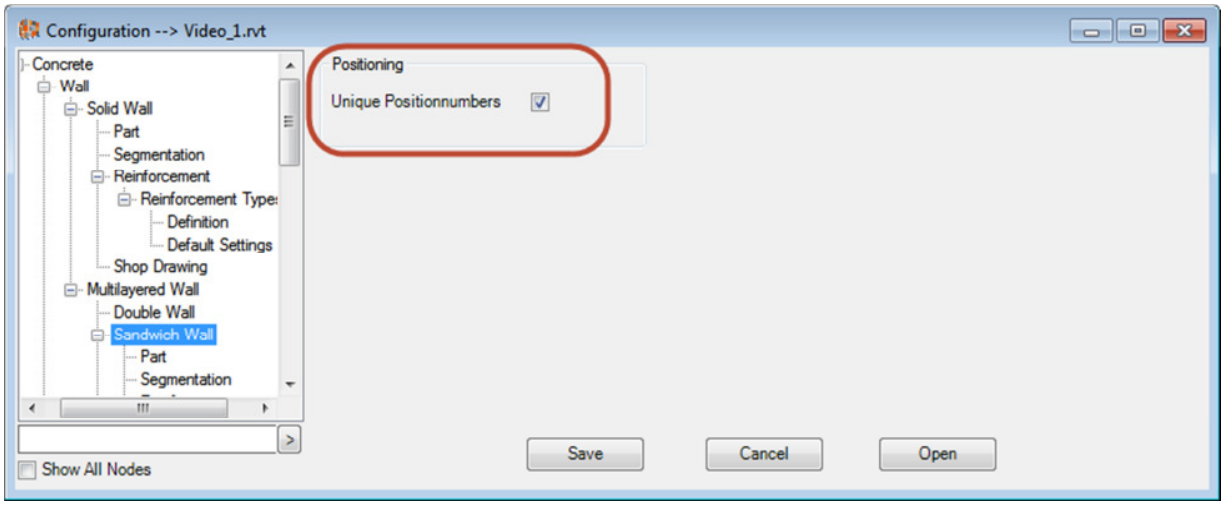


During the creation of the assembly the system checks which assemblies are the same and gives them the same assembly type name which reflects the position number. In the data of the assembly also a unique production number is stored:

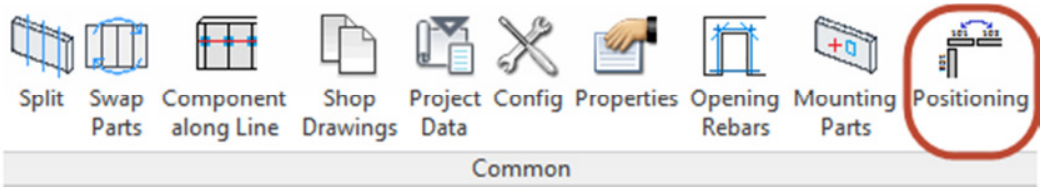


This unique production number is used for naming the machine data files.

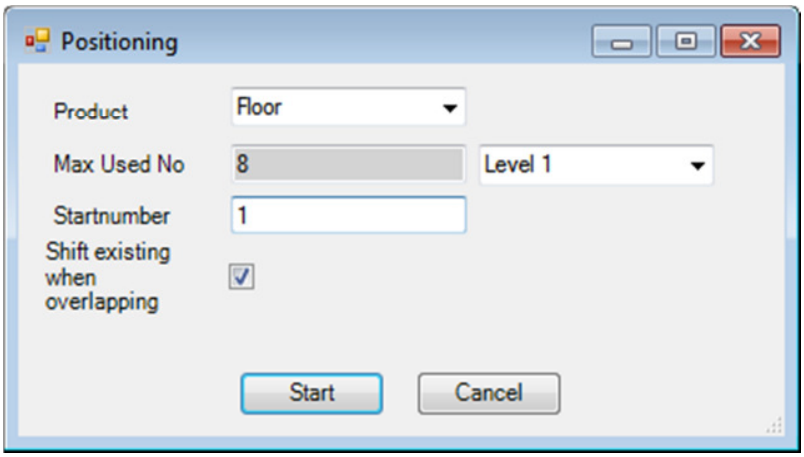
It is also possible to give each assembly a unique position number. You can activate this feature in the configuration for each product type.



You can reorganize the position numbers with the command Positioning:



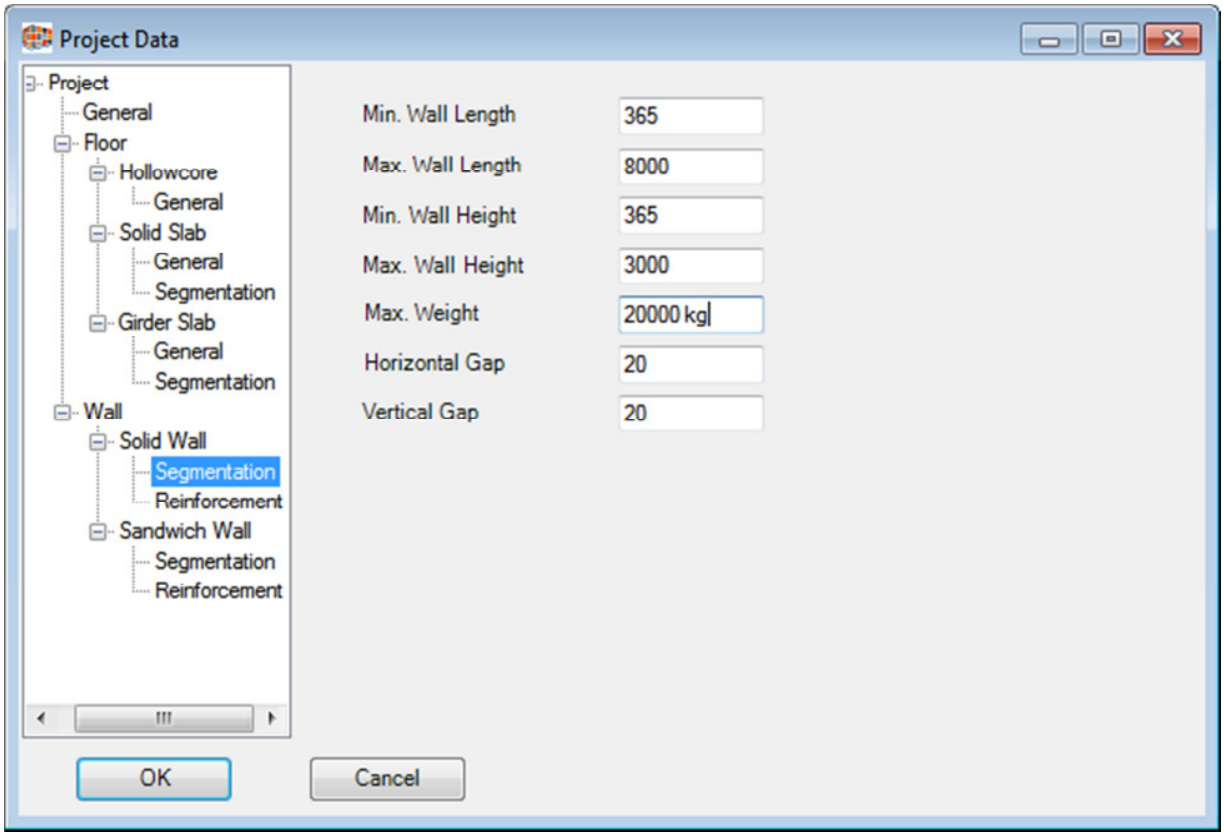
After you start this command you get the following dialog:



Here you can choose the product and define the start number. After choosing start you can select the assemblies in that order how you want to enumerate them.

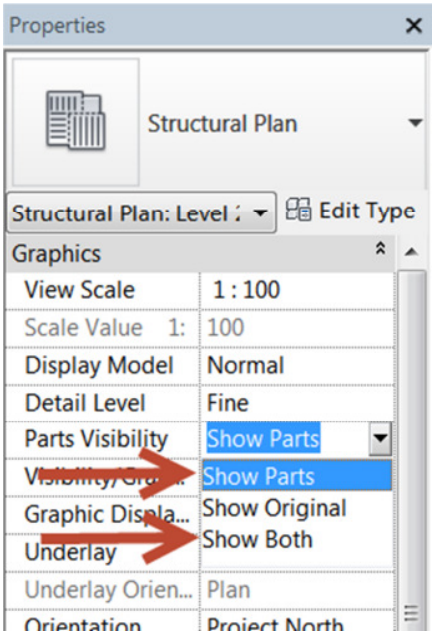
Parameter for dividing

Depending on the product you have you can set different parameters for the dividing in the project data:

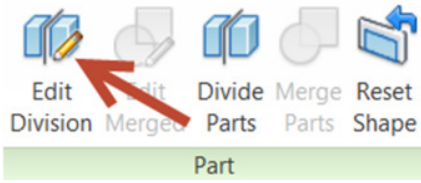


Manual dividing

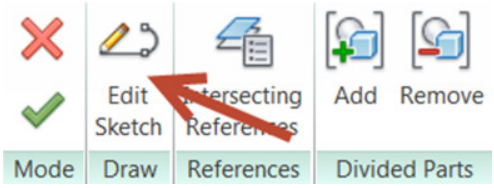
After the automatic dividing you can manually change the diving. Therefore you have to select one part of the wall or the slab. To be able to select the parts, the part visibility must be on. You can switch the parts visibility in the properties on by selecting “Show Parts” or “Show Both”:



If you select one part of the wall or the slab you must choose the command “Edit Division” from the Modify|Parts tab.



After that choose “Edit Sketch”



Now Revit shows the dividing lines:

This allows you to move, delete or add additional dividing lines. After you closed the edit mode, the Revit Precast Tools will create new panels according the changed dividing lines.

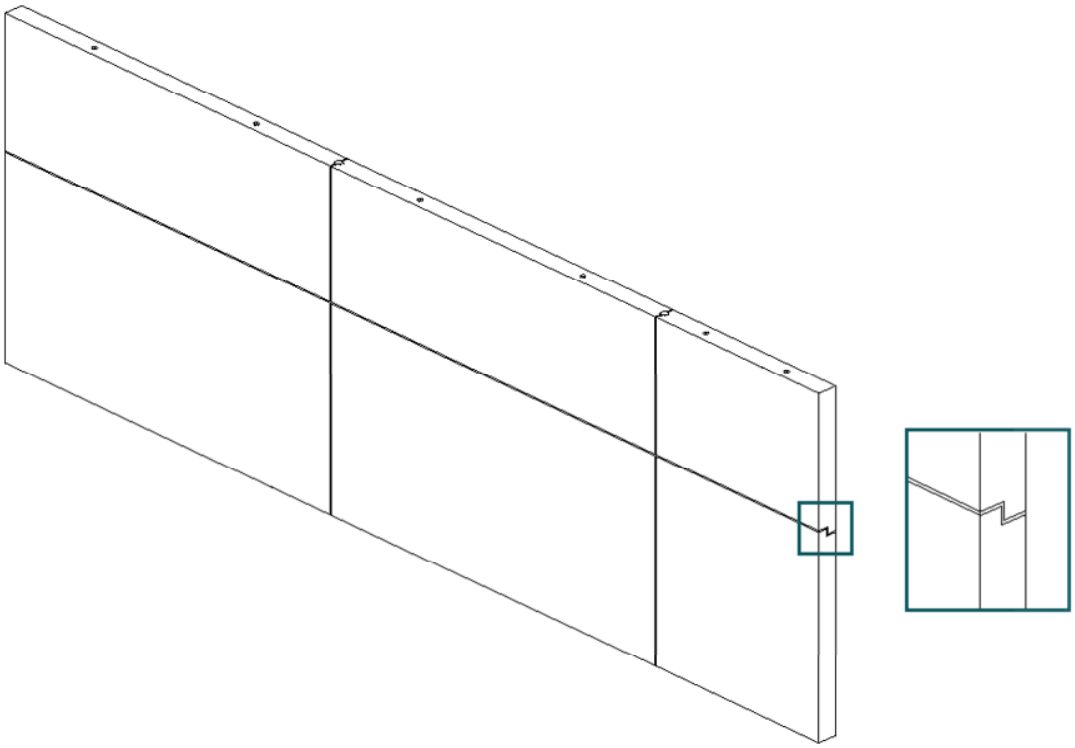
Diving of walls:

The important parameters for the dividing of walls are the minimal and maximal wall length and height as well as the maximal panel weight. The dividing will always be within the limits of the parameters.

The horizontal gap is the gap of the panel to the bottom of the wall. If the wall is divided in more than one layer it also defines the gap between them.

Horizontal dividing

If the wall is higher than the maximal wall height the program automatically divides the wall horizontal into layers:



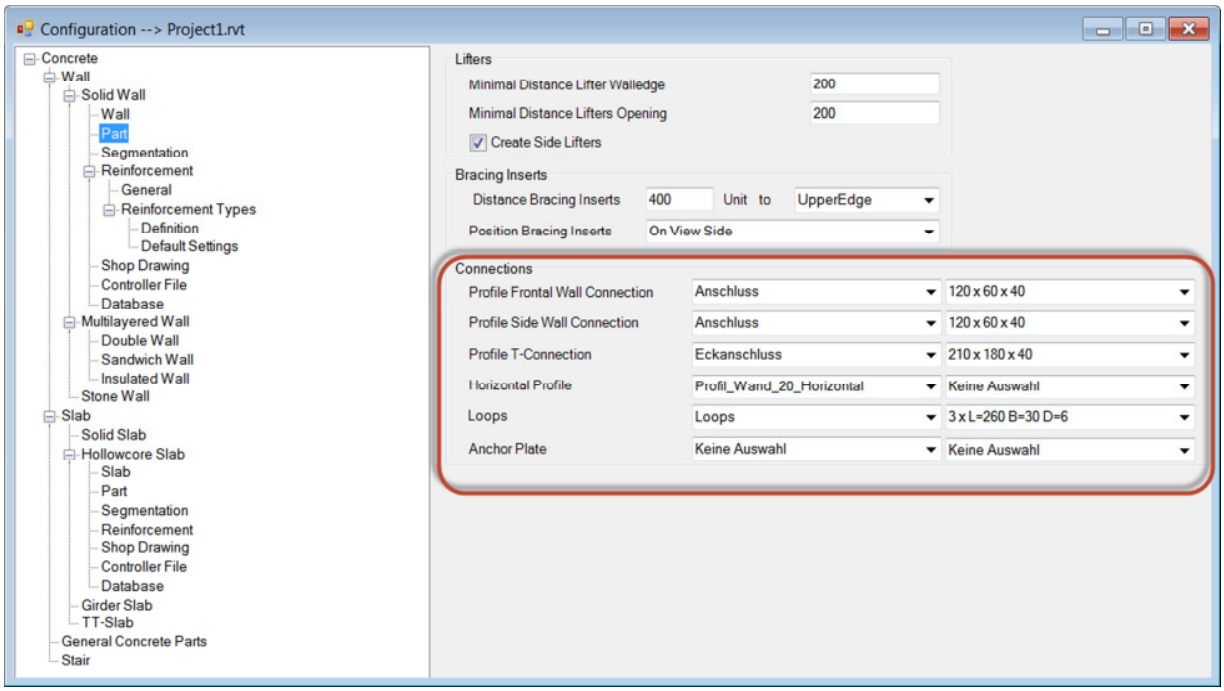
The profile between the layers can be set in the configuration.

Connections between the wall panels

The wall panels can be connected with the following options:

- Loops
- Anchor plates
- Grout pipes and dowels

The type of connection can be set in the configuration with the following dialog:



For the connection with loops you can choose the family for the loops and the families for the profiles. To connect the panels with anchor plates you can set the family, the program should use.

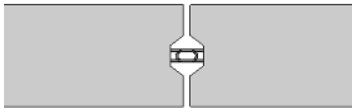
The profile for the horizontal dividing can also be set in this dialog.

All the families are in the folder “C:\ProgramData\IDAT\Revit Precast Tools 2015\IDATFamilies\en-US\Solid Wall\Mounting Parts”.

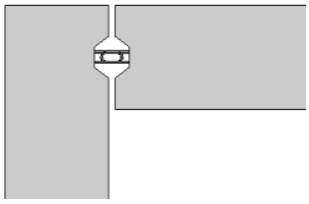
Horizontal connections with loops

For the connection with loops the program creates a profile and the loops according the predefined families. In the family it is defined how many loops should be created depending on the height of the wall. The program automatically performs the following connections:

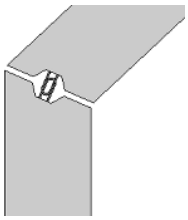
Straight connection:



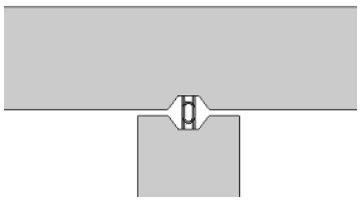
90° connection:



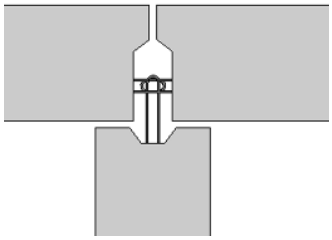
Non 90° connection:



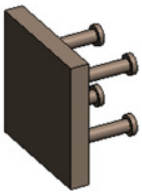
T-connection:



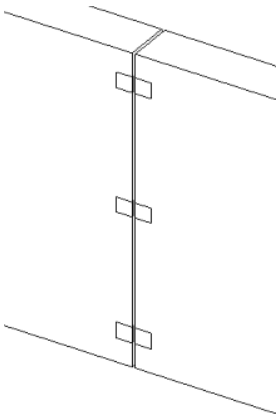
T-connection with a straight connection:



Horizontal connections with anchor plates

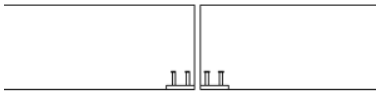


For the connection with anchor plates the program inserts the plates according the predefined families. Depending on the height of the panels two or more plates are created. The rules for that can be defined in the family.

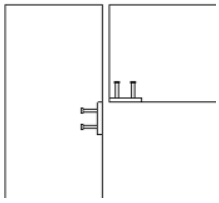


The program automatically performs the following connections:

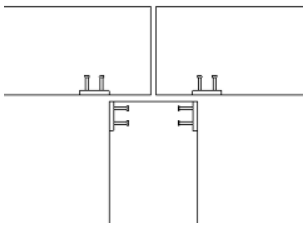
Straight connection:



90° connection:

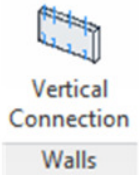


T-connection:

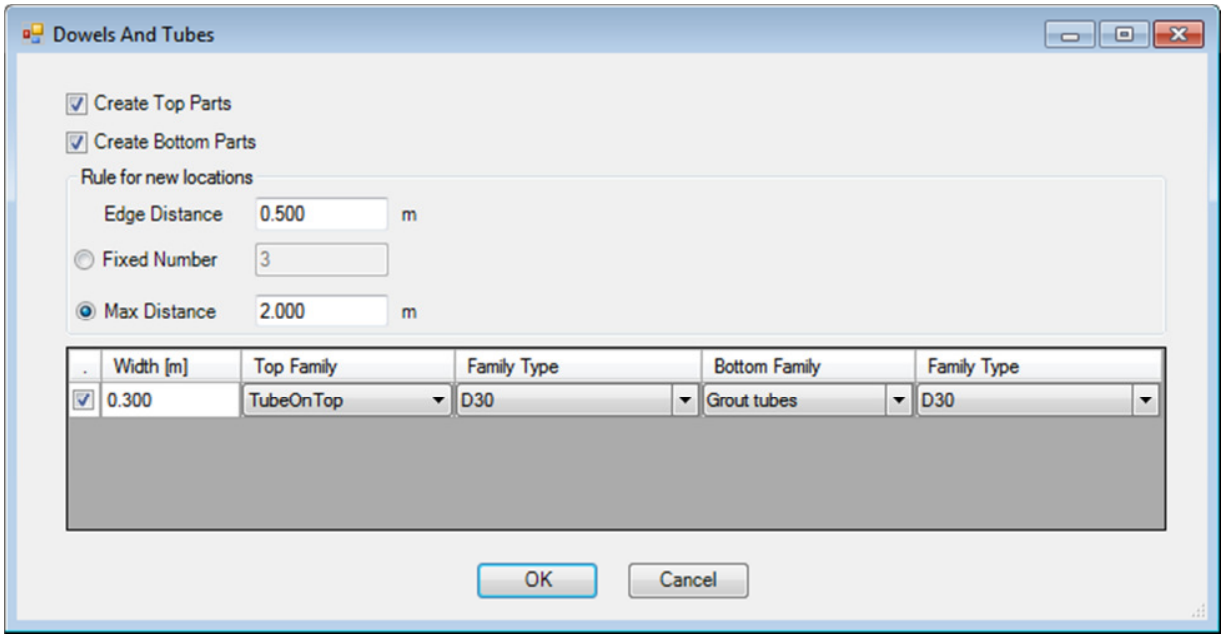


Vertical connections with grout pipes and dowels

To create vertical connections start the command Vertical Connection:

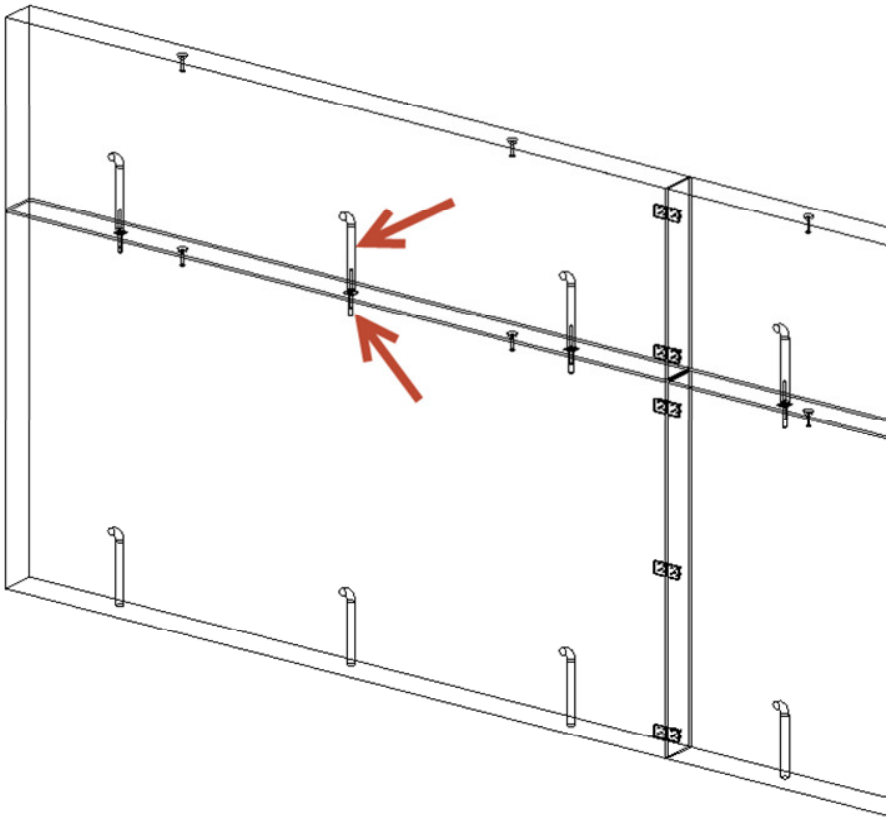


After you start this command you have to select all the assemblies where you want to create vertical connections. When you press finish the following dialog is presented:



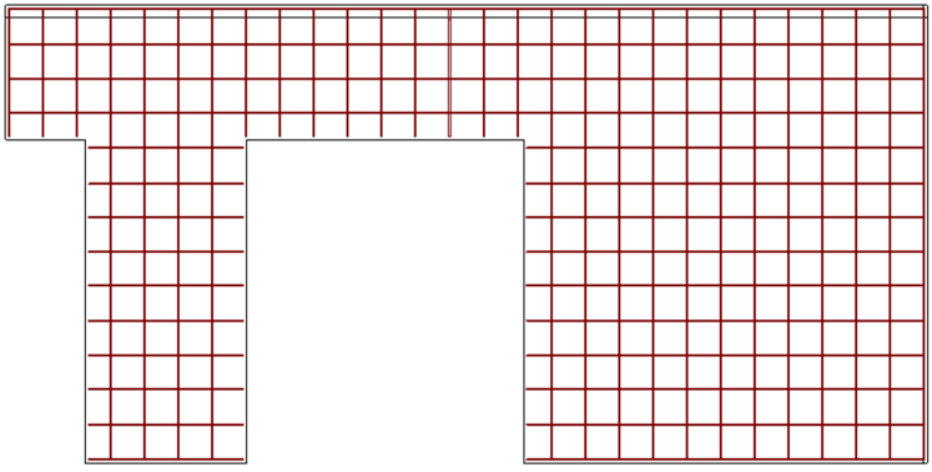
Here you can choose if you want to insert families on the top and/or the bottom of the wall. You define the distance from the edge of each wall panel and a maximum distance (or a fixed number) between the connections. For the top and for the bottom you can choose a different family and a family type.

As a result you get following:

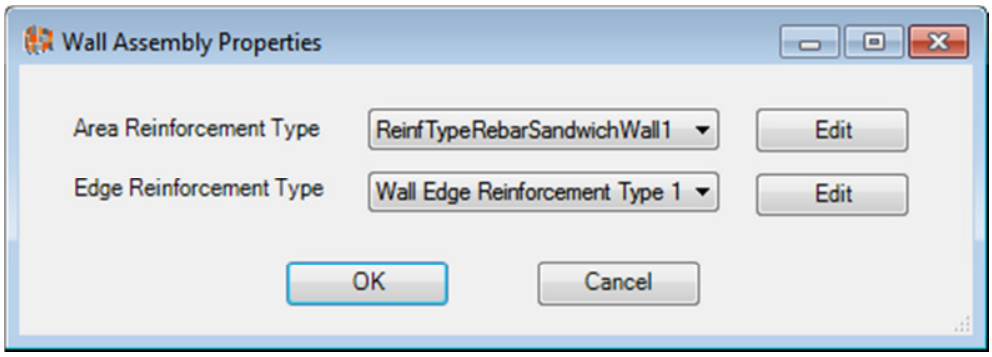


Wall reinforcement

During the dividing the program creates the reinforcement for each wall panel:



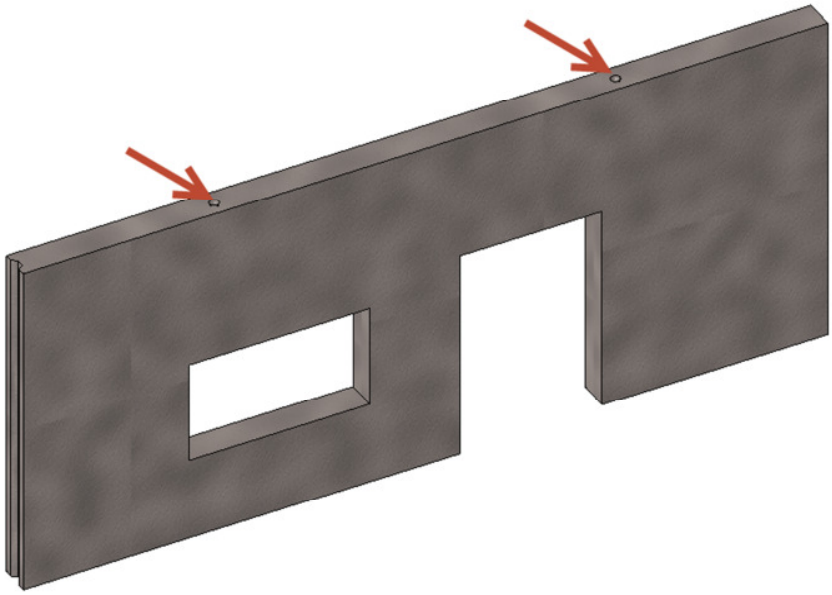
The reinforcement is created according reinforcement types which are set in the configuration. If you select the wall or a wall assembly and start the command “Properties” from the Revit Precast Tools, you will get the following dialog:



In this dialog you can choose the area reinforcement type as well as the edge reinforcement type for the wall. If you choose a wall assembly and change the reinforcement type in the assembly, the already created reinforcement will change automatically to the new type.

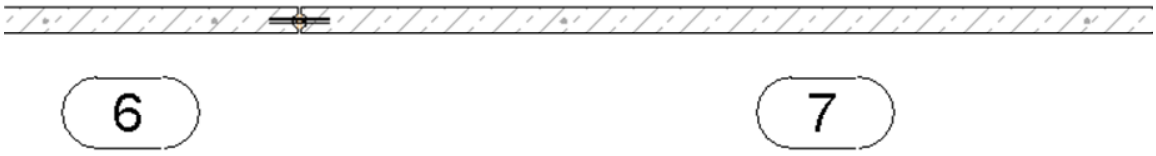
Lifting anchors

The lifting anchors are created automatically during dividing and placed according the center of gravity:



Wall marker

Each wall panel gets automatically a wall marker. The style of the wall marker for solid walls can be defined in the family AnnotationMW.rfa in the folder “C:\ProgramData\IDAT\Revit Precast Tools 2015\IDATFamilies\en-US\Solid Wall\Annotations”.

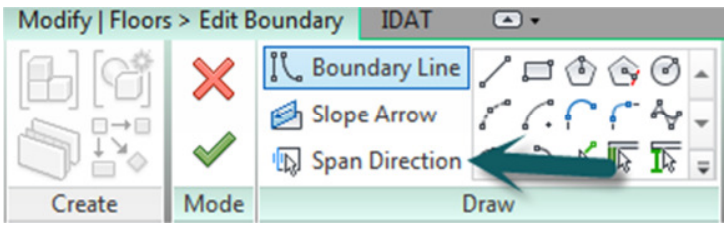


The position of the wall marker influences the view direction on the shop drawing. The side where the wall marker is placed defines the view side for the shop drawing.

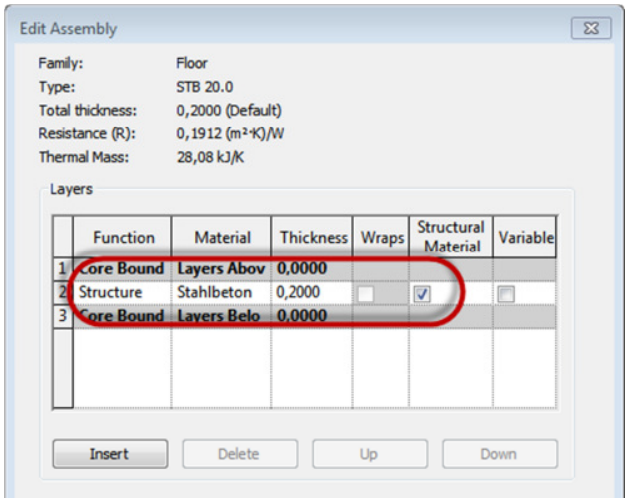
Dividing of floors

A floor can be divided into slab elements. Therefor it is important that the span direction in the floor is defined correct:

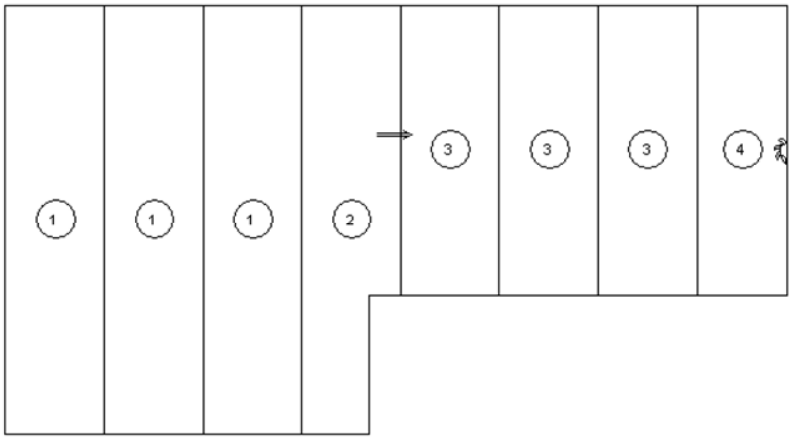
If you edit the boundary of the floor you can chose the span direction with the marked command:



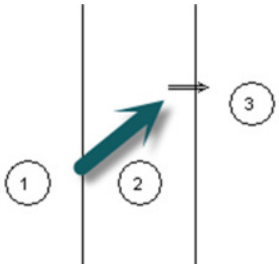
In the type properties of the floor must a structural layer with a structural material exist:



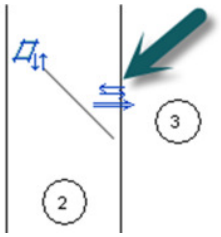
The result will be shown in the structural plan view where the position number of the elements can be seen:



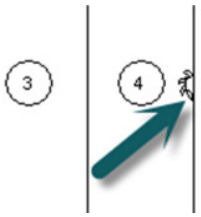
In this view also the shifting direction is shown:



The program starts during the segmentation with the first element and puts the next elements in shifting direction. The shifting direction can be changed by clicking the control arrows 



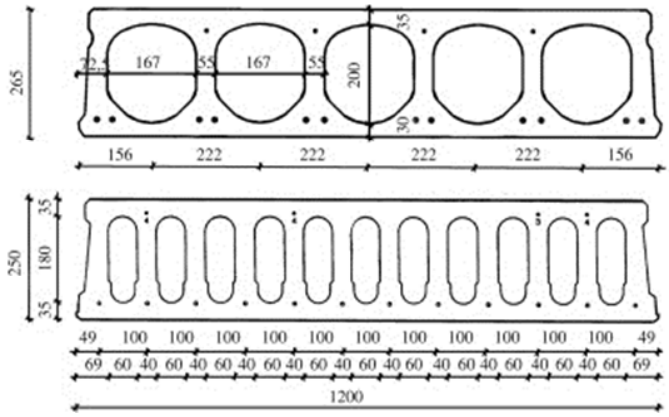
If the last element of hollow core slabs has not the standard width, it must be cut. The side where the element must be cut in the factory is marked with a saw symbol:



The side of the saw cut can also be changed with clicking the control arrows  of the cut symbol.

Hollow core slabs

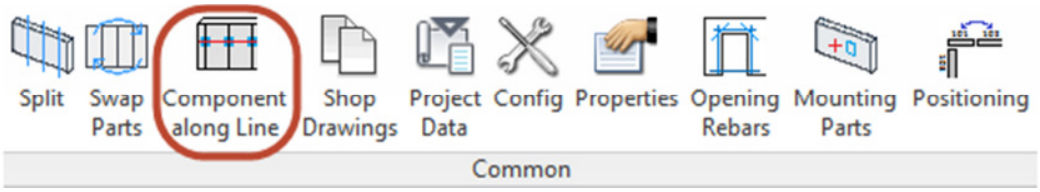
The definition of the cross section with the cores, the position of the strands and the profile on the sides can be self-made within families.



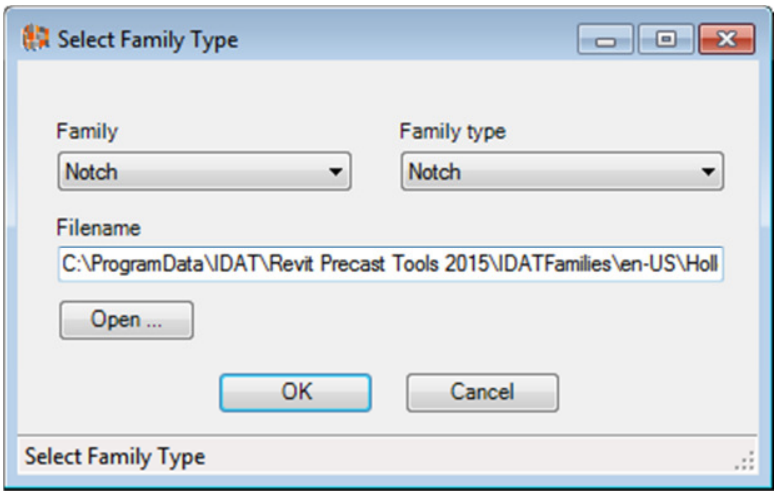
The families for that can be found at “C:\ProgramData\IDAT\Revit Precast Tools 2015\IDATFamilies\en-US\Hollow Core Slab”

Component along a line

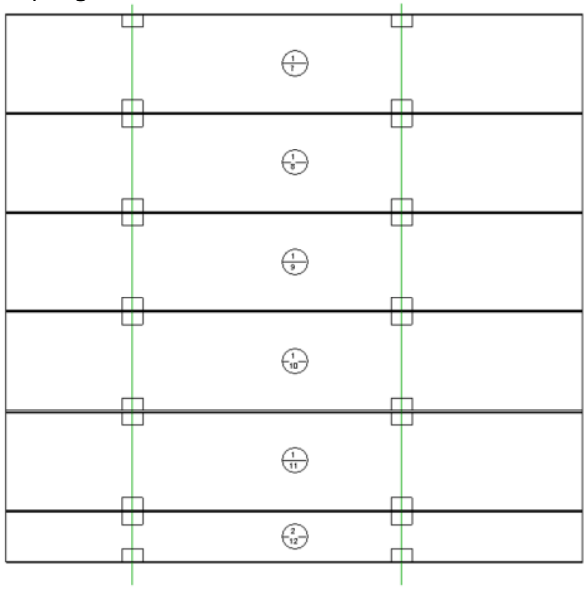
With the command “Component along Line” you can insert a family instance on an edge where a model line intersects the edge of a part.



First you have to draw model lines on top of the parts, start the command and select one or more model lines and press finish. In the following dialog you can choose a Family which should be inserted:

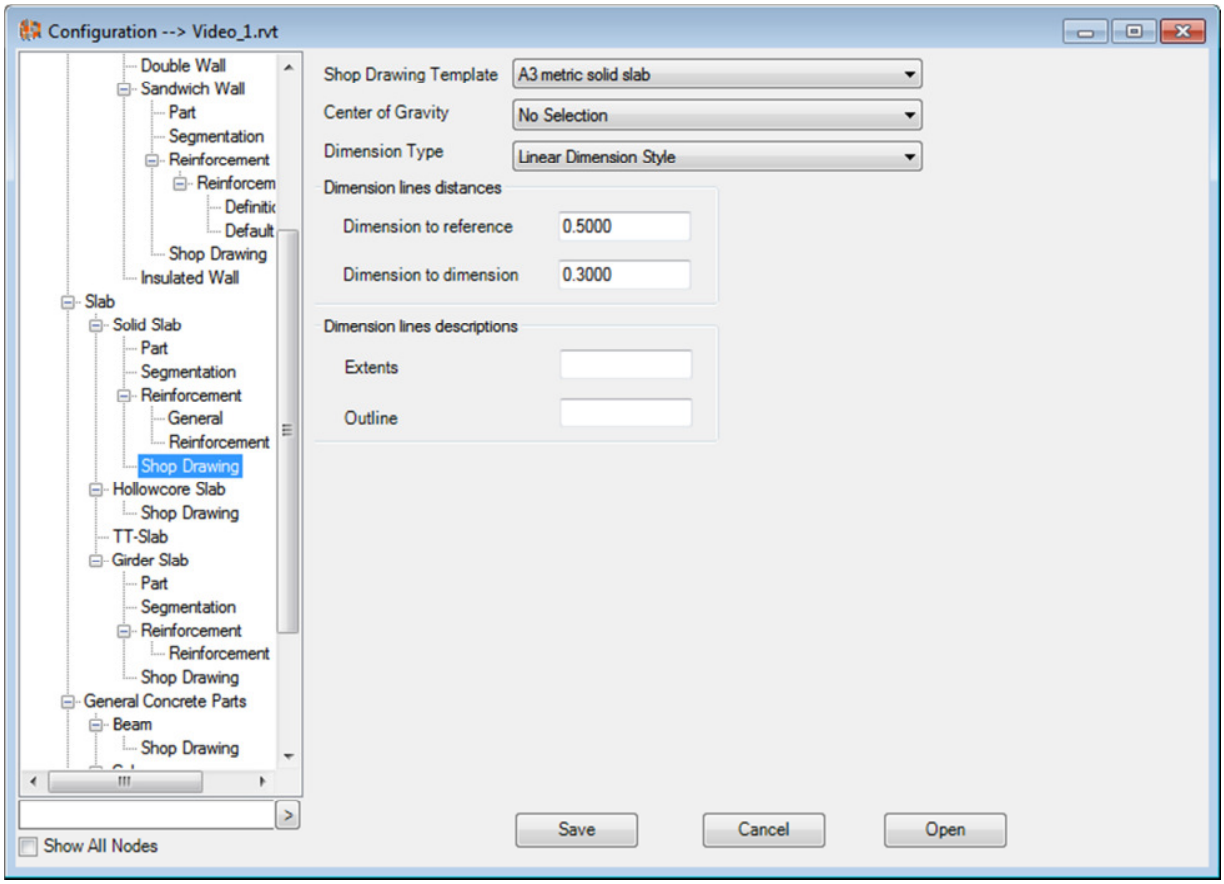


As a result you could for example get notched inserted between hollowcore slabs:



6. Shop drawings

For each assembly a shop drawing can be created automatically. Therefor a title block template has to be defined and set in the configuration:



Title block

Which views are placed where on the shop drawing you can define in the title block. If you want to define your own shop drawing layout the best practice is to open one of the delivered title blocks and adapt it to your needs.

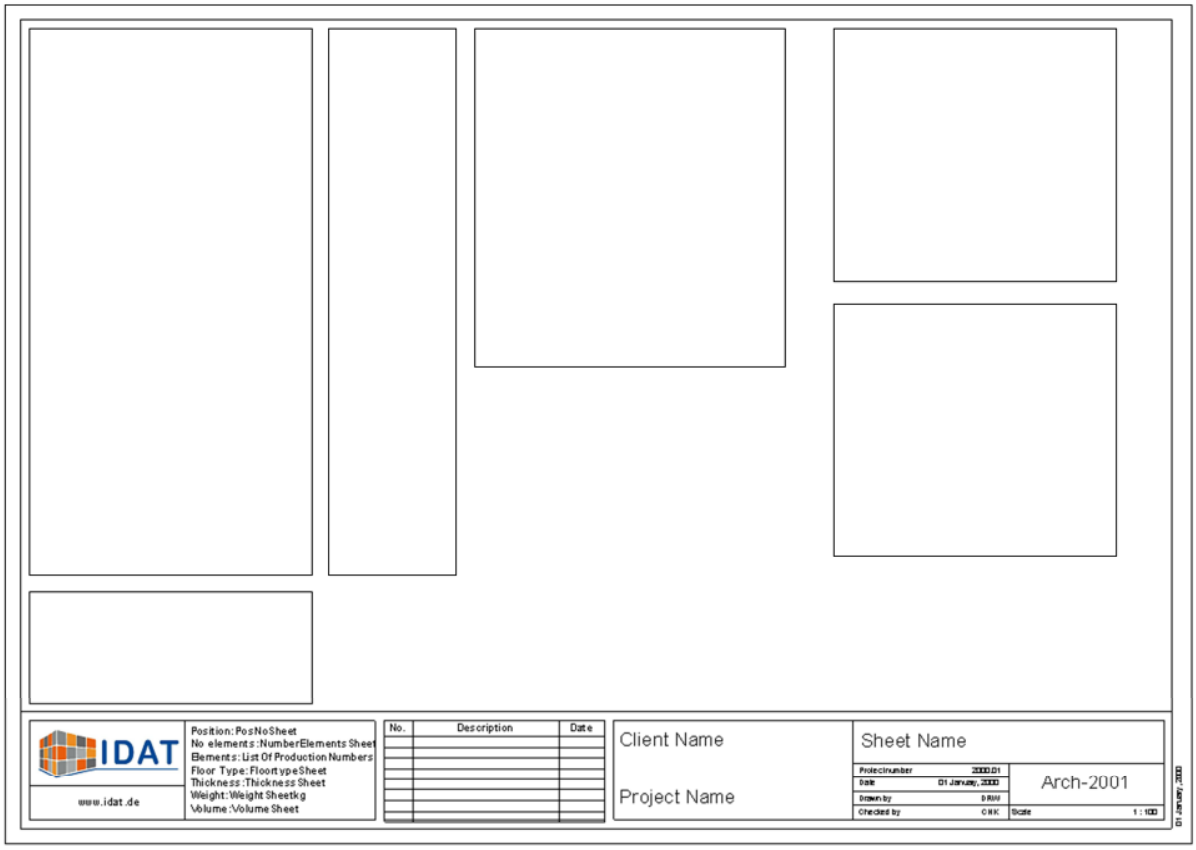
In the title block template you can place viewports where you define from which direction you want to see the element. Optionally you can define for each viewport a view template and a list of scales what the program should use.

You can also place schedules on the title block. For each template you have to define a Schedule Template in the project where you use the title block.

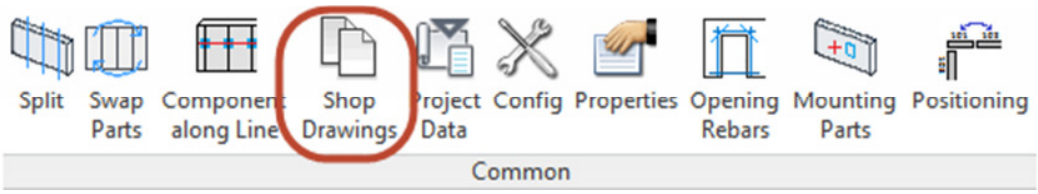
The following Shared Parameters with additional element information are available for labels on the title block:

Parameter	**Meaning**
PosNoSheet	Position number of the element
ListOfProductionNumbers	List of the production numbers for the element on the sheet
NumberElementsSheet	Number of elements must be produced
ThicknessSheet	Thickness of the element
WeightSheet	Weight of the element
VolumeSheet	Concrete volume for the element

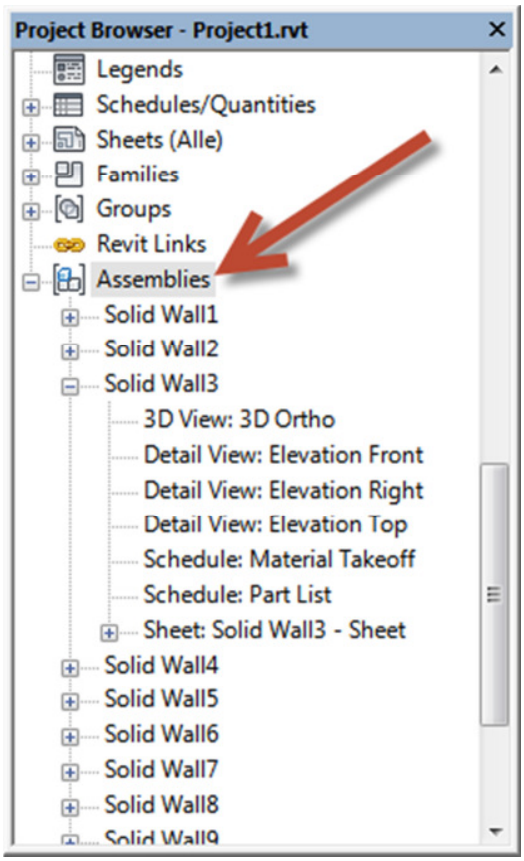
Example of a title block template:



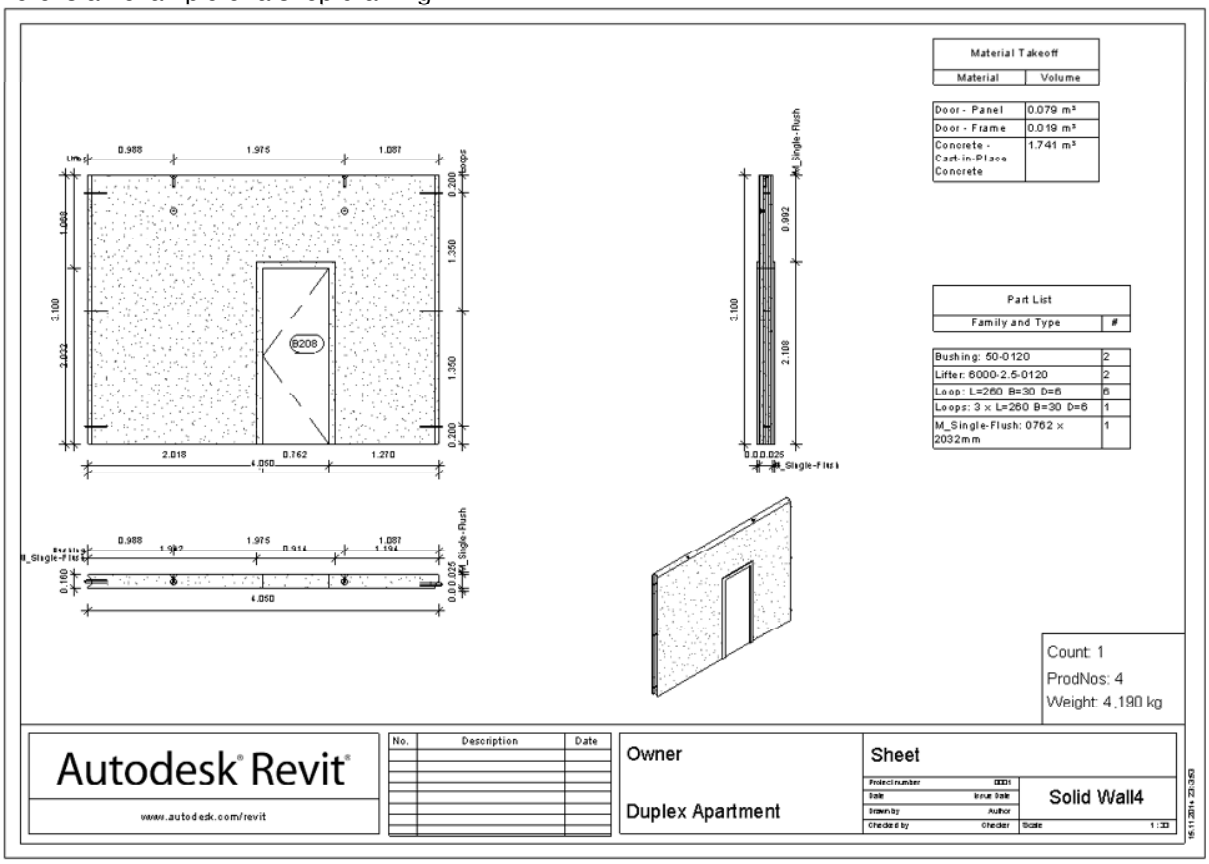
To create the shop drawings you have to select all the assemblies you want to have a shop drawing for and start the command Shop Drawings:



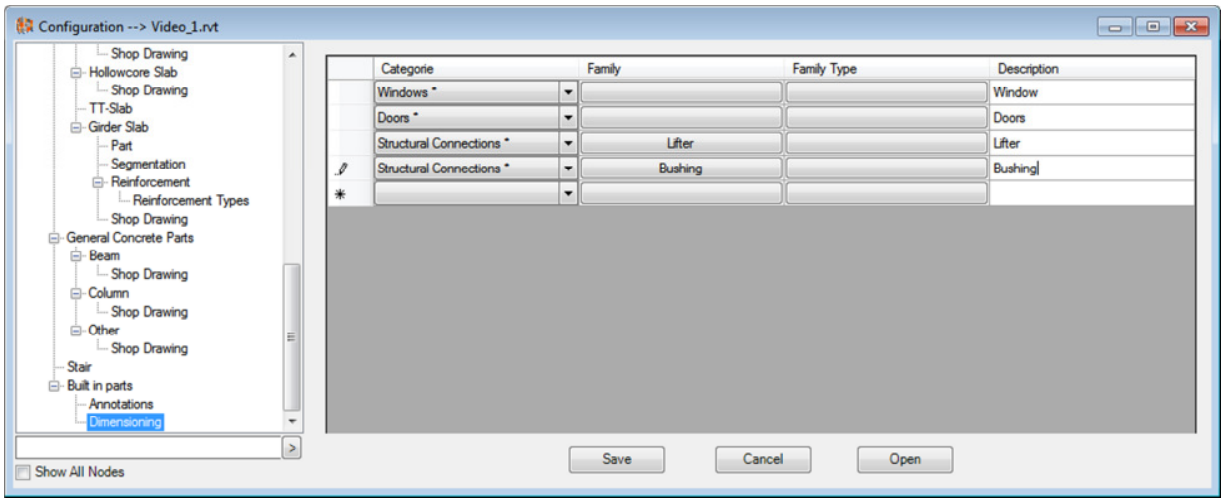
The created shop drawings can be found in the project browser of Revit under Assemblies.



Here is an example of a shop drawing:

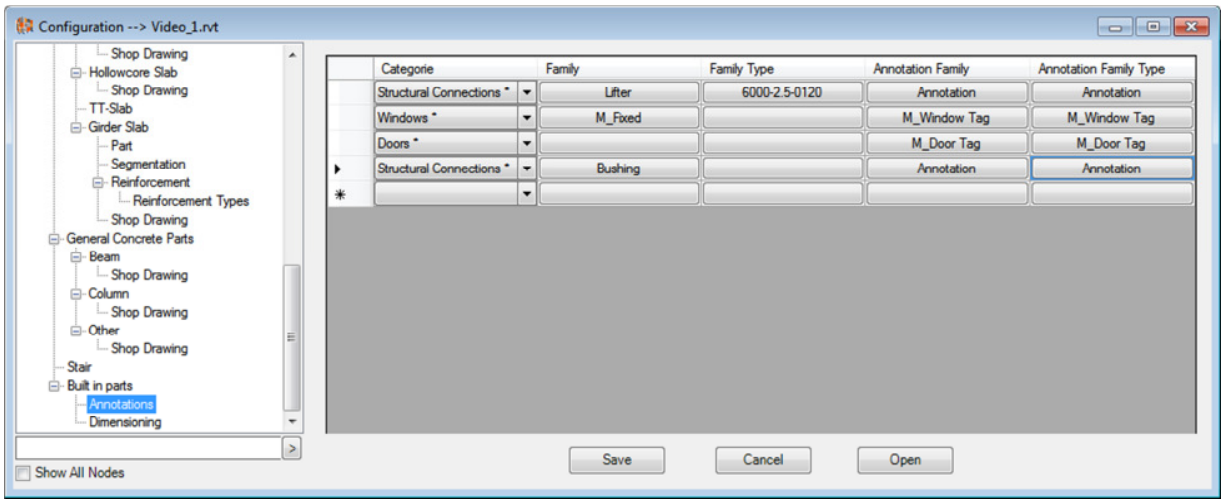


The element and the mounting parts are dimensioned automatically. The dimension line can also get automatically a description. This can be defined in the configuration for each Category and if whished for each Family and even for each Family Type.



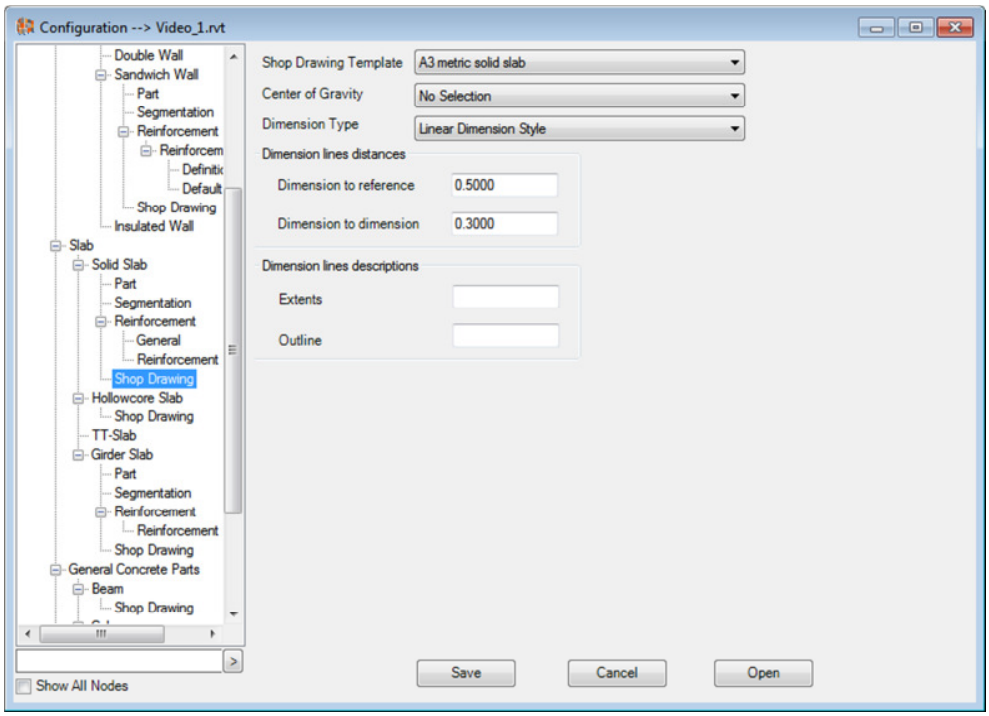
The Description is a free text will be placed beside the dimension line.

The mounting parts can also be automatically tagged. Therefore you can define in the configuration for each Category and if whished for each Family and even for each Family Type an Annotation Family.



For each element type you can also set the following in the configuration:

- If the center of gravity should be marked with a family.
- You can choose the dimension line style
- You can define a distance of the dimension lines from the element and the distance between the dimension lines.
- You can define a text for the dimension lines of the panel extends as well as for the panel dimension lines itself. The text will be positioned as a description beside the dimension line.



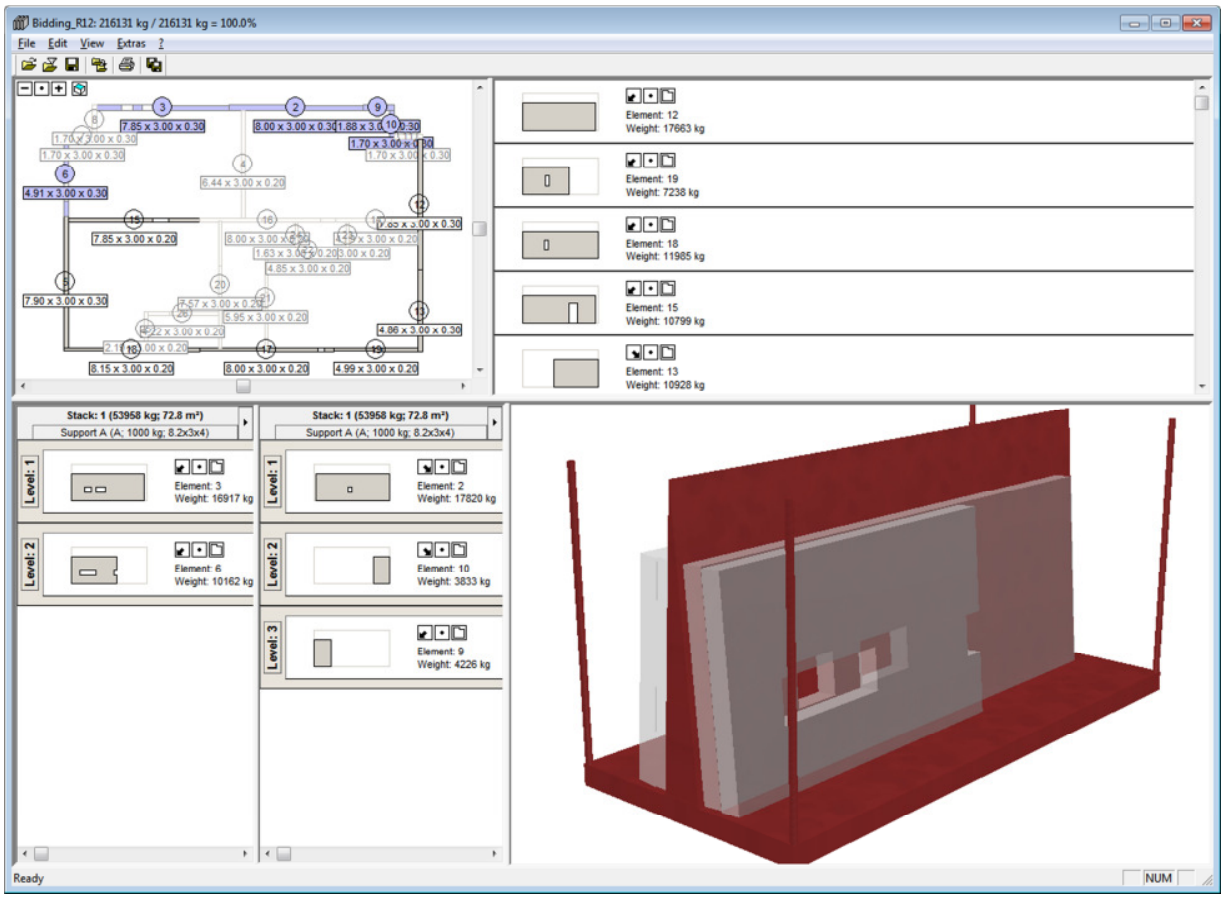
7. Creating data for production

Machine files for the Stacker program

Select one or more assemblies and call the command UNITECHNIK:

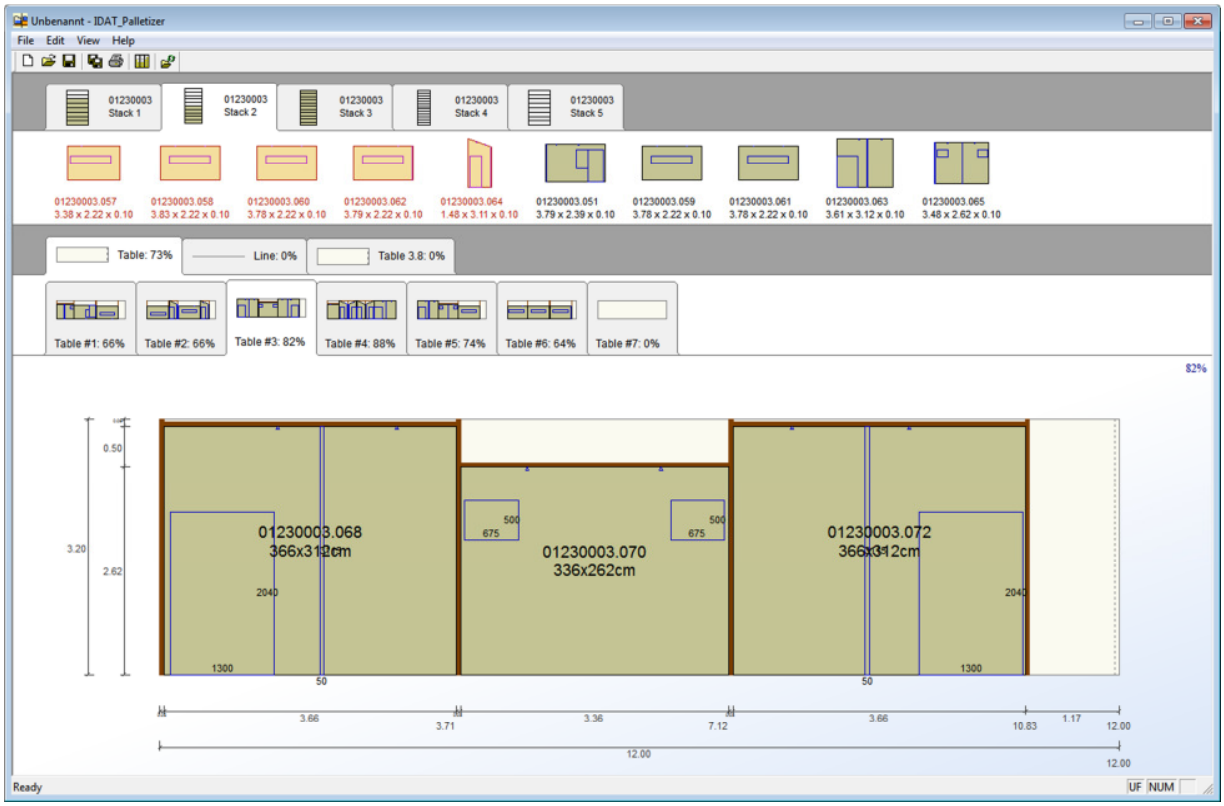
For each selected assembly a UNITECHNIK file will be created. The UNITECHNIK file format is a well-known format in the Precast Concrete Industry. With this file all the needed information like the geometry, the concrete, the mounting parts and the reinforcement are transferred to the factory for an automated production.

This file can also be used to define the transport stacks with the Stacker program:



Production planning with the Palletizer program

The Stacker program exports the stacking information with the UNITECHNIK file to the Palletizer program. With this program the planning of the production tables can be done:



In the end the Palletizer program exports the UNITECHNIK files to the master computer in the precast factory. With this data following machines in the precast factory can be operated fully automatically with the data from the Revit model.

Examples of machines are:

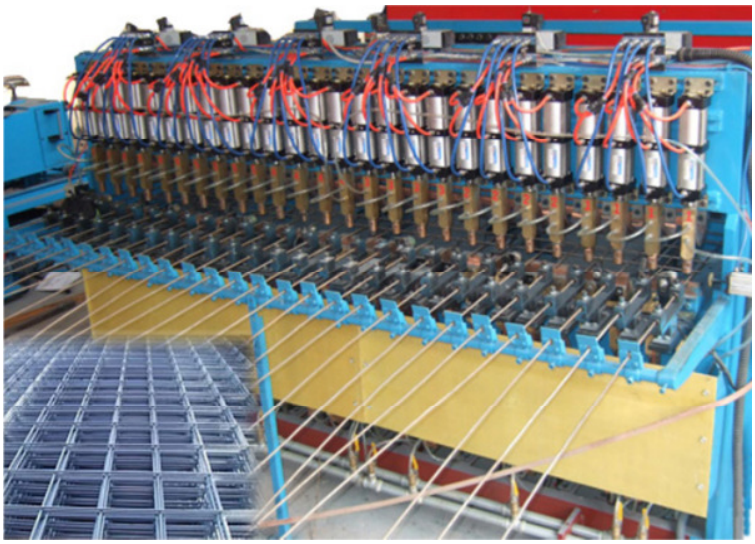
Laser which shows the outline, the mounting parts and the position of the reinforcement on the pallet

Plotter marks the position of inserts

Shuttering robot puts the shutters on the pallet

Bar cutting and bending machine is operated with the data from the Revit model

Mesh welding machine



Concrete spreader fills in the concrete

Change to the model

If there is a change in the Revit model after all the machine files are created only the UNITECHNIK files for the according assemblies must be created again.

8. Summary

The Revit Precast Tools supports the Precast Concrete Industry in the following areas:

- Automatic dividing of walls and floors
- Creation of panels with lifters, reinforcement and connections
- Converting to assemblies with equality check
- Creation of shop drawings
- Exporting data for production

The Revit Precast Tools supports and speeds up the full workflow from design to fabrication for Precast Elements inside of Revit