



# Precast Concrete Industry Extensions for Autodesk® Revit® Structure 2014

Reinhard Lackner – IDAT

## FB1846

This class shows how extensions to Autodesk Revit Structure software can dramatically speed up creation of precast elements. We show you how to divide walls into producible panels with automatic creation of connections such as anchor plates, connection loops, grout tubes and dowels. We look at the Revit parts with the dividing lines and the creation of assemblies and describe how the same precast elements can be found automatically. The class also covers how to use the dividing tools in Revit Structure to divide the walls manually. We see how reinforcement and the lifting anchors are created automatically through predefined rules. We go through the automatic creation of shop drawings and data for the production in the precast factory. With the defining of the transport stacks and the production line, you see the full workflow from design to production for wall panels inside of Revit Structure.

## Learning Objectives

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

- Divide walls into producible panels with Revit dividing tools
- Automatically create precast elements with assemblies in Revit Structure
- Create reinforcement for precast elements
- Automatically create shop drawings and data for production for precast 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](http://www.idat.de)) since 1990. His technical know-how is in the precast industry.*

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## 1. Introduction

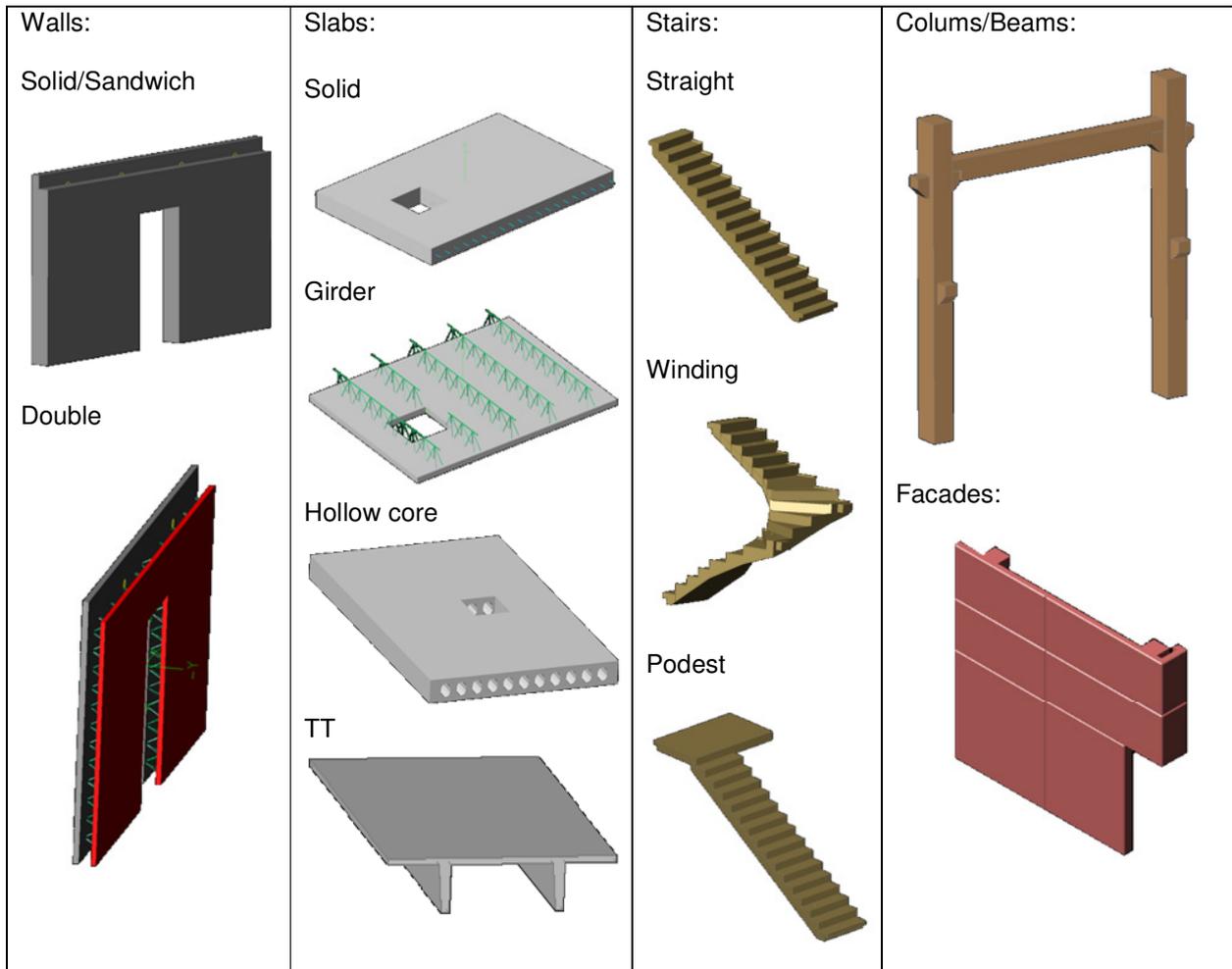
### What are the Revit Precast Tools?

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](http://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 nearly 40 countries worldwide.

The following modules are currently available for AutoCAD Architecture:



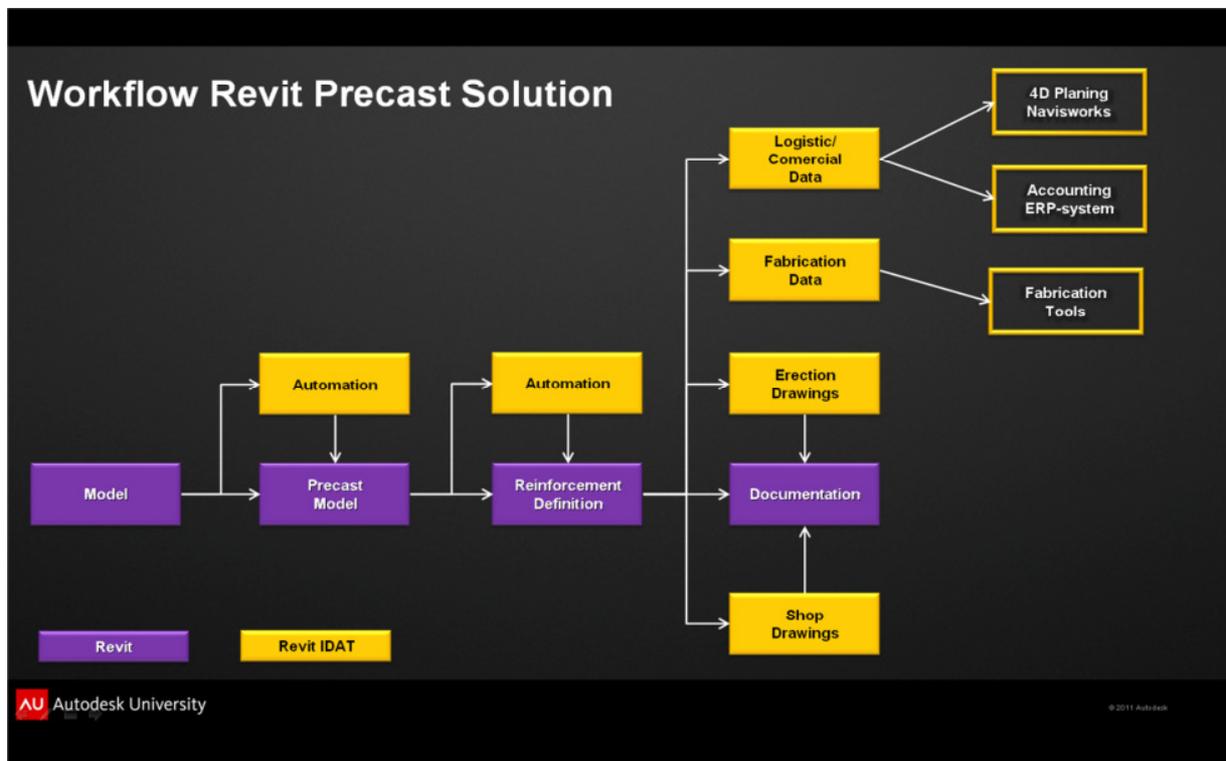
## Revit Precast Tools for Autodesk Revit Structure

A preview version of the Revit Precast Tools was released in autumn 2011 and the first commercial module for hollow core slabs in December 2012. Both versions can be downloaded from the IDAT website: [www.idat.de](http://www.idat.de)

From now on each module will be released step by step for Revit Structure. The next module is for solid wall panels and will be described here.

### Workflow of the Revit Precast Solution:

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

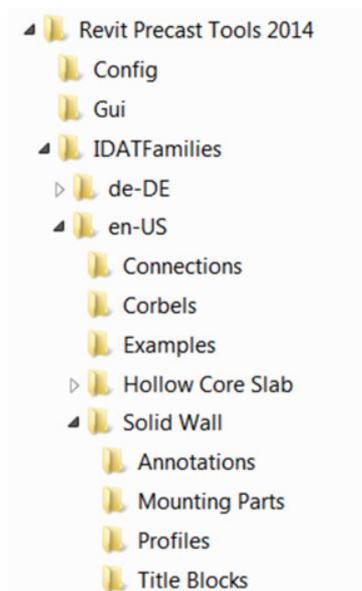


## 2. Installation

### 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 2014”

In this folder, the following folder structure is created:

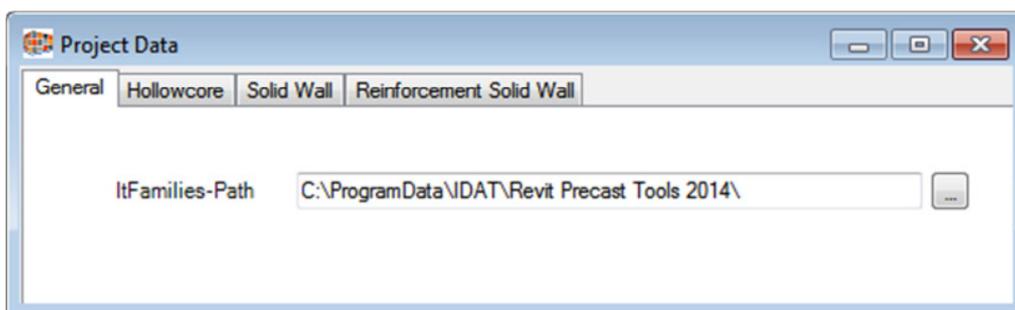


All templates for the solid wall are stored in folders under “IDATFamilies\en-US\Solid Wall”. These are:

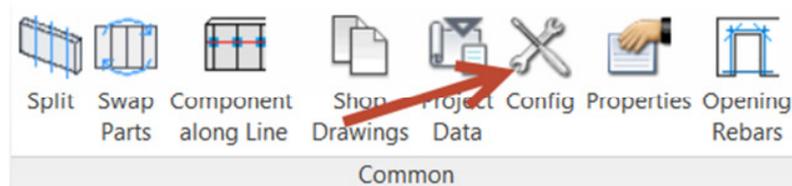
- The annotation for the wall panels in the sub folder “Annotations”
- The connection components and the lifters are in the sub folder “Mounting Parts”
- The profiles for the wall connections are in the sub folder “Profiles”
- The examples for title blocks in the sub folder „Title Blocks“

### Different factory settings

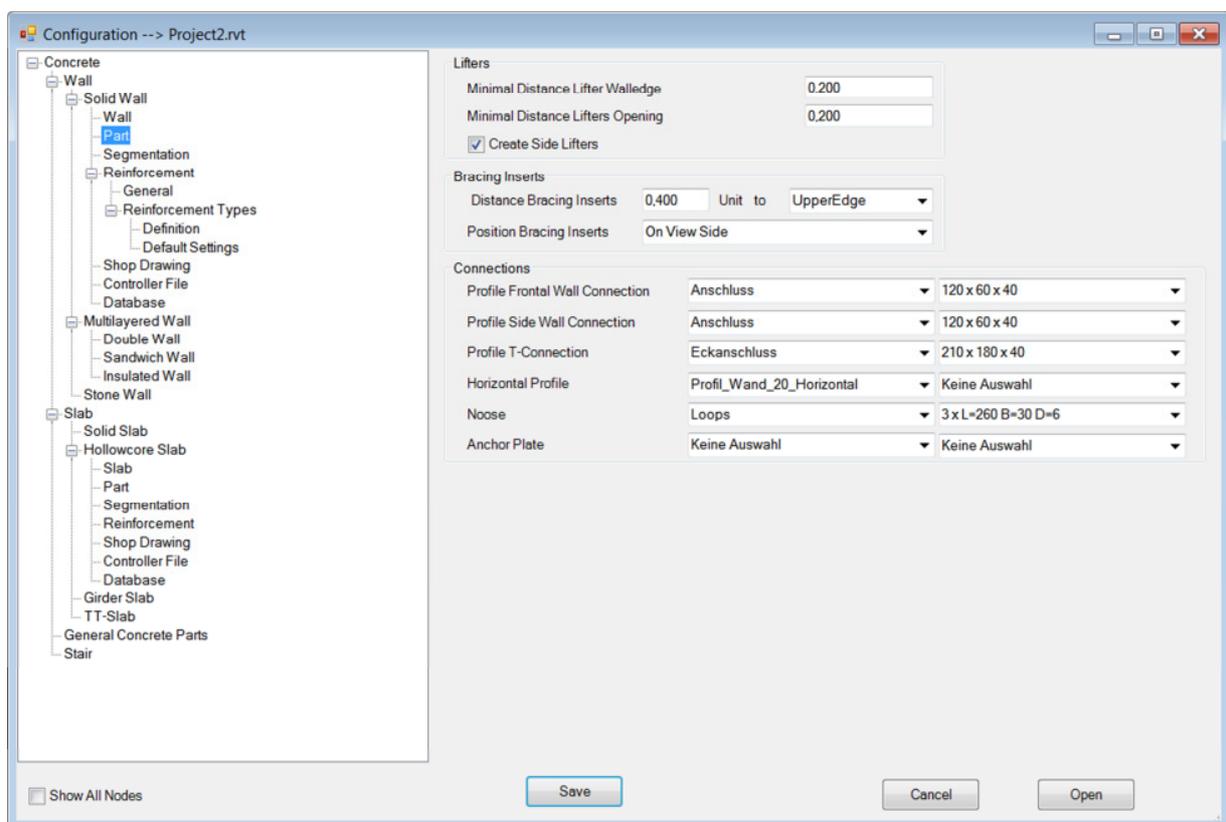
If you want to have different settings for different factories you can change the path for a project within the project data:



### 3. Configuration



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



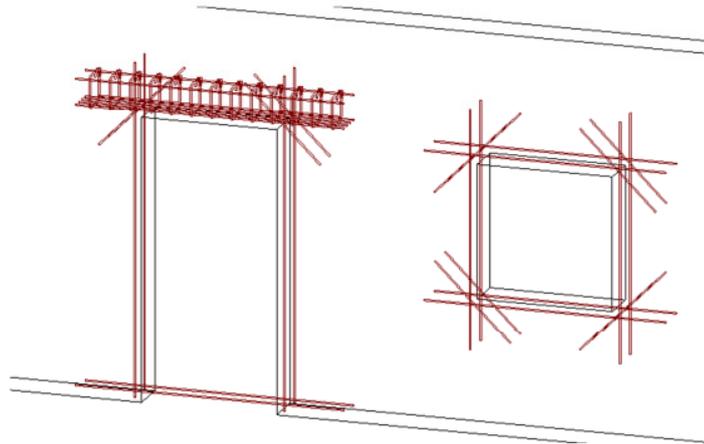
The settings are described later in the document. With the button “Save” all the changes are saved into the settings of the project.

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 2014\Config” will automatically be loaded and saved in the project.

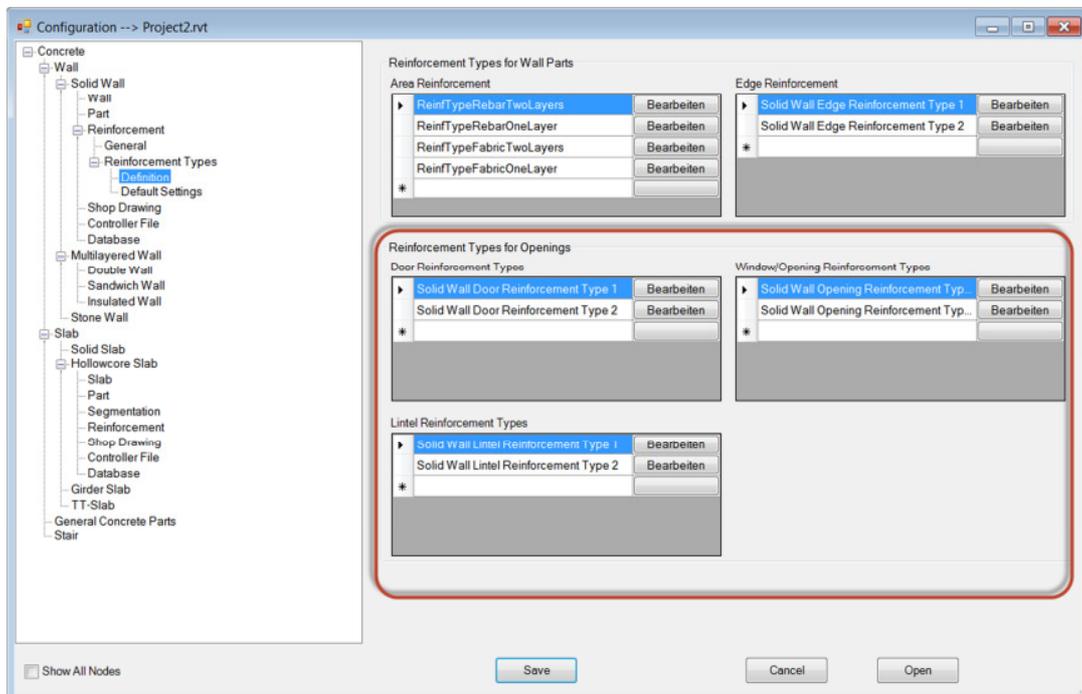
## 4. Reinforcement for openings

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.

## Door reinforcement types

**Solid Wall Door Reinforcement Type 1**

**Perimeter Bars**

Rebar Type: 10M  
 Number of Layers: 2  
 Distance to Opening: 50 mm  
 Overlap: 400

**Diagonal Rebars**

Rebar Type: 10M  
 Number of Layers: 2  
 Distance to Opening: 50 mm  
 Rebar Length: 800

**Transporteisen**

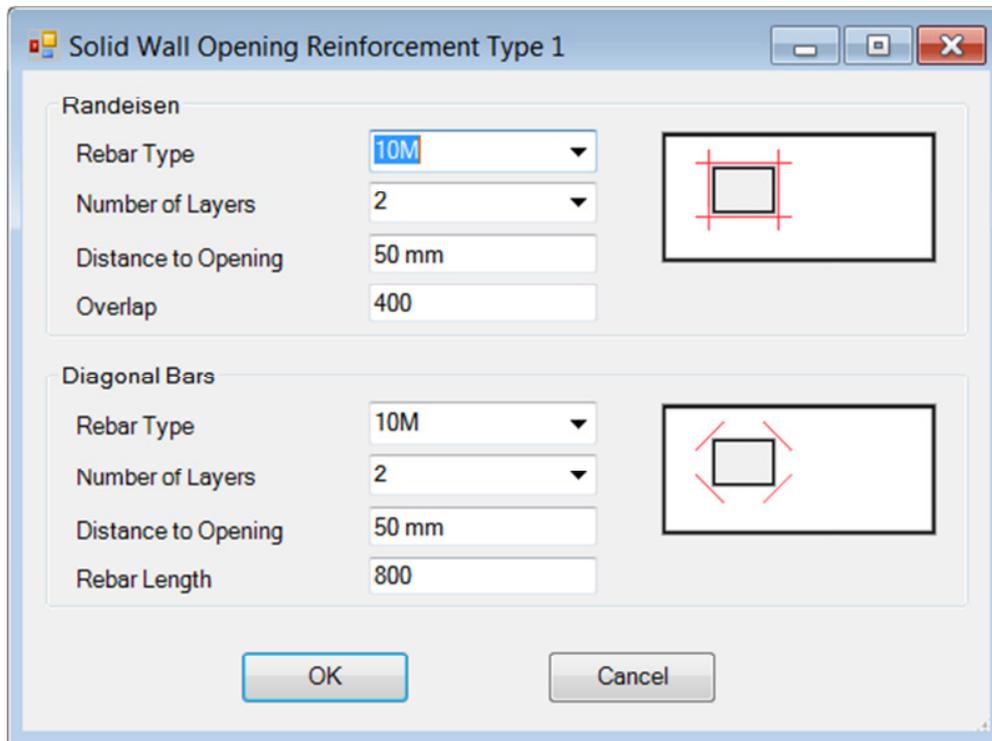
Rebar Type: 13M  
 Number of Layers: 2  
 Number of Rebars: 2  
 Overlap: 500

OK Cancel

The perimeter bars around the door can be defined with the rebar type, the number of layers (usually 1 – will be positioned in the middle of the wall or 2 – one on the inside and one on the outside of the wall), the distance to the opening and an overlapping.

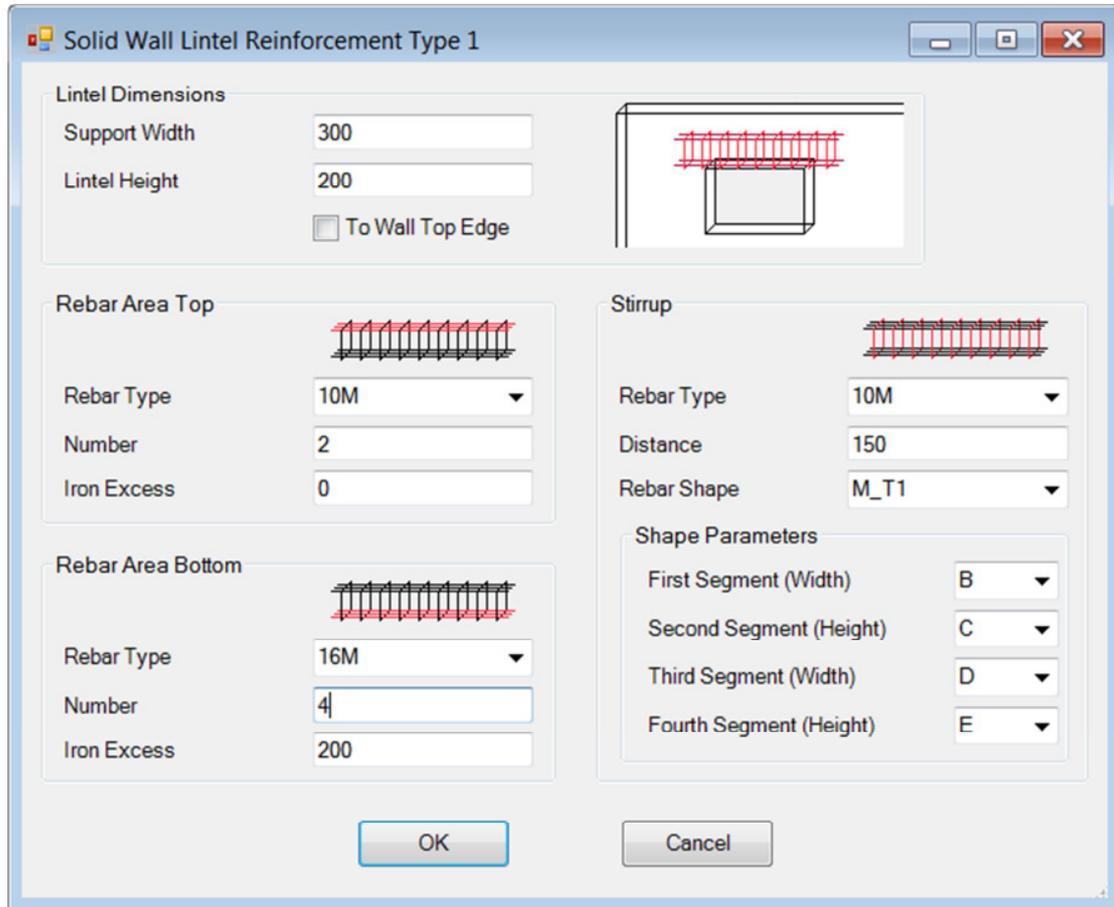
In the same way diagonal bars for the upper corner and bars for transportation at the bottom of the door can be defined.

### Window/opening reinforcement types



Perimeter and diagonal bars can be defined for windows and openings.

## Lintel reinforcement types



For all components of the lintel you can define following:

**Lintel dimensions:** Support width defines the lintel support on the left and right side of the opening. The lintel height can be defined with a fixed value or with a height from the top of the opening to the top of the wall.

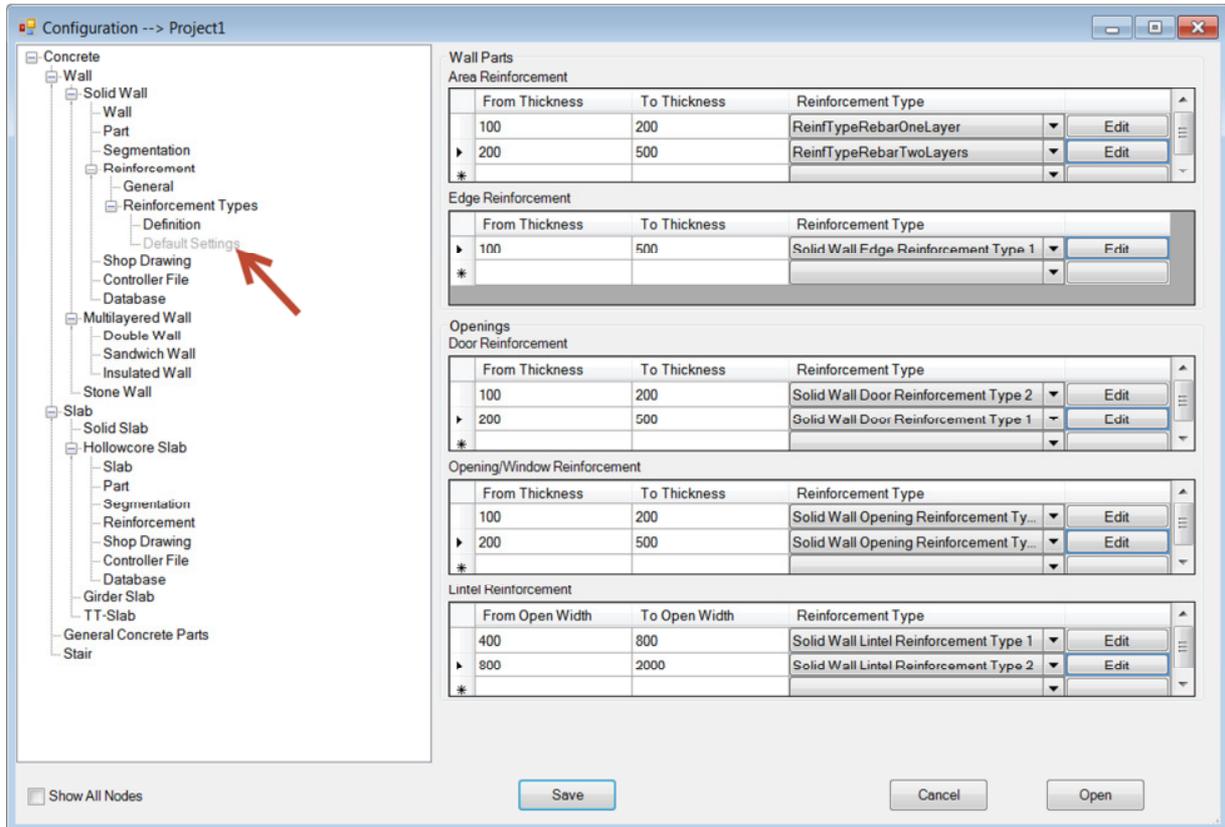
**Rebar area top:** Defines the rebar type, the number and an eventually iron excess on both sides

**Rebar area bottom:** Defines the rebar type, the number and an eventually iron excess on both sides

**Stirrup:** Defines the rebar type, the distance between the stirrups and the rebar shape. For the selected shape the parameters must be defined. Depending on the rebar shape you need to select only the first two for the width and height or all four.

## Reinforcement default settings

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

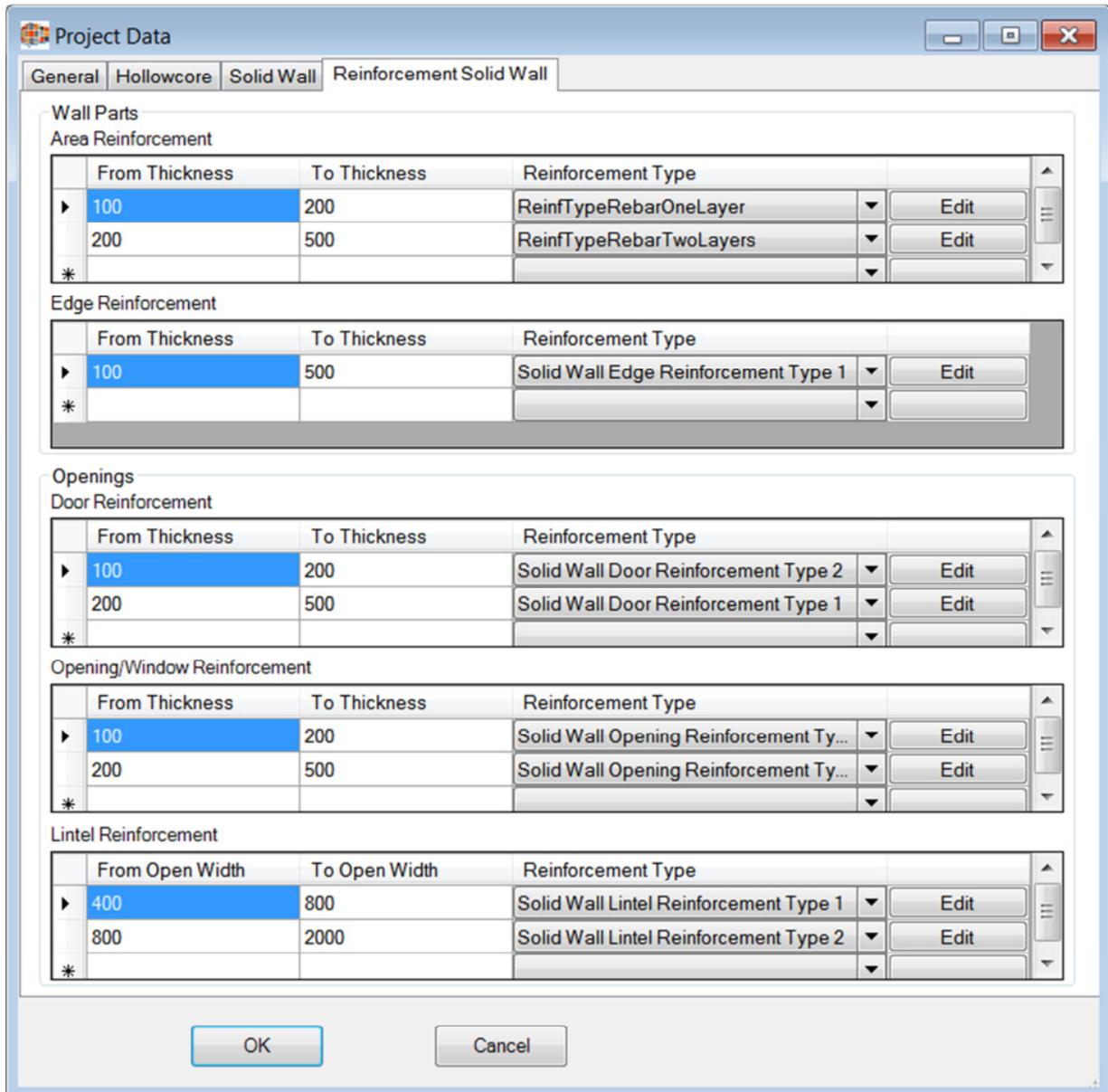


For the wall parts, the edge reinforcement and the opening reinforcement you can define different intervals of wall thicknesses and choose the desired reinforcement type for it.

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

### Project settings for opening reinforcement

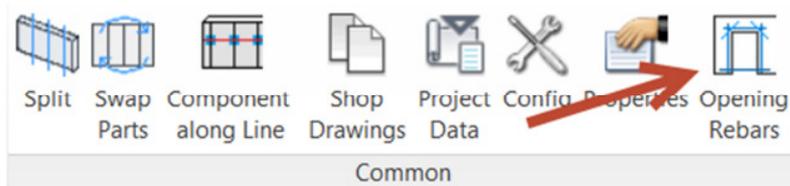
The reinforcement default settings can also be adapted in the project dialog at the page: "Reinforcement Solid Wall":



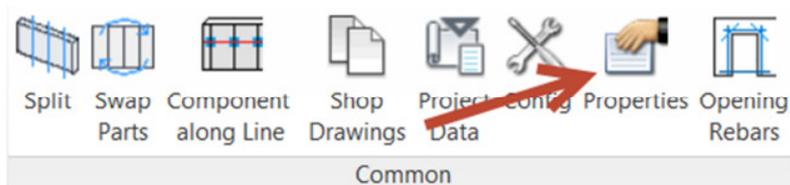
In a new project the settings from the configuration are loaded as default values for this dialog.

### Use of the opening reinforcement commands

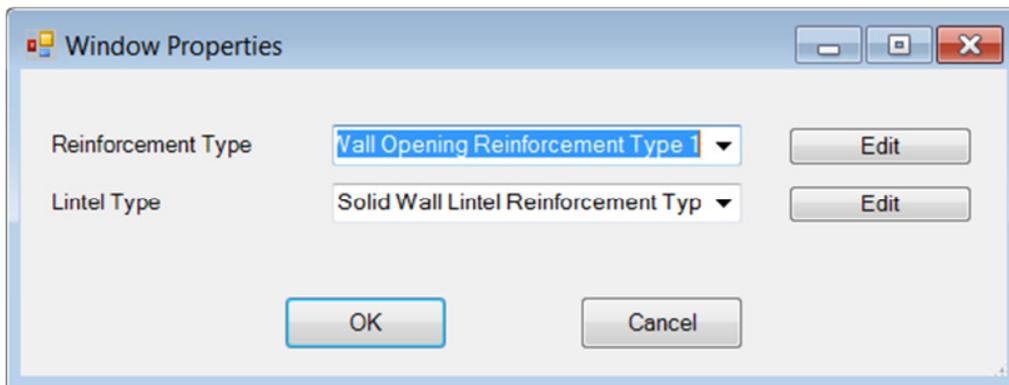
If you insert an opening in the project the opening reinforcement is automatically created. If you open a project where openings are already inserted without the Revit Precast Tools you can select the openings and start the command “Opening Rebars”:



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”:



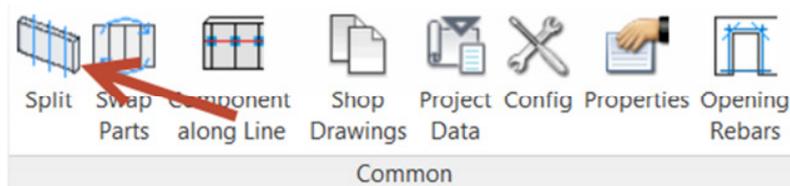
This opens a dialog where you can choose a different reinforcement and/or lintel type or edit the type directly with the edit command.



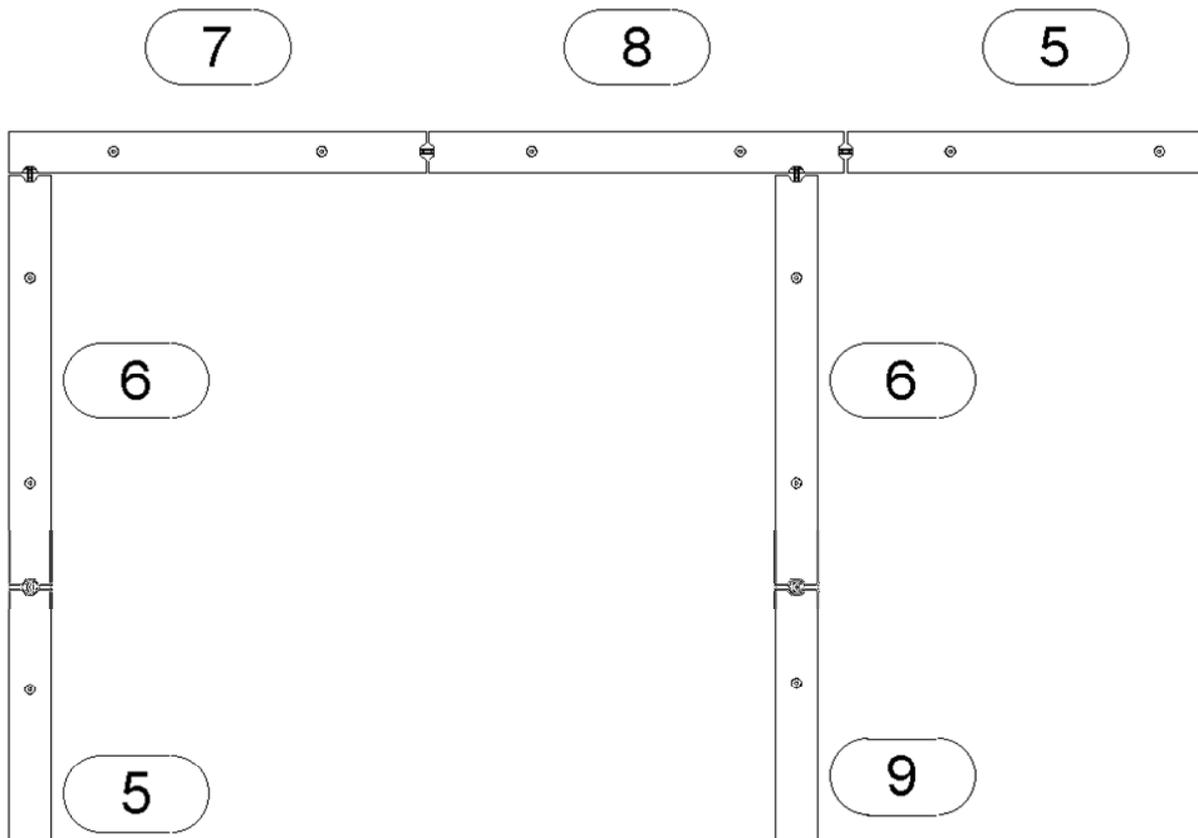
The change in this dialog will automatically replace the old reinforcement with the new type.

## 5. Dividing of walls

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

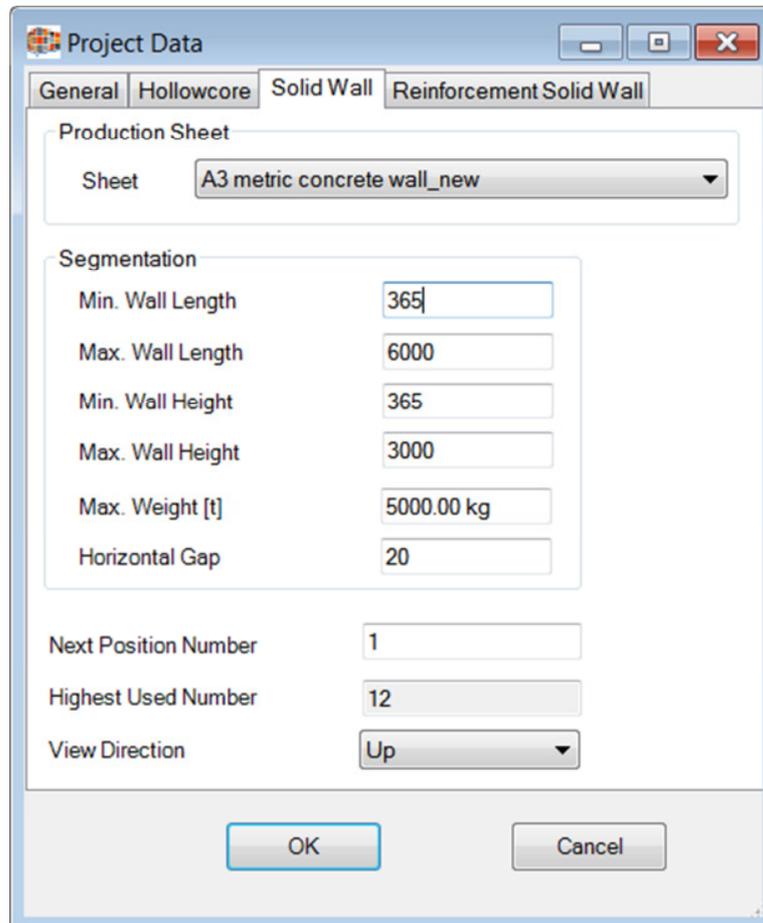


This command will create parts out of the walls, divide the parts with the Revit divide command, create connections and reinforcement and add all together to an assembly:



## Parameter for dividing

You can set parameters for the dividing in the project data:



The screenshot shows the 'Project Data' dialog box with the 'Solid Wall' tab selected. The 'Production Sheet' dropdown is set to 'A3 metric concrete wall\_new'. The 'Segmentation' section contains the following parameters:

Parameter	Value
Min. Wall Length	365
Max. Wall Length	6000
Min. Wall Height	365
Max. Wall Height	3000
Max. Weight [t]	5000.00 kg
Horizontal Gap	20

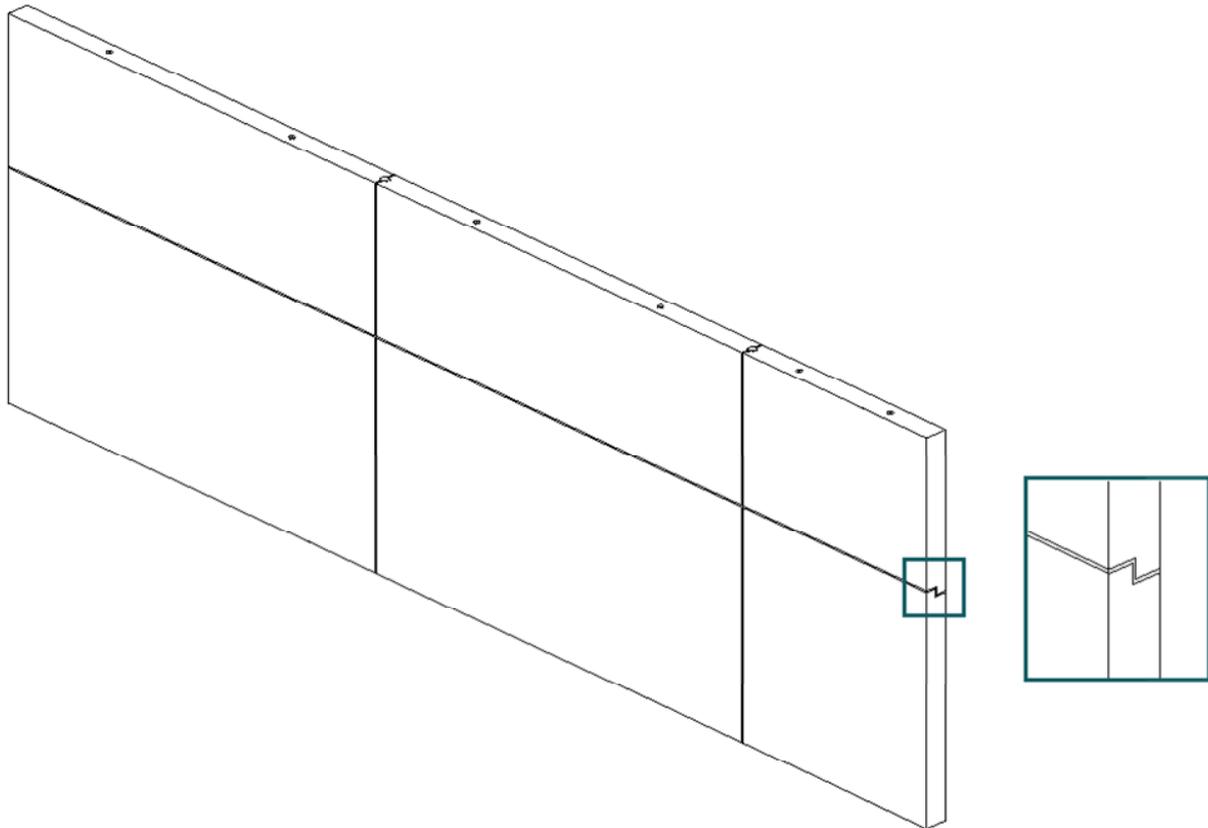
Below the segmentation section, the 'Next Position Number' is 1, the 'Highest Used Number' is 12, and the 'View Direction' is set to 'Up'. 'OK' and 'Cancel' buttons are at the bottom.

The important parameters for the dividing 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

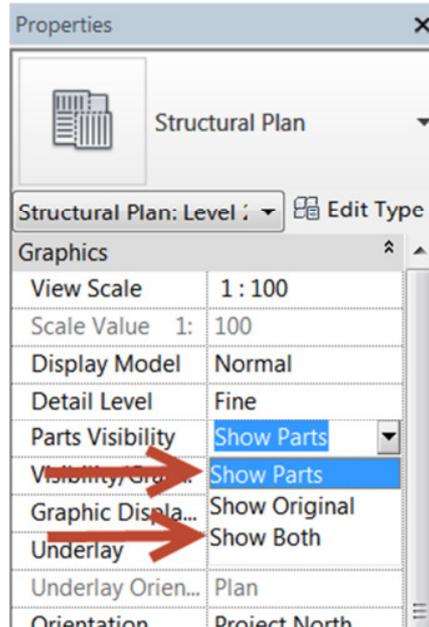
If the wall is higher than the maximal wall height the program automatically divides the wall horizontal into layers:



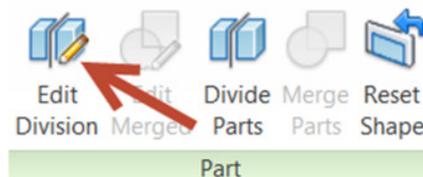
The profile between the layers can be set in the configuration.

### Manual dividing

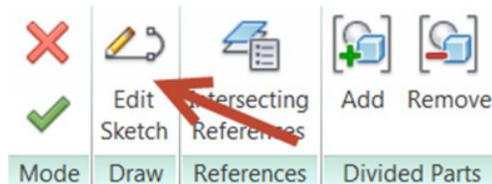
After the automatic dividing you can manually change the diving. Therefore you have to select one part of the wall. To be able to select the parts, the part visibility must be on. You can switch the parts visibility in the properties on by selecting “Show Parts” or “Show Both”:



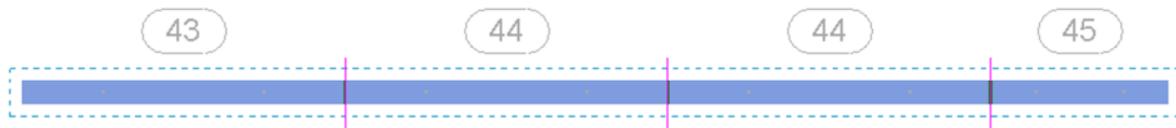
If you select one part of the wall you must choose the command “Edit Division” from the Modify|Parts tab.



After that choose “Edit Sketch”



Now Revit shows the dividing lines:



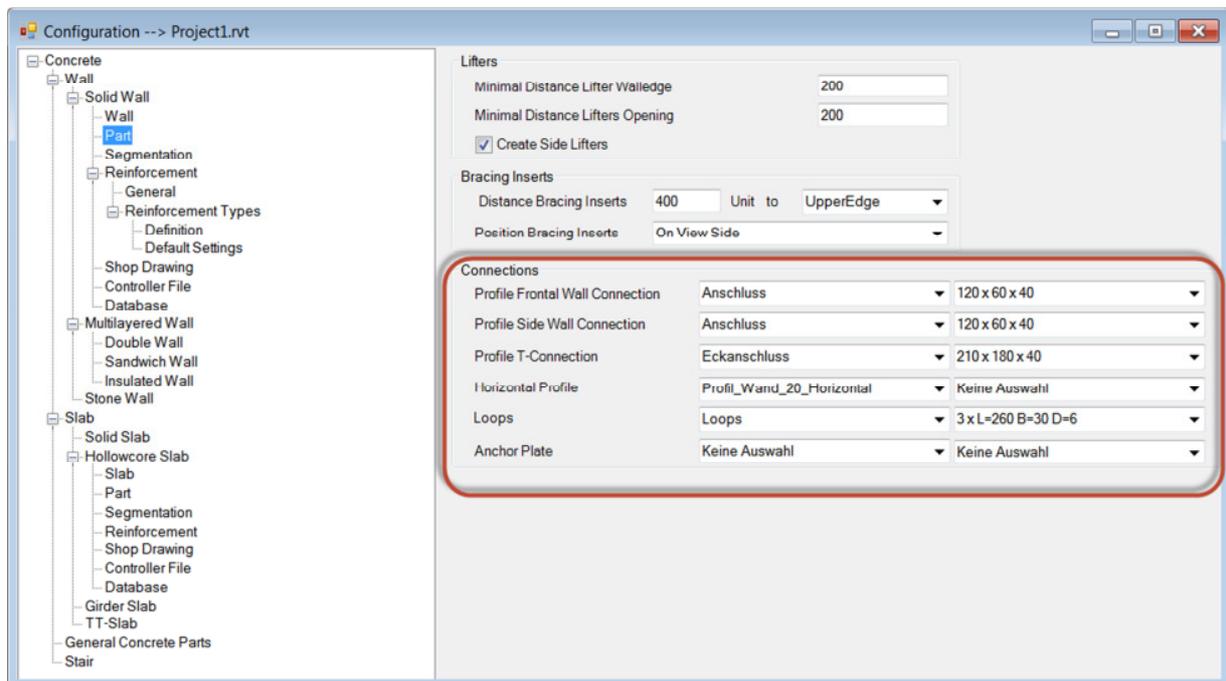
This allows you to move, delete or add additional dividing lines. After you closed the edit mode, the Revit Precast Tools will create new wall panels according the changed dividing lines.

### 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.

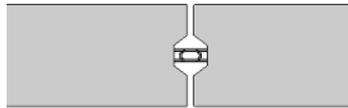
All the families are in the folder "C:\ProgramData\IDAT\Revit Precast Tools 2014\IDATFamilies\en-US\Solid Wall\Mounting Parts".

## Horizontal connections with loops

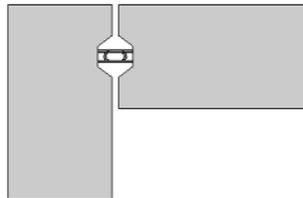


For the connection with loops the program creates a profile and the loops according the predefined families. In the family it is defined how many loops should be created depending on the height of the wall. The program automatically performs the following connections:

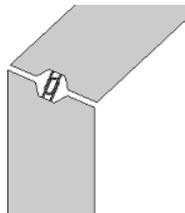
Straight connection:



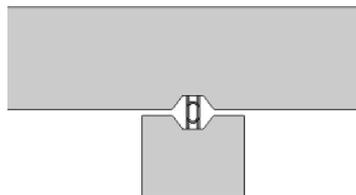
90° connection:



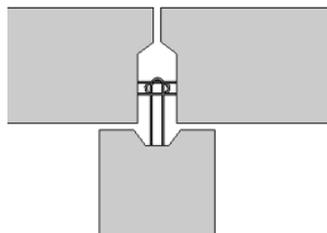
Non 90° connection:



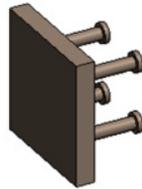
T-connection:



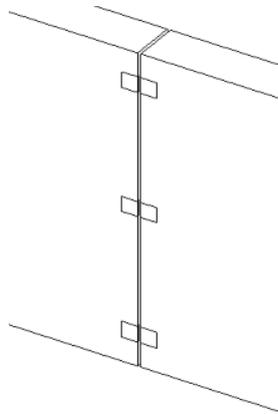
T-connection with a straight connection:



### Horizontal connections with anchor plates

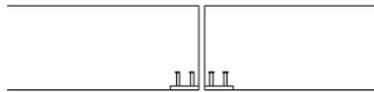


For the connection with anchor plates the program inserts the plates according the predefined families. Depending on the height of the panels two or more plates are created. The rules for that can be defined in the family.

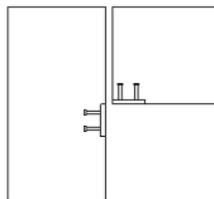


The program automatically performs the following connections:

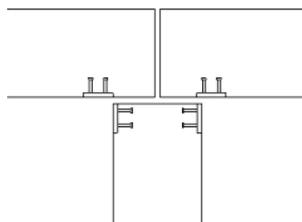
Straight connection:



90° connection:



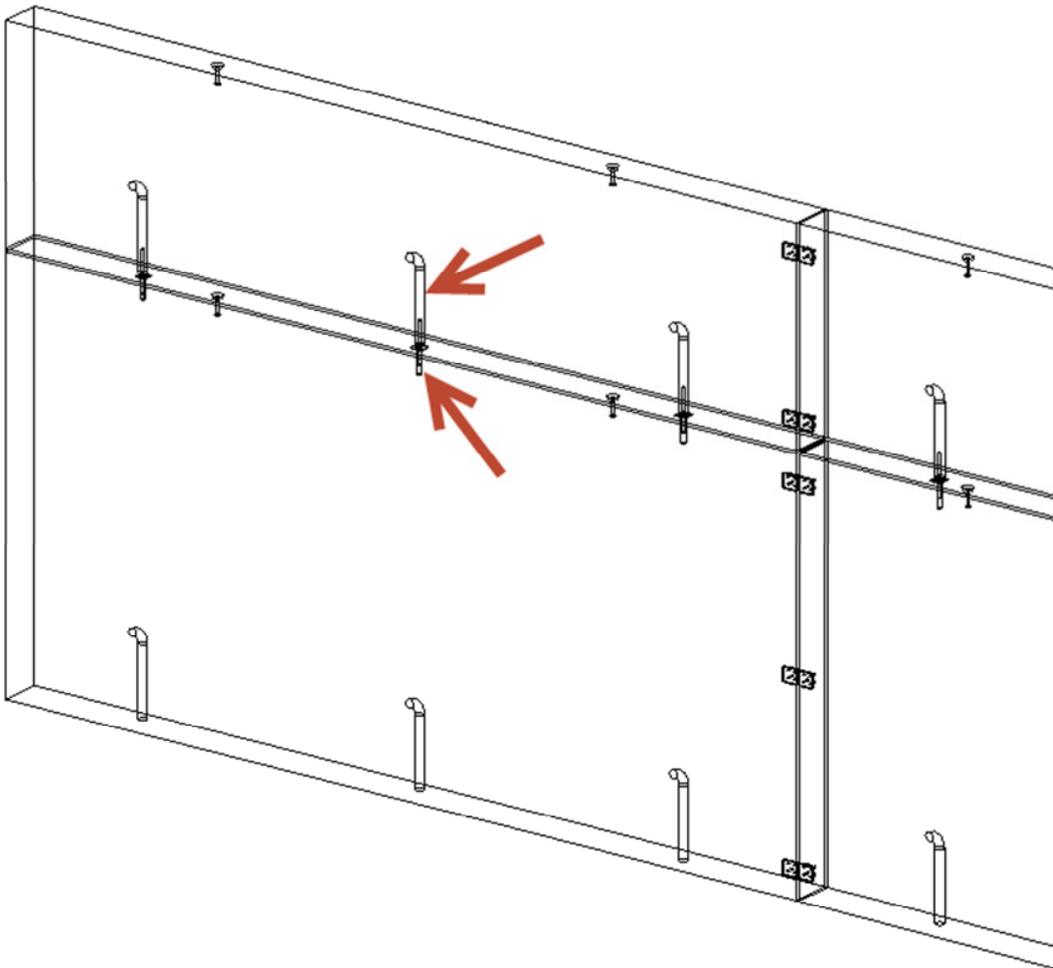
T-connection:



### Vertical connections with grout pipes and dowels

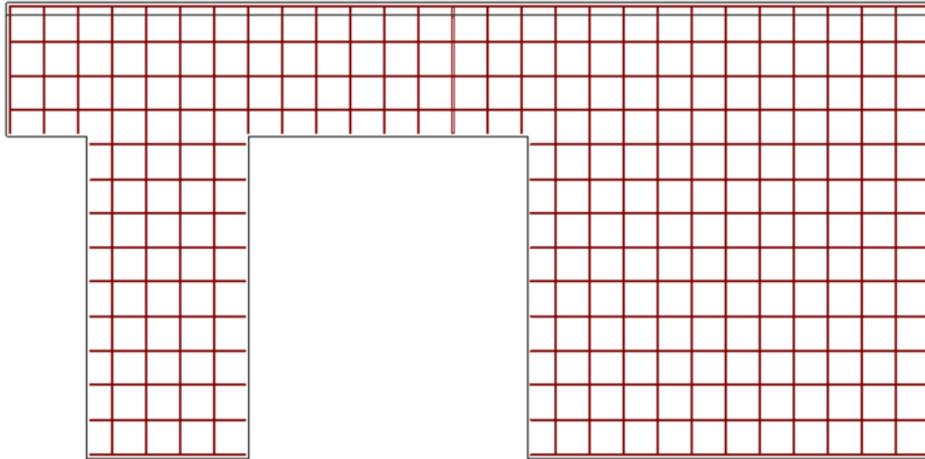


Grout pipes can be generated on the bottom of the wall panels and dowels on the top:

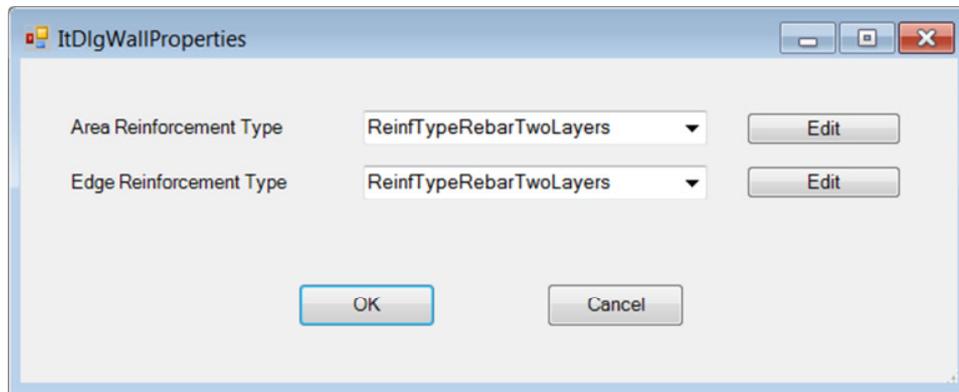


## Wall reinforcement

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

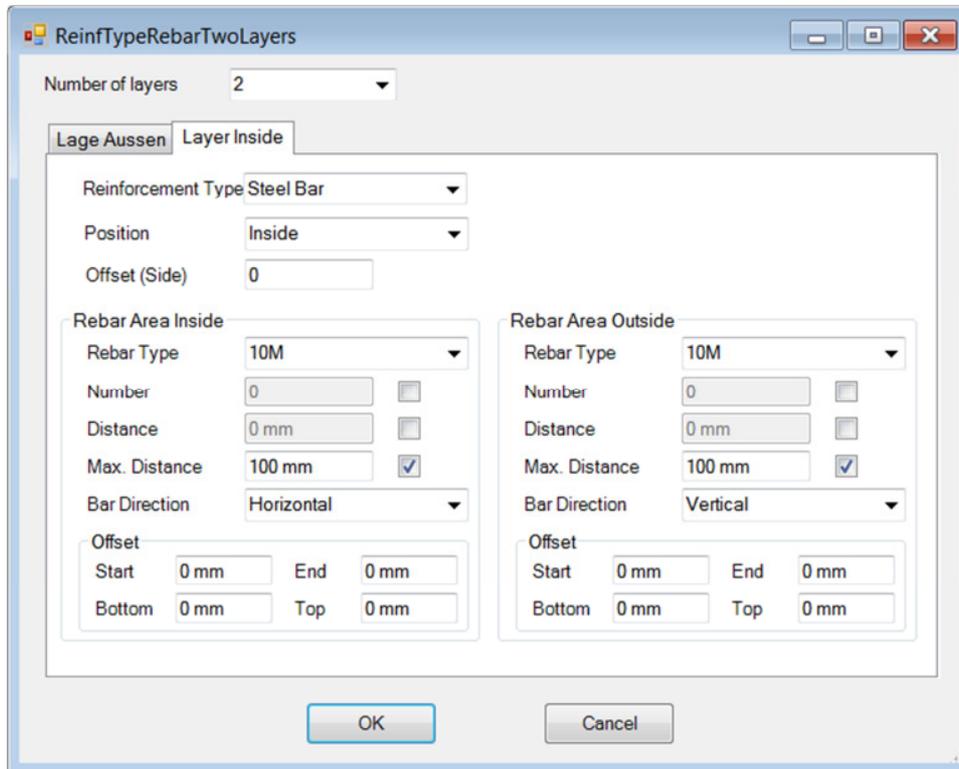


The reinforcement is created according reinforcement types. If you select the wall and start the command “Properties” from the Revit Precast Tools, you will get the following dialog:



In this dialog you can choose the area reinforcement type as well as the edge reinforcement type for the wall. The reinforcement types can be defined in the configuration under the section “Definition” of the reinforcement types (see also “Configuration of the reinforcement for openings”).

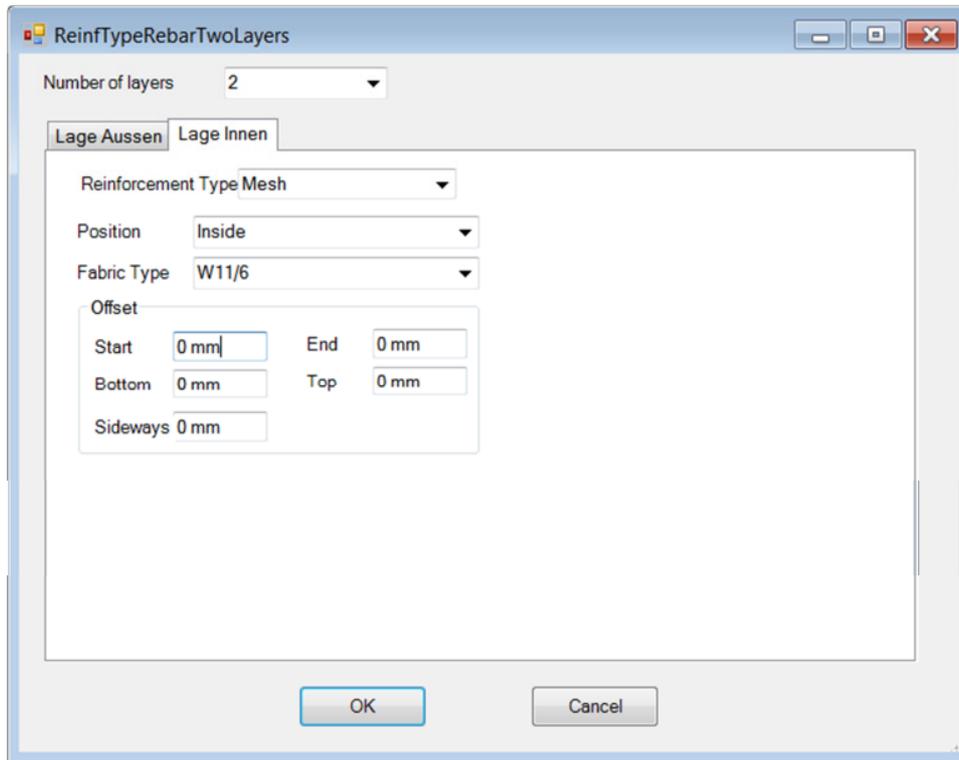
The configuration of wall reinforcement with rebars looks like this:



You can define a type with one layer (in the middle of the wall) or two layers (one on the inside and one on the outside of the wall). Sidewise an additional offset can be defined. If the offset is zero, the outside bars are placed at cover.

For each bar distribution you can define the bar type, the distance and the direction. Optionally it is possible to define an additional offset for each side. If the offset is negative, the bars will go outside of the panel.

The configuration of wall reinforcement with fabric wire mesh looks like this:

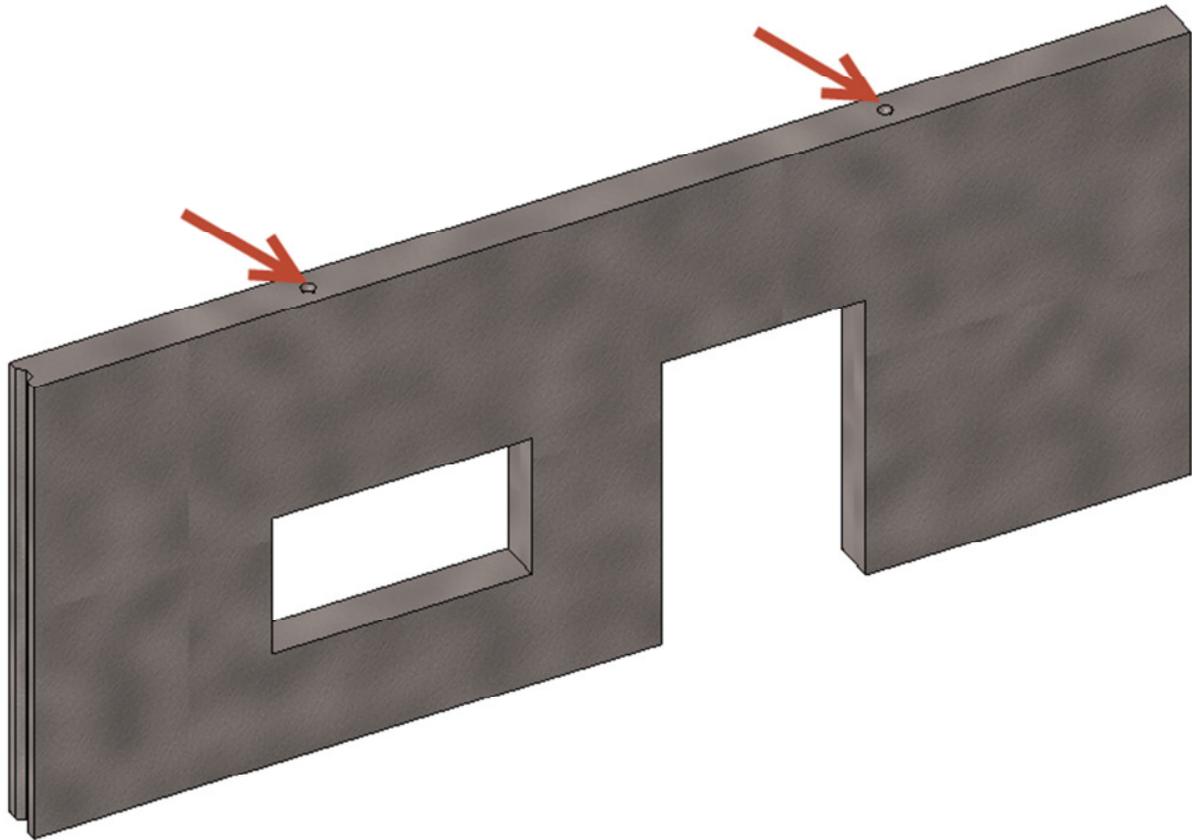


You can define a type with one layer (in the middle of the wall) or two layers (one on the inside and one on the outside of the wall). Sidewise an additional offset can be defined. If the offset is zero, the outside bars are placed at cover.

For each side you choose the fabric wire mesh type and optionally offsets.

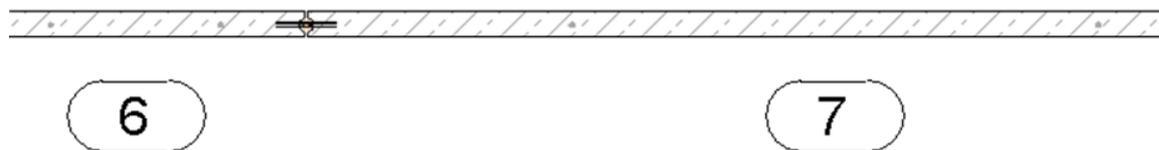
### Lifting anchors

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



### Wall marker

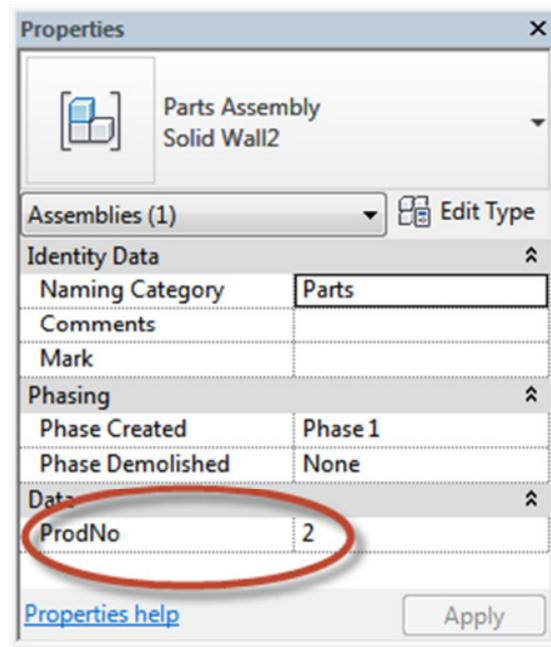
Each wall panel gets automatically a wall marker. The style of the wall marker can be defined in the family AnnotationMW.rfa in the folder "C:\ProgramData\IDAT\Revit Precast Tools 2014\IDATFamilies\en-US\Solid Wall\Annotations".



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

## 6. Assemblies

For each solid wall panel (part) an assembly will be created and the part itself with all the mounting parts and the reinforcement will be assigned to the assembly. During the creation of the assembly the system checks which assemblies are the same and gives them the same assembly type name. In the data of the assembly the unique production number is stored:



## 7. Shop drawings

For each solid wall assembly a shop drawing can be created automatically. Therefore a title block has to be defined and set in the project data.

### Title block

Which views are placed where on the title block will be defined by adding instances of a viewport family (included) on the title block definition in the title block family. A title block example is included, "A3 metric concrete wall.rfa", in the folder "Title Blocks". In the same folder is the family "Viewport.rfa" placed, which is needed to define the position of the views on the sheet.

To create your own title block follow these steps:

- Open the title block family you want to use as template, or create a new one.

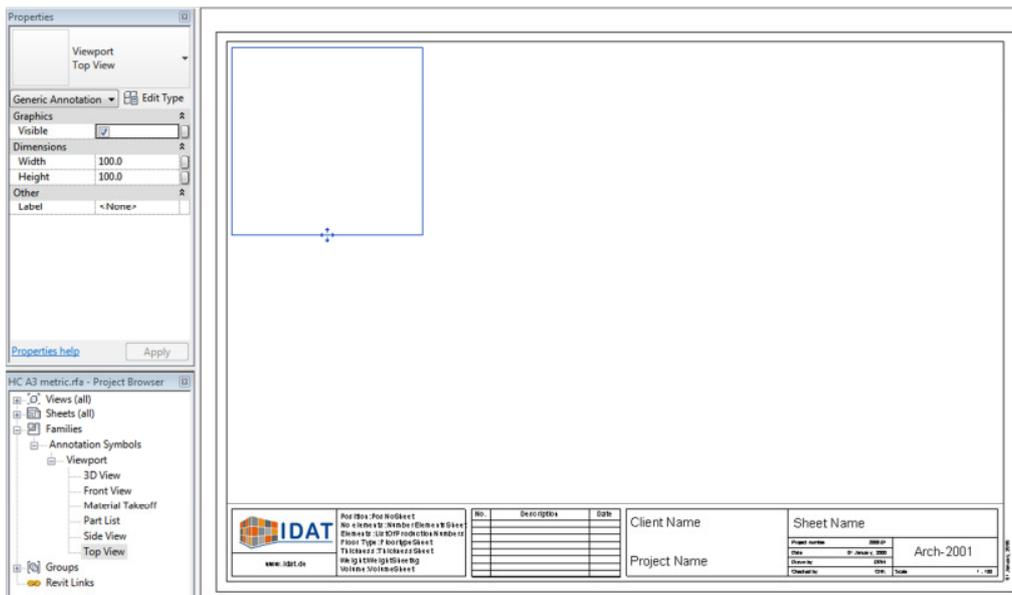


- Modify the title block to suite your needs, adding data fields, company logo, ...
- The following Shared Parameters with additional element information are available for labels on the title block:

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

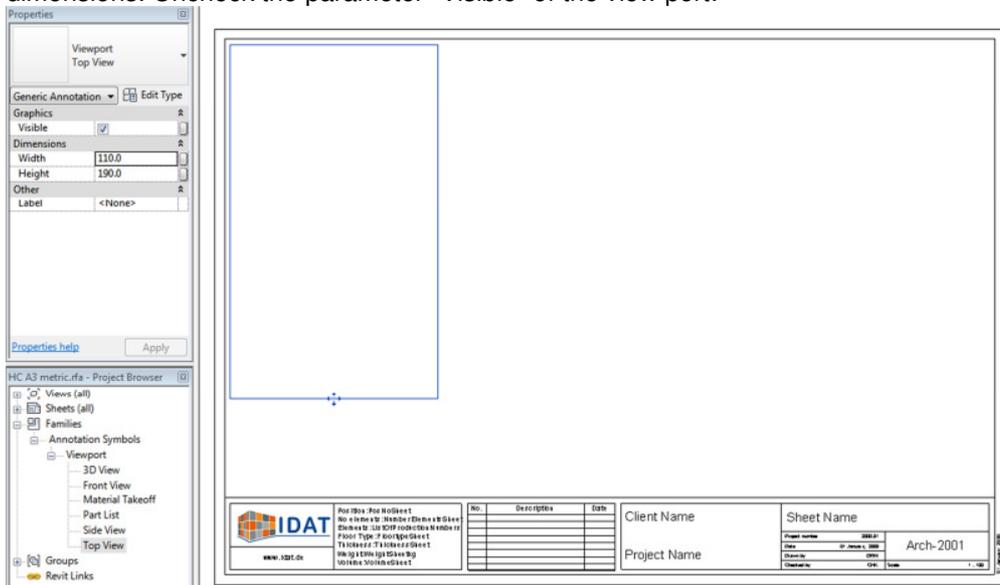
Insert the labels in the following way:

- Create and place a label on the title block: Create → Text → Label
  - In the dialog “Edit Label” click on the button “Add Parameter”
  - In the dialog “Parameter Properties” click the button “Select” and select the parameter you need. Close the dialog “Parameter Properties”
  - Add the added parameter to the label, using the button “Add parameter(s) to label” (green arrow) and edit the prefix and suffix.
  - Repeat as necessary.
- Load the family “Viewport.rfa”: *Insert → Load from Library → Load Family*. The family can be found in the “Title Blocks” folder in the IDAT ProgramData-Folder. E.g. “C:\ProgramData\IDAT\Revit Precast Tools 2014\IDATFamilies\en-US\Solid Wall\Title Blocks”
  - Insert Viewports: *Create → Detail → Symbol*; before placing the view port select the view port type from the properties. The following view ports can be used: Top View, Side View, Front View, 3D View, Material Takeoff, Part List

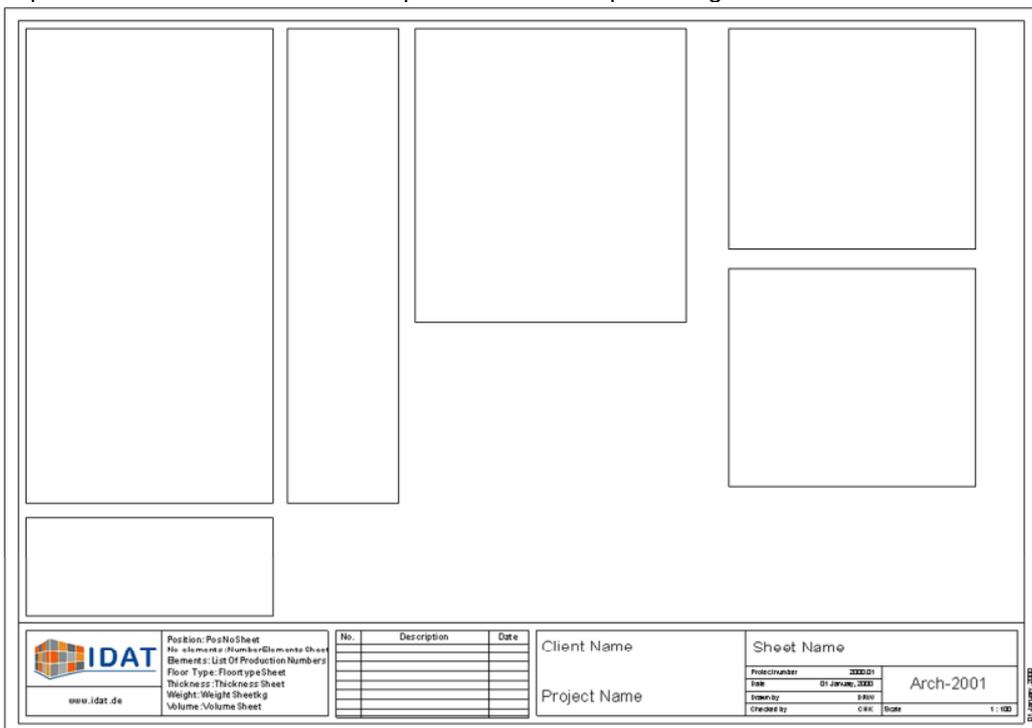


Precast Concrete Industry Extensions for Autodesk® Revit® Structure 2014

- Select the inserted view port and modify the parameters Width and Height to the correct dimensions. Uncheck the parameter “Visible” of the view port:

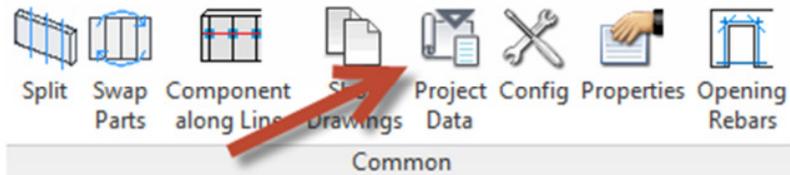


- Repeat for all views that should be placed on the shop drawings:

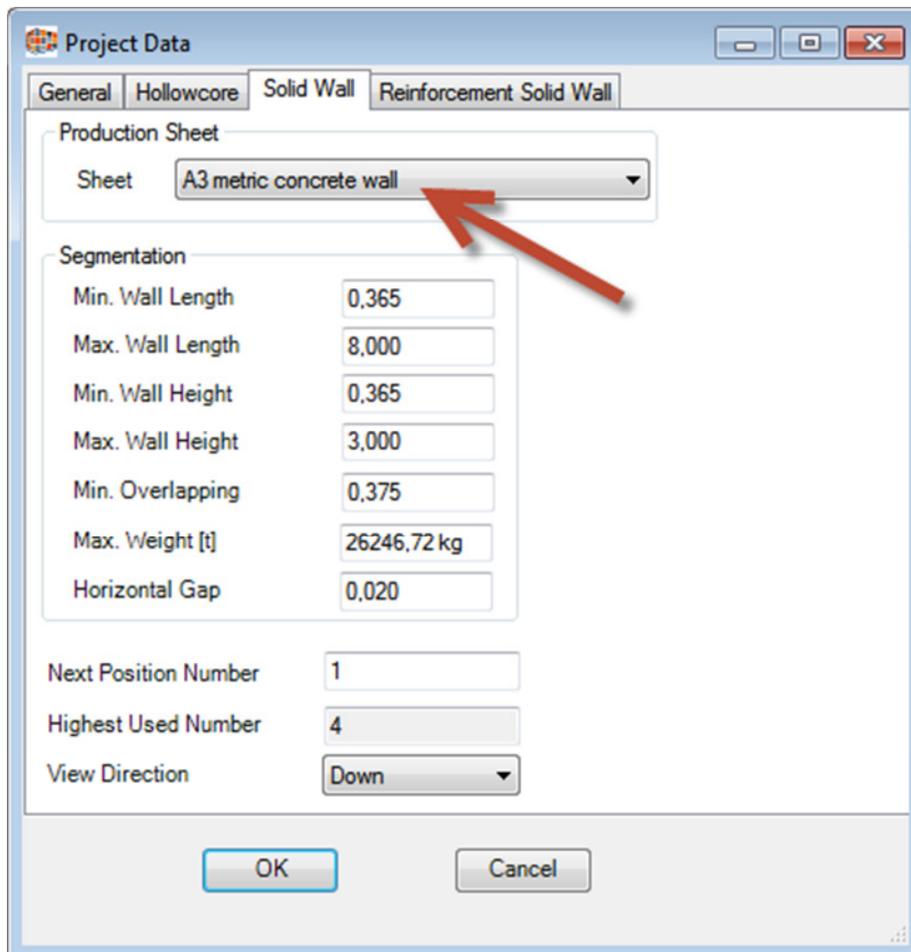


- Save the title block.

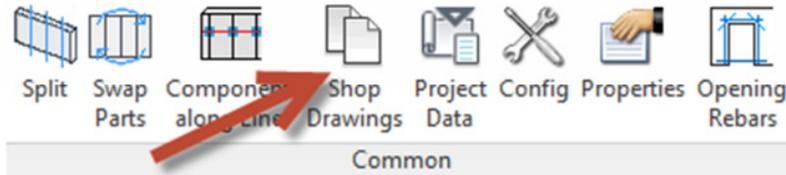
Load the family into the project in which the title block should be used and choose this title block for sheets in the project data:



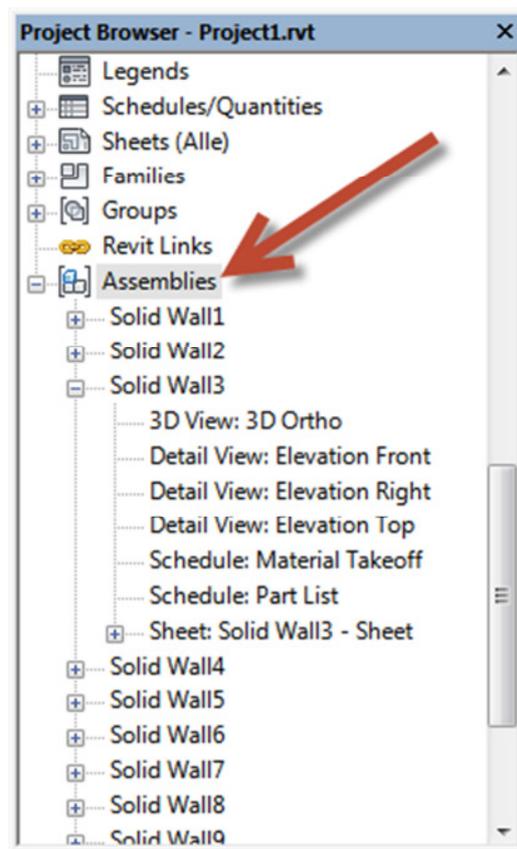
In the project data dialog you choose the title block for the sheets:



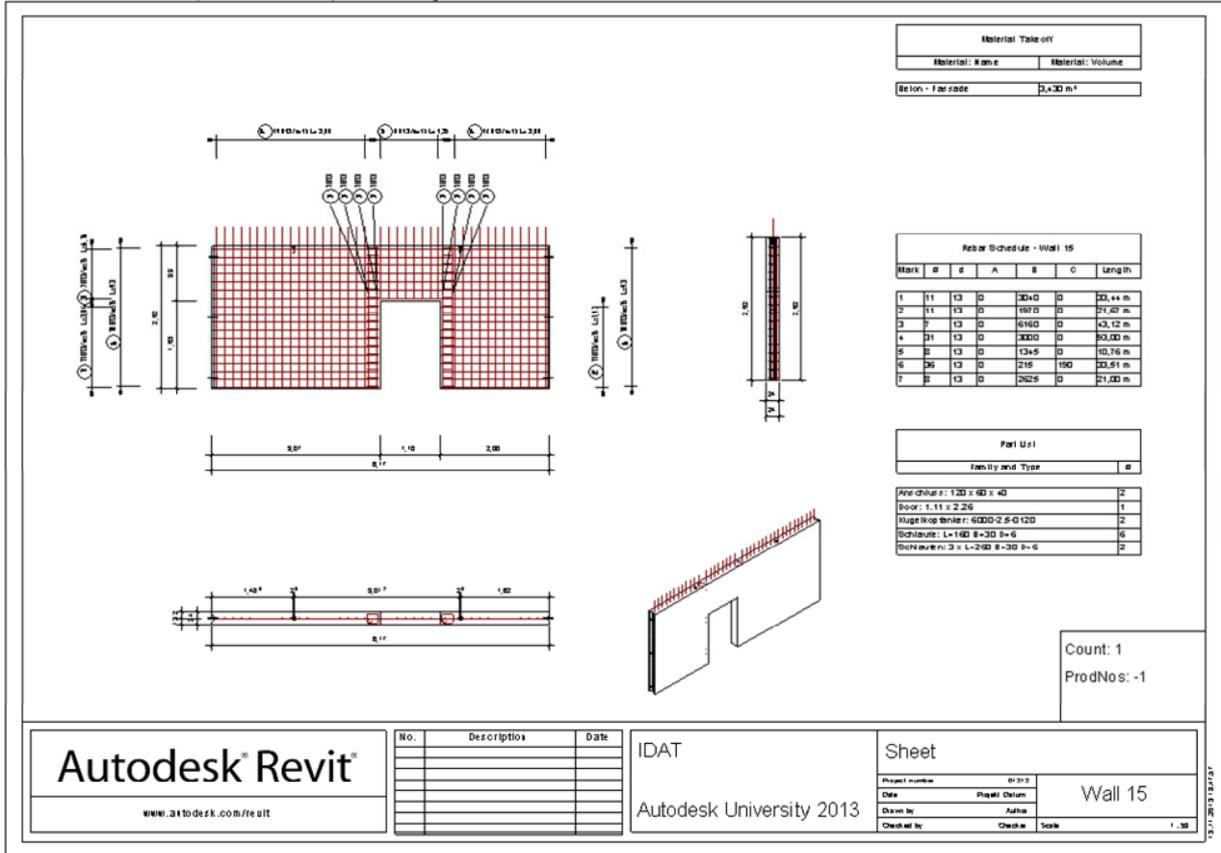
To create the shop drawings you have to select all the assemblies and start the command Shop Drawings:



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 part are dimensioned automatically. Also the reinforcement is tagged fully automatically.

### SOFiSTiK tools

The generation of the bar marks and the tagging of the bars are done automatically with the SOFiSTiK Reinforcement Detailing app. You can download the app from the Autodesk app store.

## 8. Creating data for external programs

### Data for external database

Call the command Database:



The data for all assemblies in the project will be written to an external database. This contains the geometric data, all the mounting parts and the reinforcement. Lists can be created out of this data or they can be exported to other programs like ERP systems.

Wall element list								Date: 13.11.2013
IDAT		Orderer: IDAT						Order #: 1234 01
		Building Proj.: Building Demo 1						Storey o.: FF
		Constr. loc.: Darmstadt - 64293						
		Editor: Lackner						
Panel	Concrete	Length ft	Height ft	Area Sqft	Thickness Inch	Volume ft3	Weight ft	
1	C25/30	32.360	2.450	79.282	3.60	23.785	59.462	
2	C25/30	27.550	2.450	67.497	3.60	20.249	50.623	
3	C25/30	10.550	3.350	35.343	3.60	10.603	26.507	
4	C25/30	20.373	3.950	63.583	3.60	19.075	47.687	
5	C25/30	5.725	2.450	14.026	3.60	4.208	10.520	
6	C25/30	6.025	4.050	24.192	3.60	7.258	18.144	
7	C25/30	21.600	1.800	38.880	2.40	7.776	19.440	
8	C25/30	6.512	4.400	28.651	3.60	8.595	21.489	
9	C25/30	0.025	4.400	1.320	3.60	0.032	0.081	
10	C25/30	10.885	2.450	26.668	3.60	8.000	20.001	
11	C25/30	5.660	4.050	22.668	3.60	6.800	17.001	
12	C25/30	34.200	2.450	83.790	2.40	16.758	41.895	
13	C25/30	1.070	2.447	2.618	2.40	0.523	1.309	
14	C25/30	7.990	2.447	19.552	2.40	3.901	9.753	
15	C25/30	7.980	2.447	19.527	2.40	3.888	9.719	
16	C25/30	0.542	2.447	1.325	2.40	0.244	0.609	
17	C25/30	7.980	2.447	19.527	2.40	3.885	9.714	
18	C25/30	7.980	2.447	19.527	2.40	3.888	9.719	
19	C25/30	0.505	2.447	1.236	2.40	0.238	0.595	
20	C25/30	6.250	2.050	12.812	2.40	2.563	6.406	
21	C25/30	2.105	2.047	4.254	2.40	0.839	2.098	
22	C25/30	3.370	2.047	6.898	2.40	1.368	3.419	
23	C25/30	0.695	2.047	1.423	2.40	0.266	0.666	
24	C25/30	10.600	2.950	31.270	2.40	6.254	15.635	
25	C25/30	7.970	2.947	23.488	2.40	4.687	11.717	
26	C25/30	2.570	2.947	7.574	2.40	1.493	3.733	
27	C25/30	5.380	2.547	13.703	2.40	2.722	6.805	
28	C25/30	0.756	2.547	1.925	2.40	0.366	0.916	
29	C25/30	2.504	2.547	1.797	2.40	0.350	0.875	
30	C25/30	34.325	7.127	198.698	2.40	39.740	99.349	
31	C25/30	34.325	7.127	198.698	2.40	39.740	99.349	

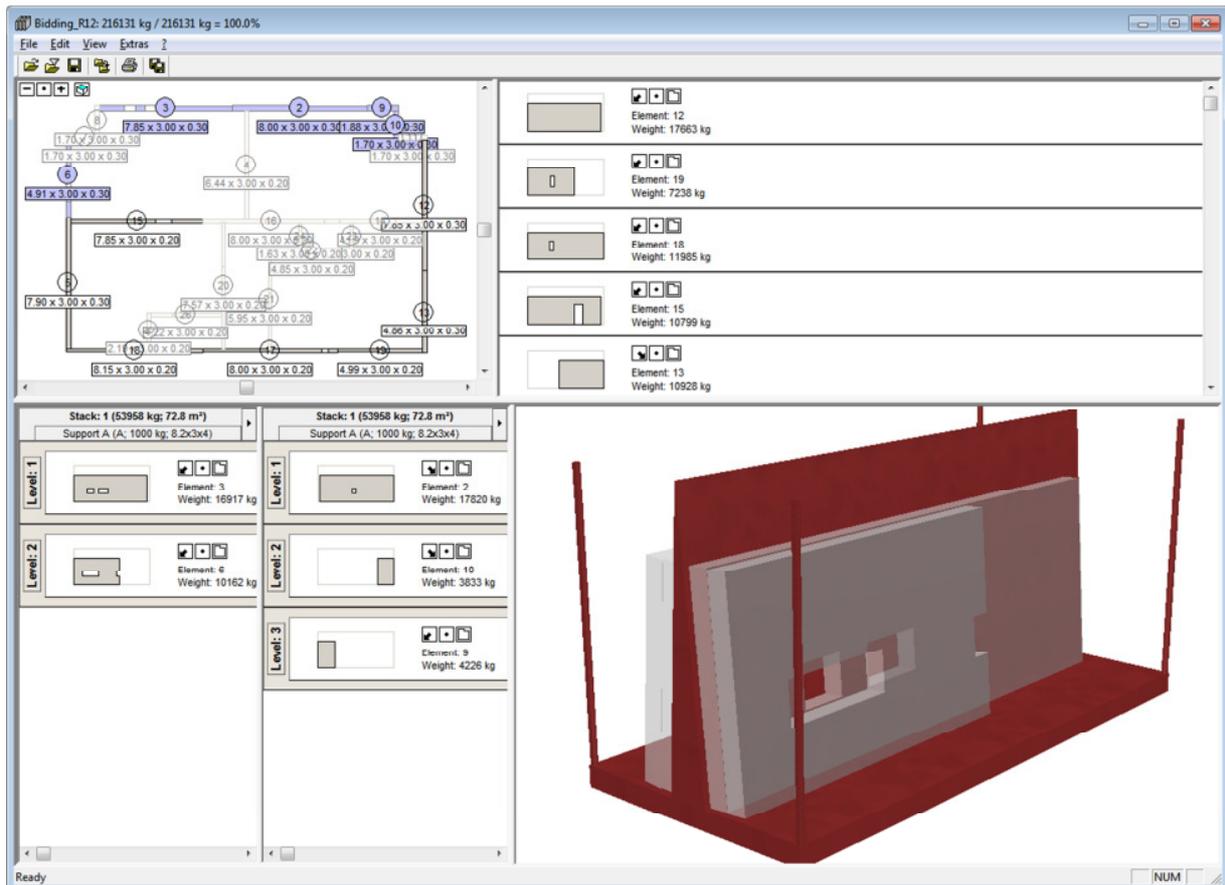
## Machine files for the Stacker program

Select one or more solid wall assemblies and call the command UNITECHNIK:



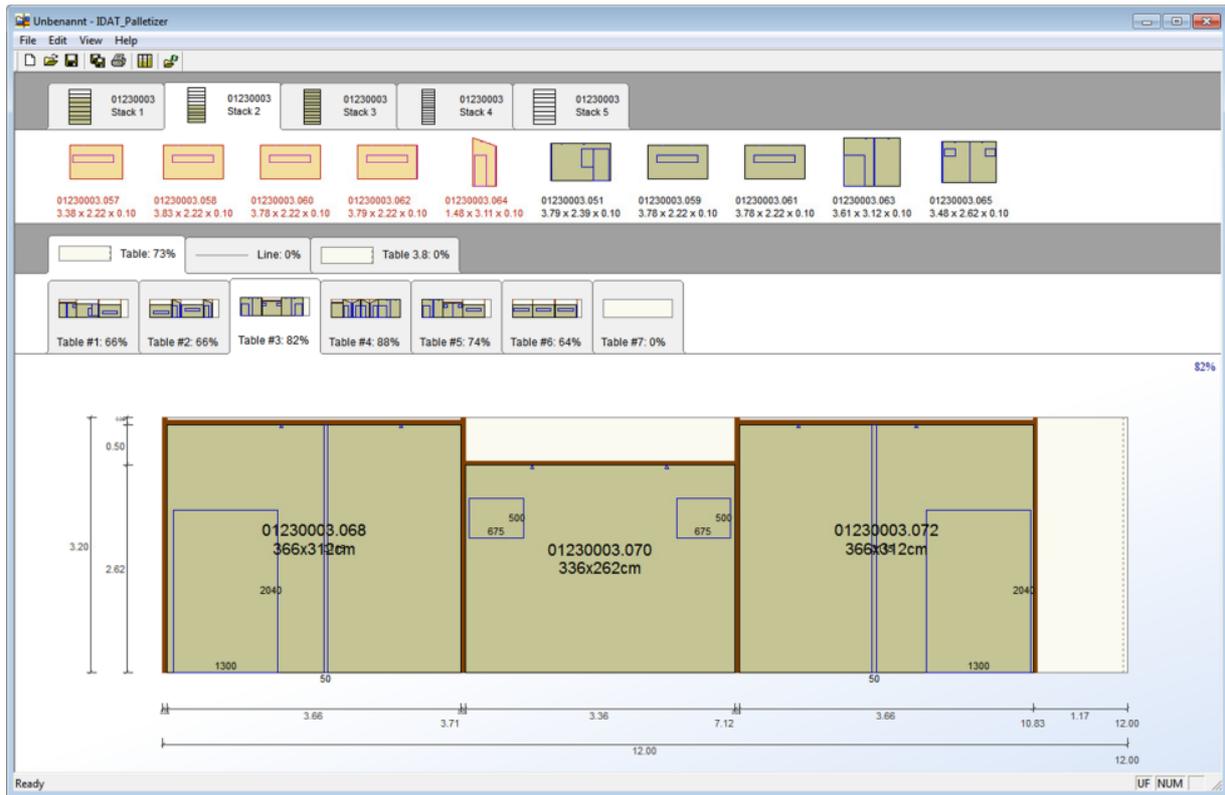
For each selected wall assembly a UNITECHNIK file will be created. The UNITECHNIK file format is a well-known format in the Precast Concrete Industry. With this file all the needed information like the geometry, the concrete, the mounting parts and the reinforcement are transferred to the factory for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



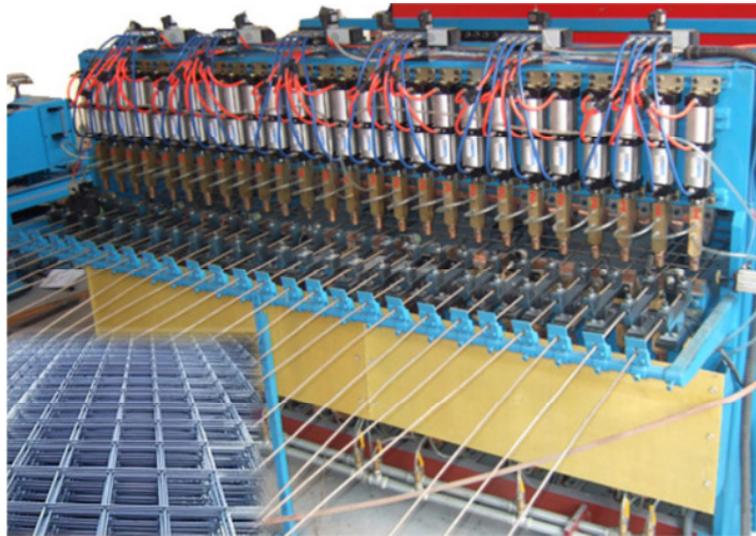
Shuttering robot puts the shutters on the pallet



Bar cutting and bending machine



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.

## 9. Summary

The module Solid Walls of the Revit Precast Tools supports the Precast Concrete Industry in the following areas:

- Automatic dividing
- Creation of solid wall panels with reinforcement and connections
- Converting to assemblies with equality check
- Creation of shop drawings
- Exporting data to external programs
- Changes in the model
- Production

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

**A trial version of the Revit Precast Tools can be downloaded: [www.idat.de](http://www.idat.de)**