Ingenieur-Software
Dlubal

Version
February 2010

Interface

RX-Revit

Link between RFEM / R STAB and Autodesk Revit Structure

Program Description

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1. Introduction

1.1 General Information about BIM

Building Information Modeling (BIM) is already widely-used in the automobile industry as well as in mechanical engineering and plant construction. Now, civil engineering benefits from this new planning method.

The term describes a new concept of digital planning in which all processes related to a building's life circle are connected with each other. It is an integrating overall process used to redesign planning, construction and management of buildings and structural works.

BIM is offering an innovative approach for designing, constructing and managing buildings. It is characterized by the direct and continuous availability of consistent and reliable high-quality information concerning a project's design, timing and cost development.

Building Information Modeling does not represent an independent technology but a method for which appropriate basic technologies are required to use it efficiently. In this context, examples may be the following (efficiency in ascending order):

- CAD
- Object-oriented CAD
- Parameterized structural modeling

1.2 RX-Revit

As RFEM is based on an object-oriented data model and Revit Structure on the parametric structural modeling, the objects' intelligence won't get lost when exchanging data. This means that you will get an equivalent object for every column, wall or beam in Revit Structure/RFEM, not only a collection of lines or surfaces.

1.3 RX-Revit Team

The following people were involved in the development of RX-Revit:

Program coordination

Dipl.-Ing. Georg Dlubal

Programming

Dis. Jiří Šmerák

Program supervision

Ing. Tomáš Ferencz

Dipl.-Ing. (FH) Alexandra Lazar

Manual, help system and translation

Dipl.-Ing. (FH) Alexandra Lazar

Ing. Ladislav Kábrt

Dipl.-Ü (Uni) Gundel Pietzcker

Technical support and quality management

Dipl.-Ing. (FH) Alexandra Lazar

M.Eng., Dipl.-Ing. (FH) Walter Rustler

2. Installation

RFEM provides an integrated interface to Revit Structure by default. In Revit Structure, however, after it has been installed, the interface must be activated manually.

2.1 Versions

The following versions of Autodesk Revit Structure are supported:

- Autodesk Revit Structure 2009 32-bit (development stopped)
- Autodesk Revit Structure 2010 32-bit
- Autodesk Revit Structure 2010 64-bit

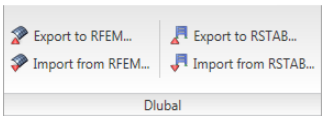
2.2 Installation Procedure

If you have installed RFEM/RSTAB first and then Revit Structure, start the file "Revit-Installer.exe" to install the interface. The file can be found in the following directories:

Win XP 32-bit: C:\Program Files\Common Files\Dlubal\ImportExport\RX-Revit

Win Vista 32-bit: C:\Program Files\Common Files\Dlubal\ImportExport\RX-Revit

Win Vista 64-bit: C:\Program Files (x86)\Common Files\Dlubal\ImportExport\RX-Revit



Start Revit Structure and open a model. In the menu tab "Add-Ins", you find the entry "External Tools" and the menu items "Export to RFEM...", "Import from RFEM...", "Export to RSTAB..." and "Import from RSTAB..." that enable the interface.

3. Functionality

This manual section describes to which extent the interface to Revit Structure can be used.

3.1 Export

When exporting a structure from Revit Structure to RFEM/RSTAB, different options that are described below can be selected.

"General Settings" tab

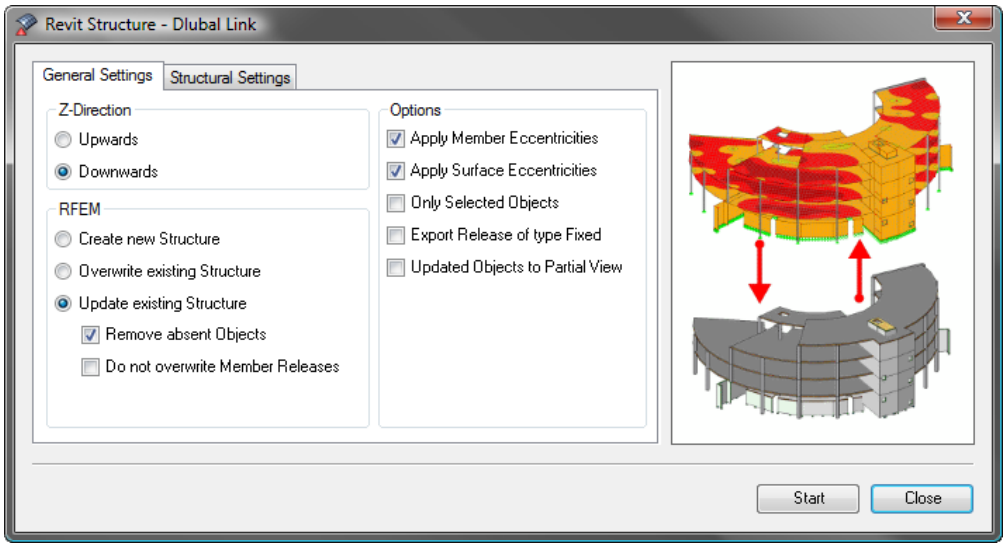


Figure 3.1: Interface in action (RFEM)

Orientation of Z-axis

The orientation of the Z-axis can be set "Upwards" or "Downwards".

In Revit Structure, upwards is set by default. In RFEM, downwards is the default setting. Therefore, it is recommended for further calculations in RFEM to set the orientation of the Z-axis downwards when importing data from Revit Structure.

RFEM / RSTAB

Use the option "Create new Structure" to export the current Revit Structure model to a new RFEM or RSTAB structure.

Select "Overwrite existing Structure" to overwrite the RFEM/RSTAB structure. If more than one structure is open, you can select the structure you want to replace.

When you select "Update existing Structure", you can update the RFEM/RSTAB structure to adjust it to the Revit Structure model. During the update process, objects that have been deleted in Revit Structure can also be removed in the RSTAB/RFEM structure by ticking the check box "Remove absent Objects". Select "Do not overwrite Member Releases" to avoid overwriting those member release definitions that have already been modified in RFEM/RSTAB.

Options

With the settings in this dialog section, you can consider member and surface eccentricities as well as selected objects only, for example to calculate a plate individually.

When you select "Export Release of type Fixed", RFEM/RSTAB interprets all releases that are defined as fixed in Revit Structure in a way that they are member releases but without degrees of freedom.

Use the option "Updated Objects to Partial View" to define a partial view in RFEM/RSTAB where only the updated objects can be found.

"Structural Settings" tab

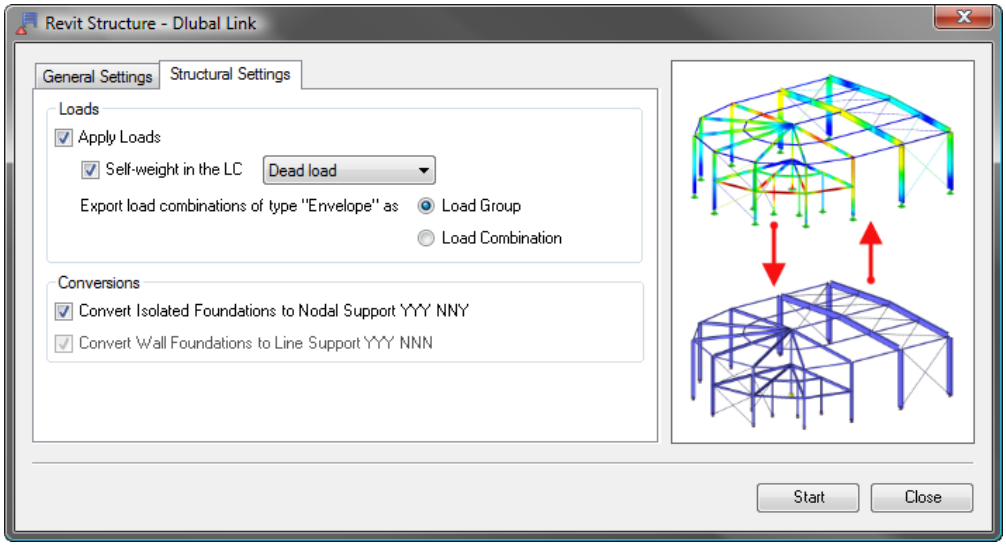


Figure 3.2: Interface in action (RSTAB)

Loads

It is possible to export loads that are available in Revit Structure to RFEM/RSTAB.

You can even decide if you want to consider the self-weight in a load case. In addition, you can select whether load combinations of the type "Envelope" should be exported as load groups or as load combinations.

Conversions

By selecting the corresponding options, single or wall foundations can be converted respectively into hinged nodal and line supports (only RFEM).

3.1.1 Structural Data

Effects of instance properties in Revit

The contents of the highlighted areas shown in the following figures are not considered when exchanging data from Revit Structure to RFEM/RSTAB. Thus, they do not influence the analysis model in RFEM/RSTAB. Furthermore, if considered necessary, you find recommendations in this chapter about how the analysis model in Revit Structure should be set.

Vertical members (columns)

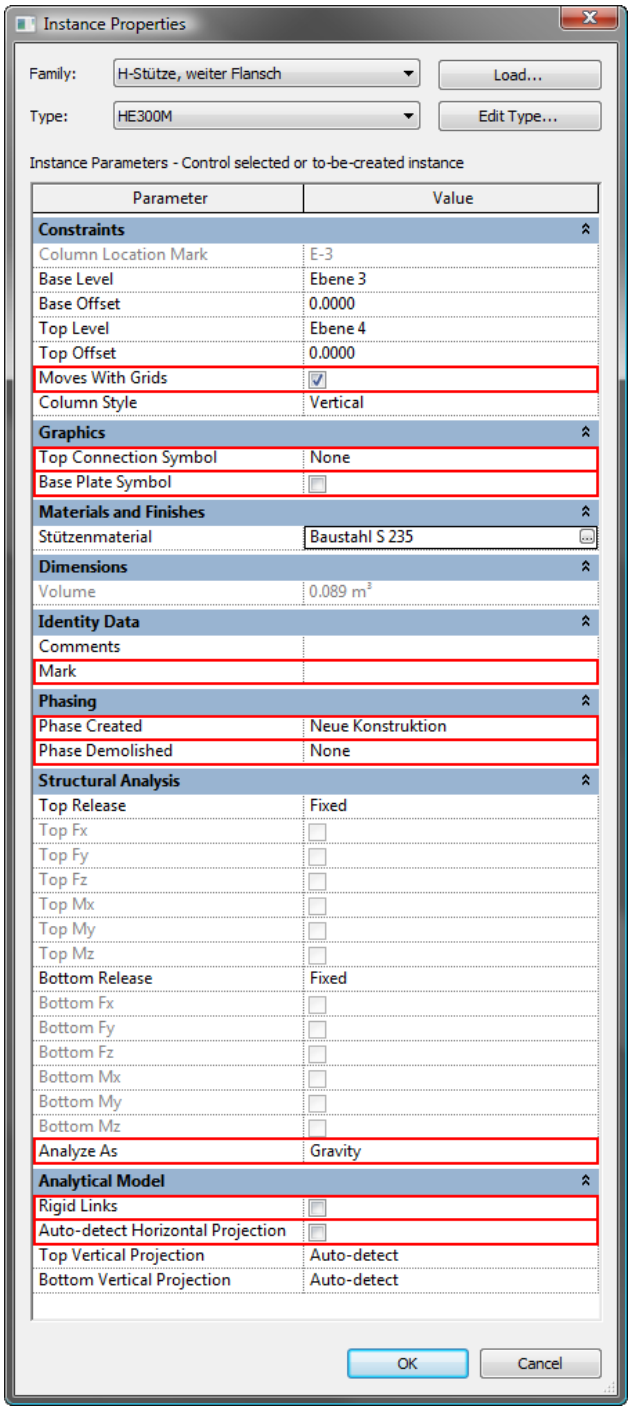


Figure 3.3: Instance properties: column

Horizontal members (girders/beams)

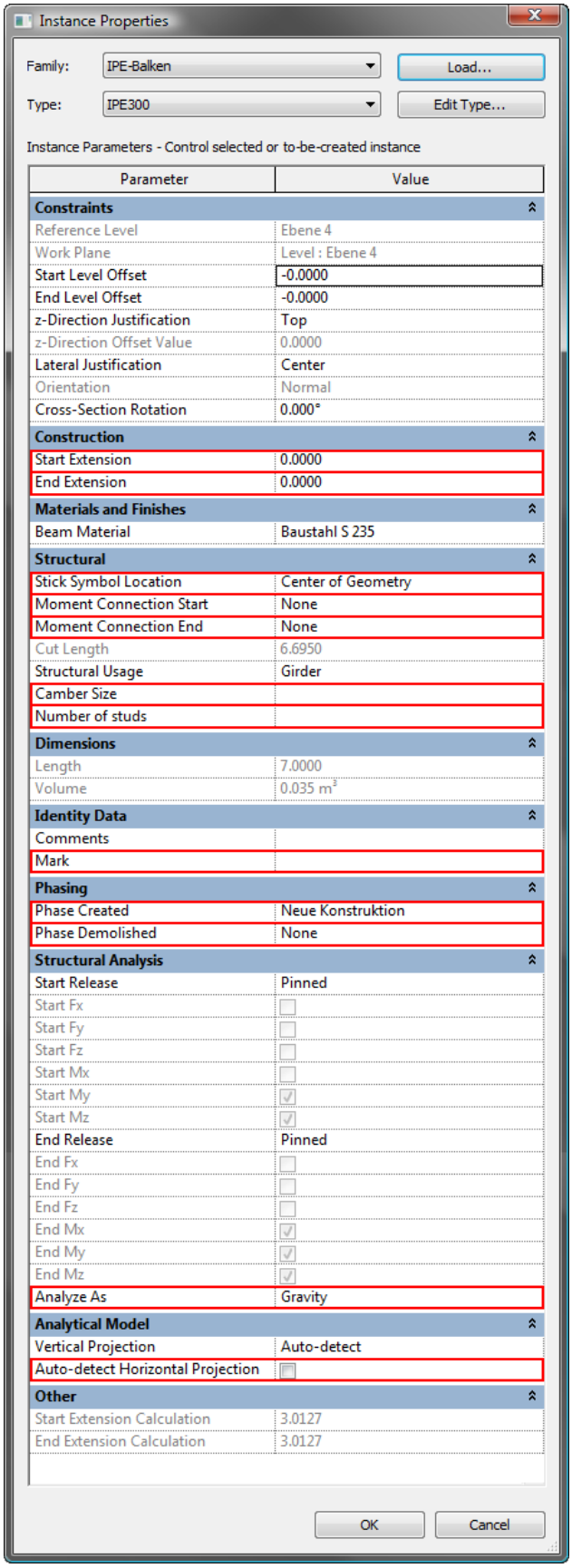
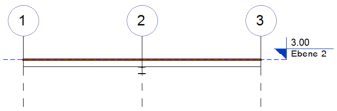


Figure 3.4: Instance properties: beams

For girders or beams that should be designed as downstand/floor beams, it is recommended to set the analysis model of those objects in Revit Structure as shown below, in case you want to export member eccentricities to RFEM as well:



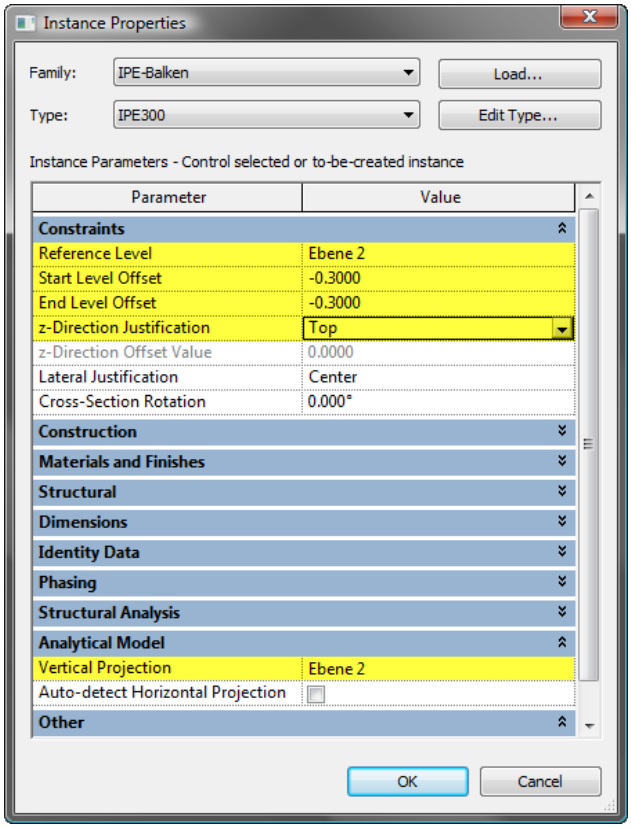


Figure 3.5: Instance properties: beam (designed as downstand beam)

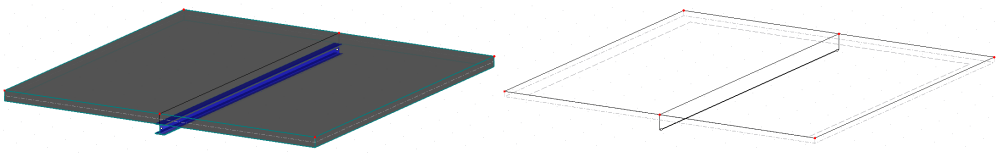


Figure 3.6: Result in RFEM

To enable the rib function so that you can use the "Effective Width", you must activate this function in RFEM first by opening the "Edit Member" dialog box and selecting "Rib" in the dialog section "Member Type".

Vertical surfaces (walls)

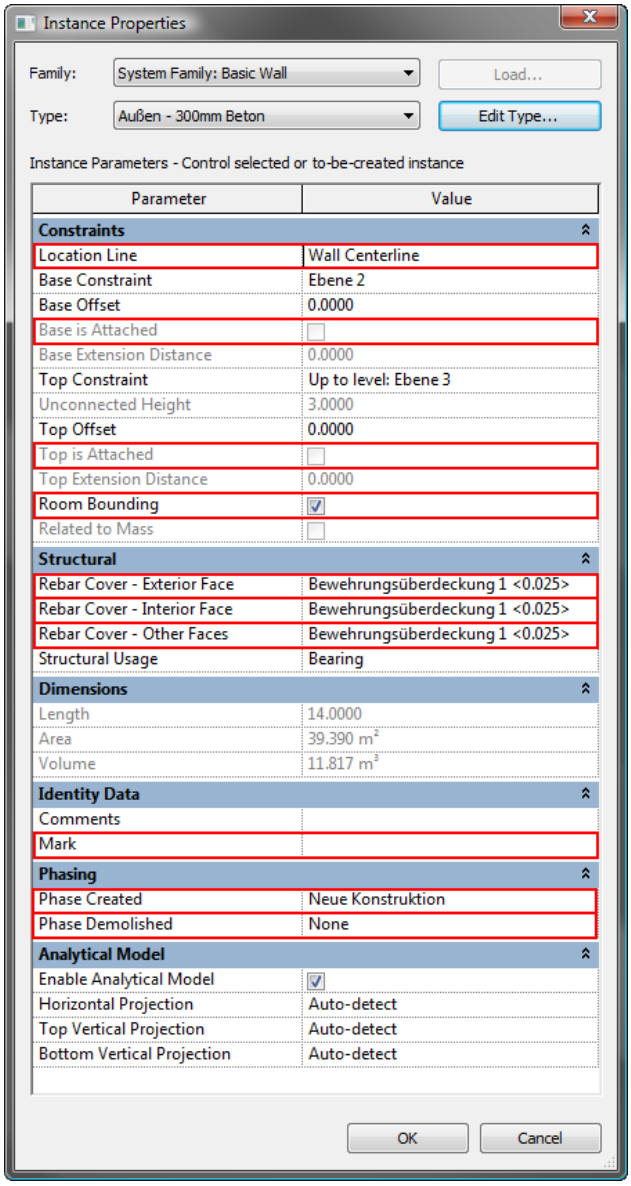


Figure 3.7: Instance properties: wall

Horizontal surfaces (floors/plates)

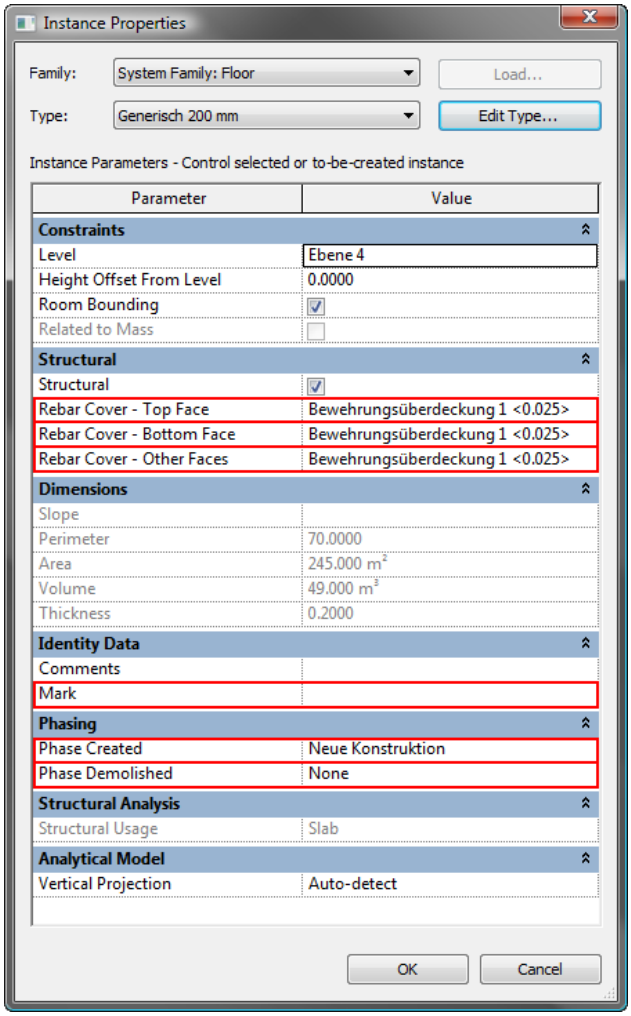
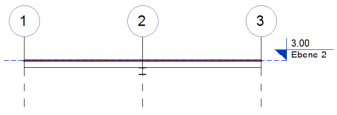


Figure 3.8: Instance properties: floor plate

For the export of floors, it is useful to fix the vertical projection of the analytical model to a plane.



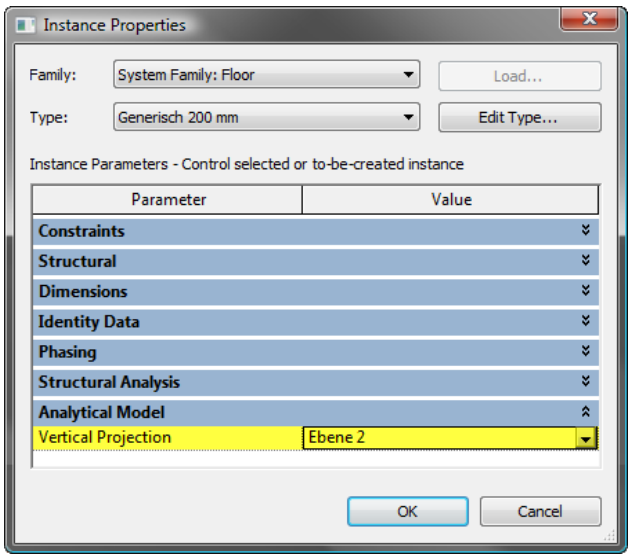
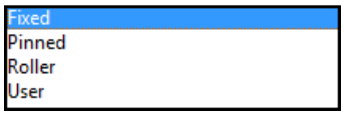


Figure 3.9: Instance properties: floor plate (relation to plane)

3.1.2 Support Data

It is possible to define supports in Revit Structure that can be exported to RFEM/RSTAB. Depending on the support condition, you can set different degrees of freedom.

Point support condition



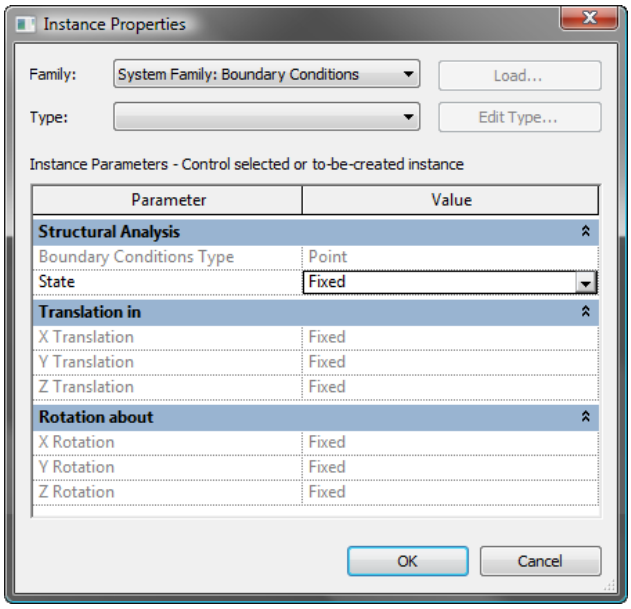


Figure 3.10: Instance properties: point support condition

In the figure above, the state "Fixed" is selected in Revit Structure. The figure below shows the corresponding equivalent in RFEM (RSTAB analog). It is also possible to export translational and rotational springs from Revit Structure to RFEM/RSTAB.

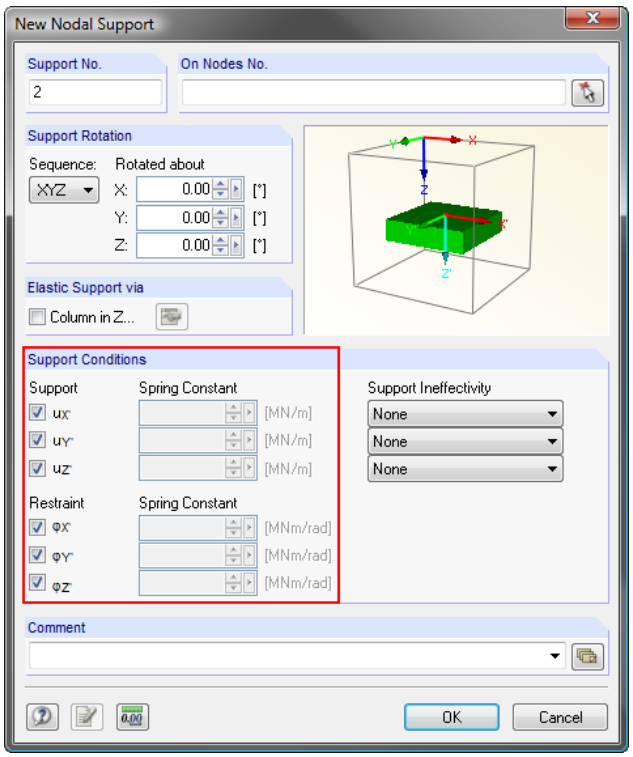


Figure 3.11: Instance properties: nodal support (RFEM)

Line support condition

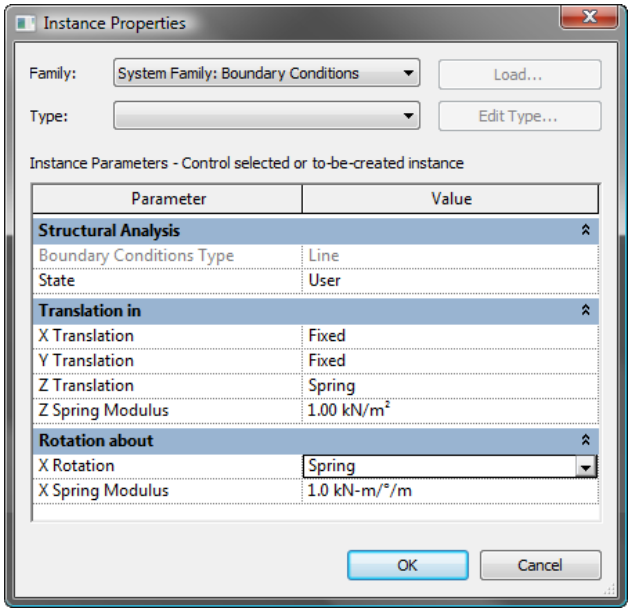


Figure 3.12: Instance properties: line support condition

Also for lines it is possible to export translational and rotational springs from Revit Structure to RFEM.

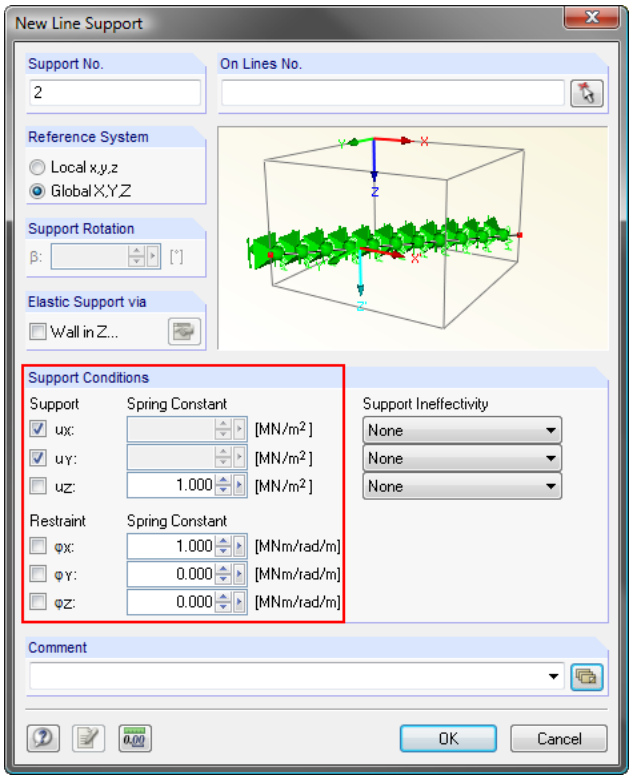
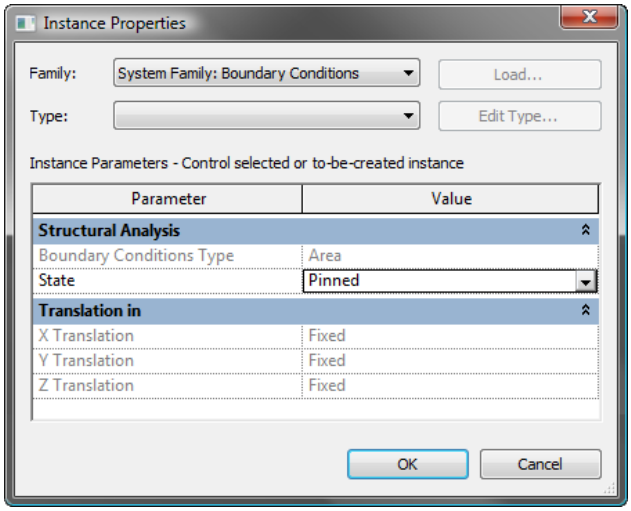


Figure 3.13: Instance properties: line support

Area support condition



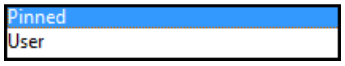


Figure 3.14: Instance properties: area support condition

When exporting an area support condition from Revit Structure to RFEM, line supports, as a matter of principle, are exclusively created on all boundary lines of the area. In case the area support condition was applied beneath a floor plate that was generated as foundation plate, a surface elastic foundation will be created in RFEM in addition to the line supports.

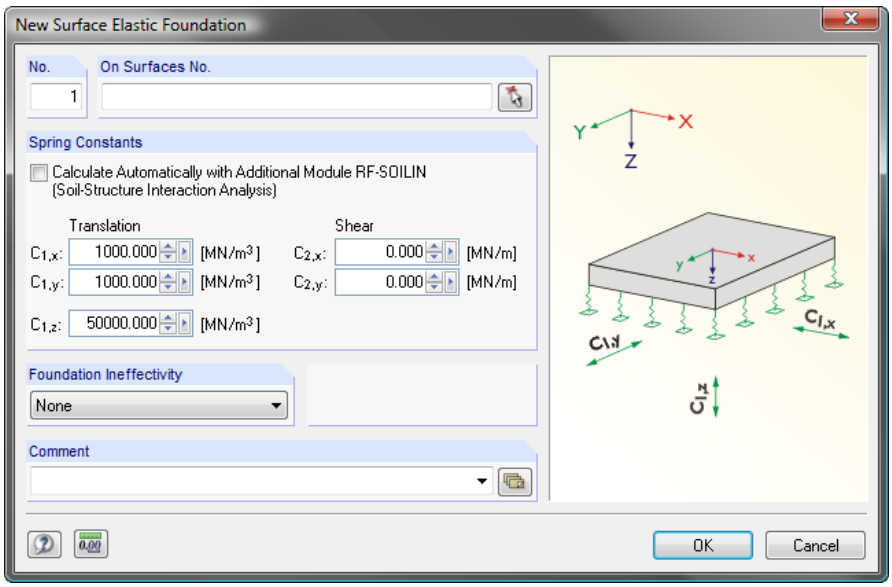


Figure 3.15: Instance properties: surface elastic foundation

The setting options for support conditions in Revit Structure are adequate, but settings in RFEM/RSTAB are more comprehensive.

3.1.3 Load Data

Revit Structure provides several options shown in Figure 3.16 to create loads.

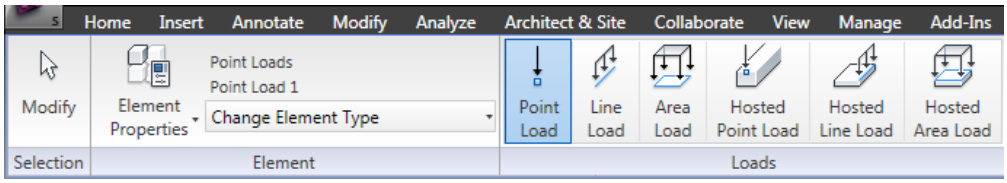
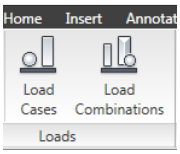


Figure 3.16: Load types in Revit Structure

The equivalent load types in RFEM are the following:

Revit Structure	RFEM	RSTAB
point load	free concentrated load	-
line load	free line load	-
area load	free polygon load	-
hosted point load	nodal load	nodal load
hosted line load	line load	member load
hosted area load	surface load	-

To tap the full potential of all load types, it is recommended to generate loads in RFEM/RSTAB, because the number of load types as well as their setting options in RFEM/RSTAB are more comprehensive than in Revit Structure.



Furthermore, it is possible in Revit Structure to create load cases and load combinations. Load groups, however, cannot be created.

Load cases are exported in the same way as they were defined in Revit Structure, provided that the option to consider the self-weight in load case 1 has been activated in order to carry out the export as shown in the following figures.

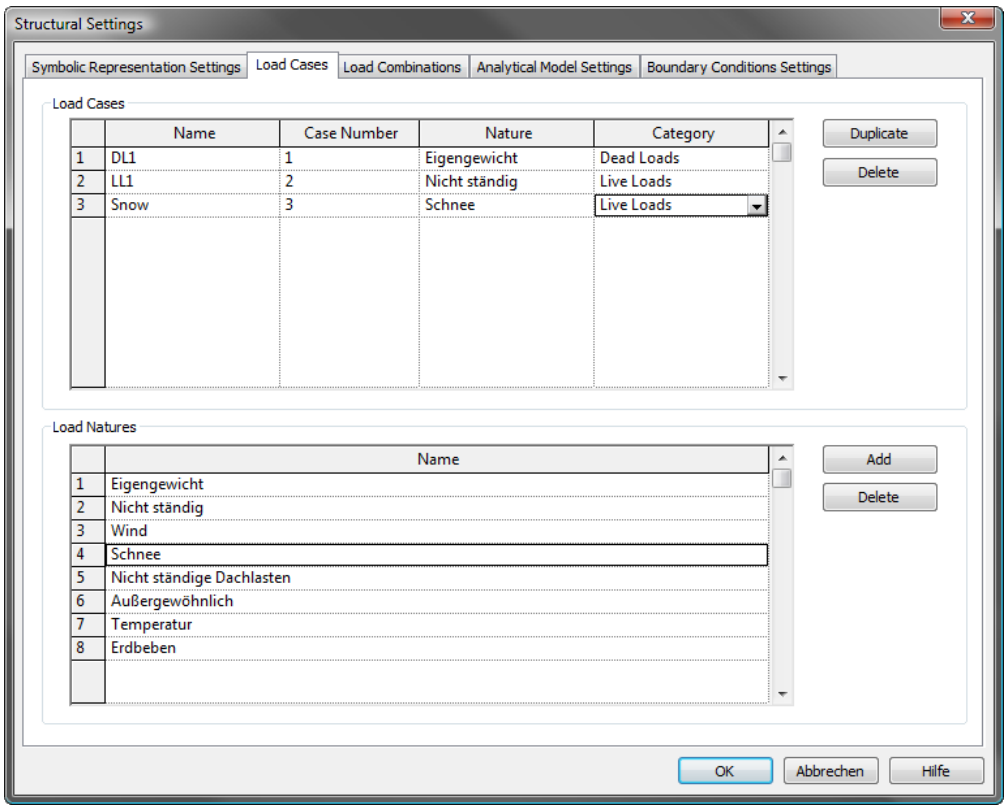


Figure 3.17: Load cases in Revit Structure

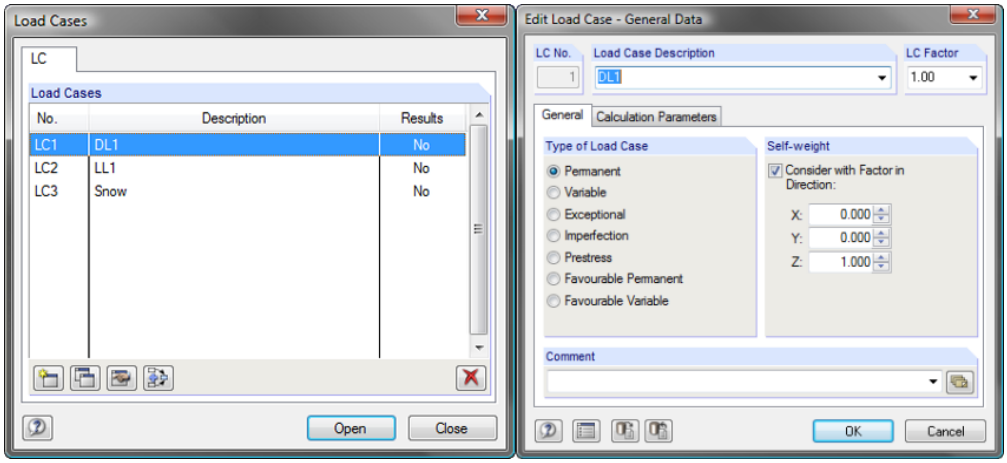


Figure 3.18: Load cases in RFEM

Load combinations may be created in Revit Structure, but it is not possible to assign a special criterion to load cases. Load combinations with the definition type "Combination" are exported as load groups to RFEM/RSTAB. For load combinations defined as "Envelope", you can decide if you want to export them to RFEM/RSTAB as load groups or load combinations.

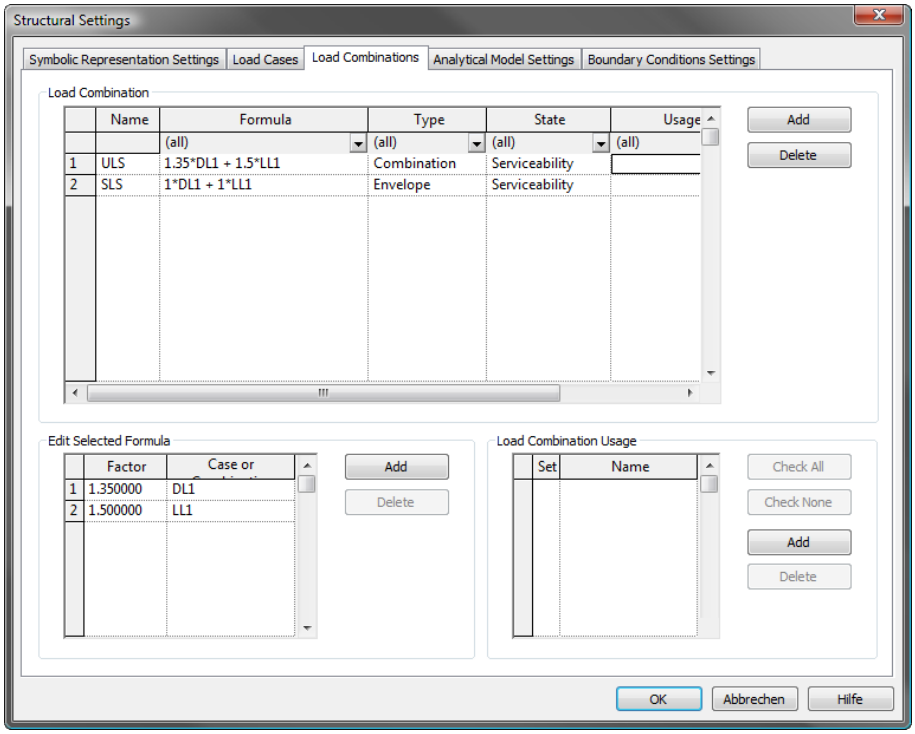


Figure 3.19: Load combinations in Revit Structure

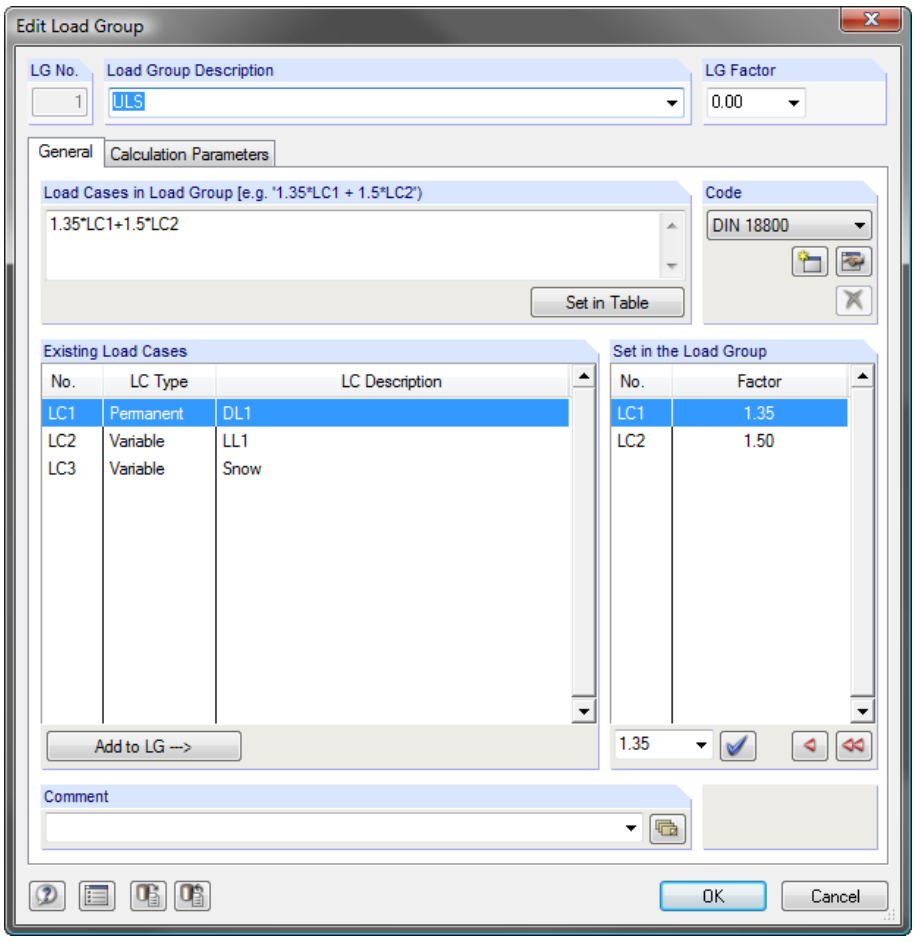


Figure 3.20: Load group in RFEM

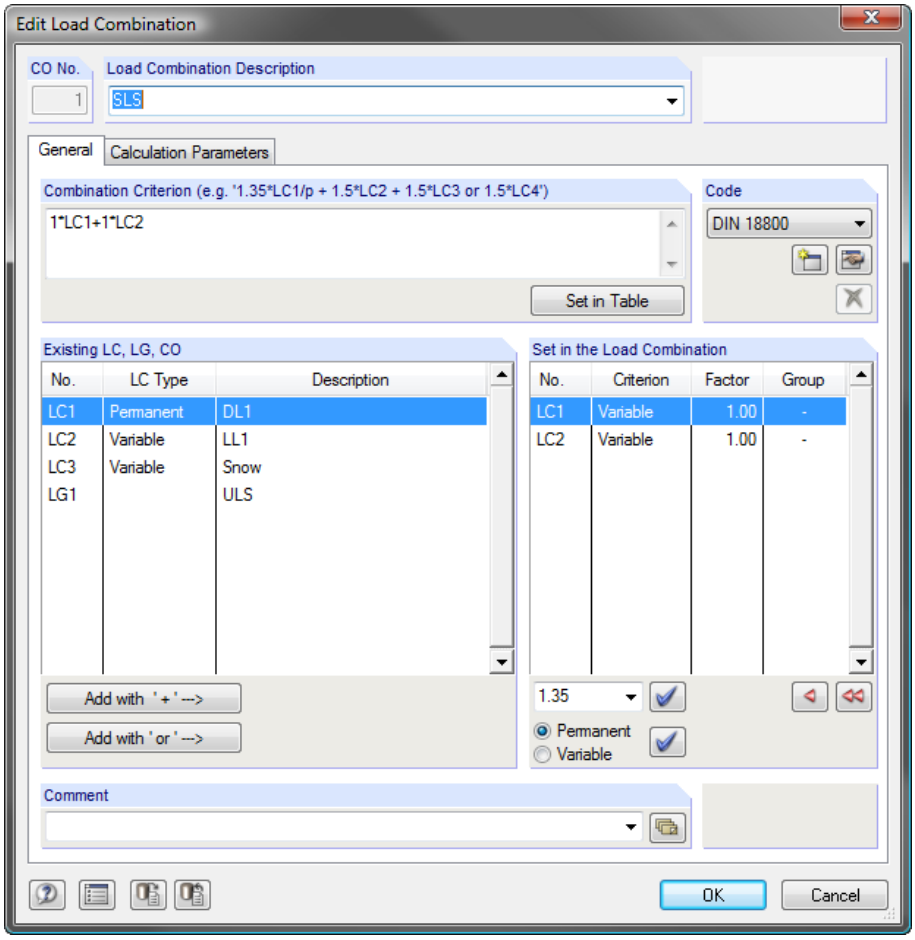


Figure 3.21: Load combination in RFEM

3.2 Import

When importing a structure from RFEM/RSTAB to Revit Structure, different options that are described below can be selected.

"General Settings" tab

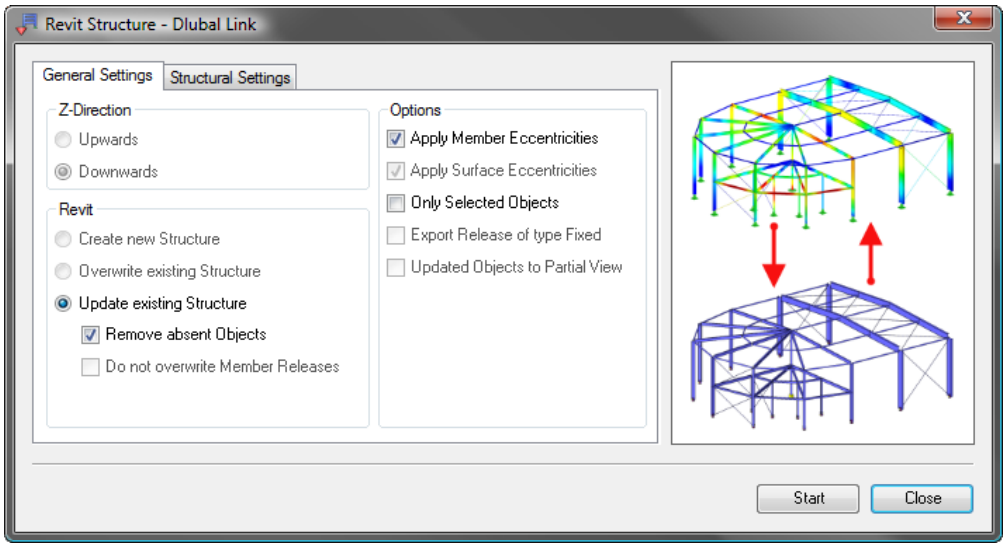


Figure 3.22: Interface in action (RSTAB)

Orientation of Z-axis

The orientation of the Z-axis cannot be changed when exporting data from RFEM/RSTAB to Revit Structure because Revit Structure does not provide such a function.

Revit

Even if the option "Create new Structure" is gray and therefore inactive, you can import a structure from RFEM/RSTAB to Revit Structure without having designed a model in Revit Structure previously. All you need is an opened/new project.

Select "Update existing Structure" to update the structure of the Revit Structure model. Tick the check box "Remove absent Objects" to remove objects in the update process, that have been deleted in RFEM/RSTAB, in the Revit Structure model.

Options

With the settings in this dialog section, you can consider member and surface eccentricities as well as selected objects only, for example to reduce the effort when aligning complex structures.

If you want to update "Only Selected Objects", take care to select all objects in RFEM that belong together (see Figure 3.23).

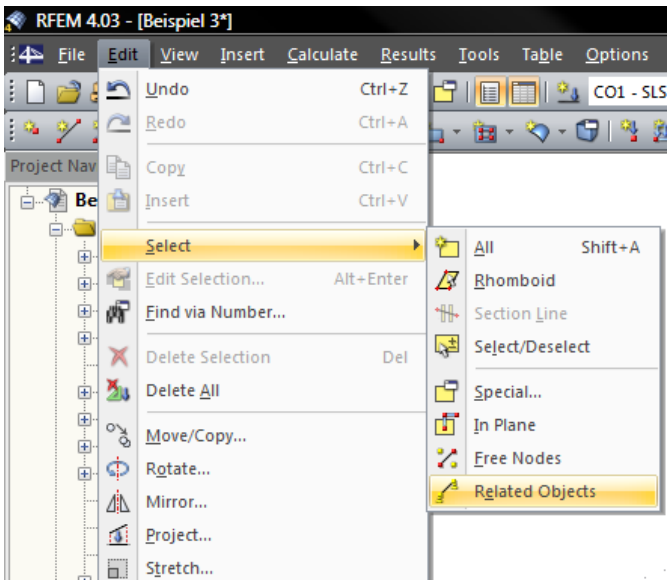


Figure 3.23: RFEM/RSTAB - selecting related objects

"Structural Settings" tab

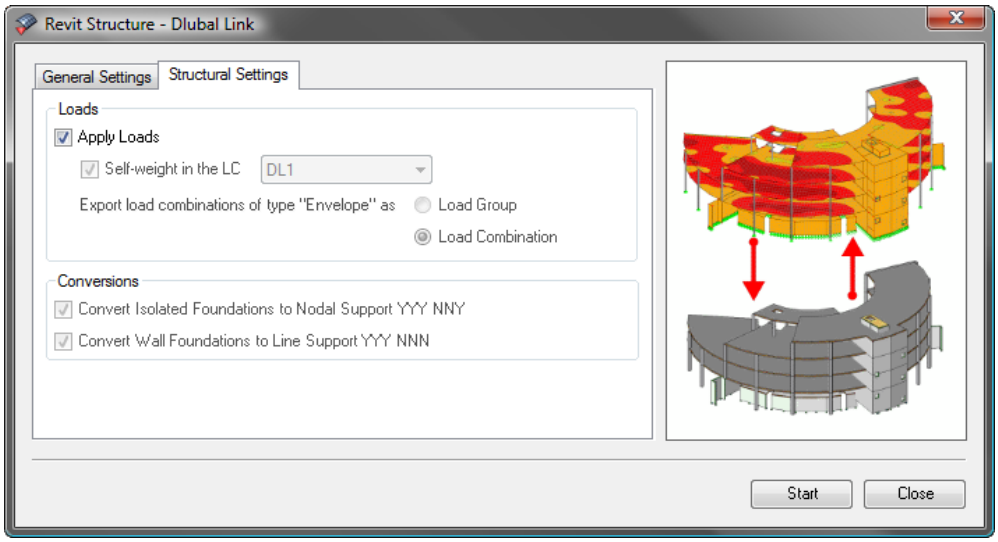


Figure 3.24: Interface in action (RFEM)

Loads

It is possible to import loads that are available in RFEM/RSTAB to Revit Structure. However, it is not possible to consider self-weight because Revit Structure does not provide such a function.

Load groups will be imported as load combinations with the definition type "Combination". When importing load combinations, the program checks first whether they include a load case, a load group and/or a load combination with the criterion "permanent". In such a case, the load combination is imported as load combination with the type "Combination". Otherwise the load combination is imported as load combination with the type "Envelope".

3.2.1 Structural Data

Basically, the extent of the import is similar to the extent of the export. However, some limitations exist on the part of Revit Structure, which are described in the following. Please note that all cross-section families to be used must be loaded before you start the import from RFEM/RSTAB to Revit Structure.

Vertical members (columns) and horizontal members (girders/beams)

see Export (chapter 3.1.1, page 9)

Vertical surfaces (walls)

In Revit Structure, it is not possible yet to model non-vertical walls by using the "wall" command. Therefore, non-vertical walls imported from RFEM are modeled as non-horizontal floor plates in Revit Structure.

Horizontal surfaces (floors/plates)

The import of rotated surfaces, B-spline surfaces and pipes from RFEM to Revit Structure is not possible, because Revit Structure does not provide equivalent objects.

3.2.2 Support Data

The setting options for supports in RFEM/RSTAB are more comprehensive than in Revit Structure. This means that there are some settings that cannot be imported to Revit Structure. These settings are shown in the highlighted areas of the figures below.

Nodal support

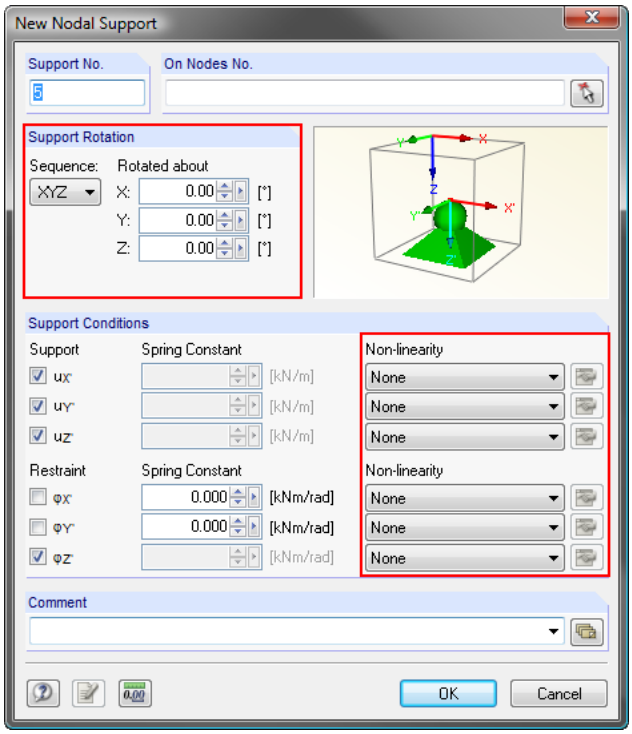


Figure 3.25: Nodal support RSTAB

Line support

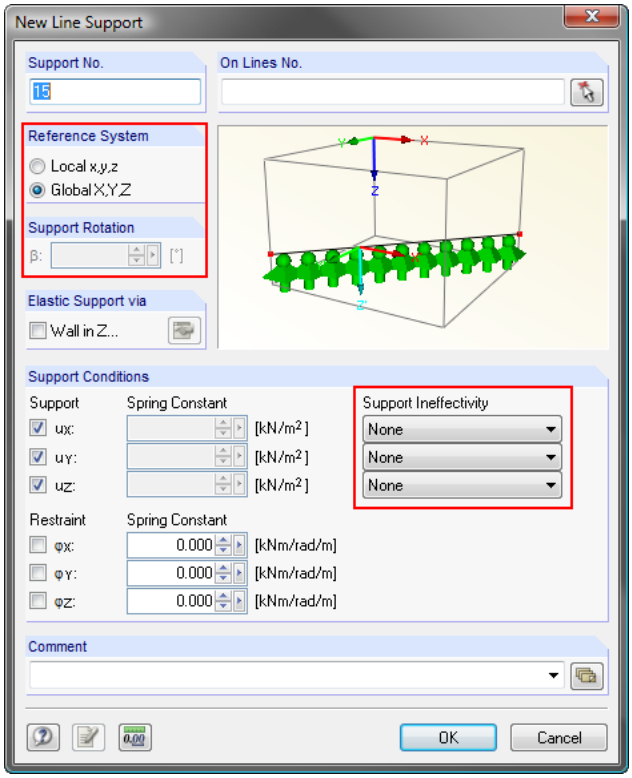


Figure 3.26: Line support

Surface elastic foundation

Surface elastic foundations are not considered when importing data from RFEM to Revit Structure. Area support conditions won't be created. If a surface elastic foundation is defined on a horizontal surface in RFEM, this surface becomes a foundation plate in Revit Structure. If the surface does not have any surface elastic foundations, the surface becomes a floor plate.

3.2.3 Load Data

The following load types are not imported from RFEM/RSTAB to Revit Structure as Revit Structure does not provide any equivalents for them.

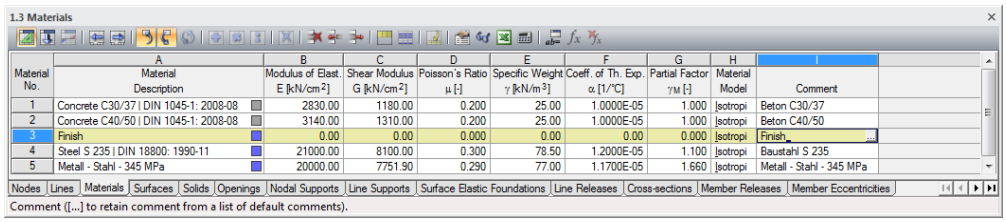
- free rectangular loads
- free circular loads
- imposed nodal deformations
- imposed line displacements
- imperfections

4. Materials and Cross-sections

As a matter of principle, when exchanging data between Revit Structure and RSTAB/RFEM, the databases for materials and cross-sections from RSTAB/RFEM are used.

The respective Revit Structure name is compared with the corresponding database and, in case they are consistent, the relevant entry will be imported from the database.

If they are not consistent, the Revit Structure name will be imported and the material and cross-section properties will be generated according to the figures below.



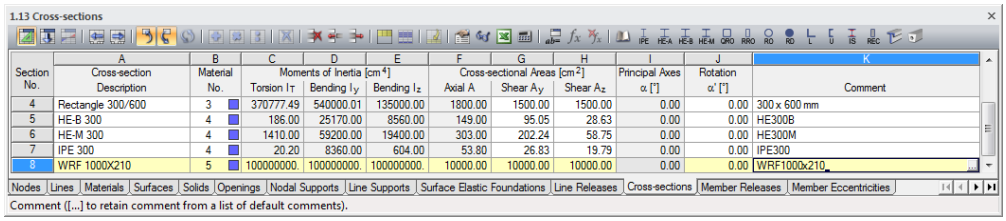
1.3 Materials

Material No.	A Material Description	B Modulus of Elast. E [kN/cm²]	C Shear Modulus G [kN/cm²]	D Poisson's Ratio μ [-]	E Specific Weight γ [kN/m³]	F Coeff. of Th. Exp. α [1/°C]	G Partial Factor γM [-]	H Material Model	I Comment
1	Concrete C30/37 | DIN 1045-1: 2008-08	2830.00	1180.00	0.200	25.00	1.0000E-05	1.000	Isotropi	Beton C30/37
2	Concrete C40/50 | DIN 1045-1: 2008-08	3140.00	1310.00	0.200	25.00	1.0000E-05	1.000	Isotropi	Beton C40/50
3	Finish	0.00	0.00	0.000	0.00	0.00	0.000	Isotropi	Finish
4	Steel S 235 | DIN 18800: 1990-11	21000.00	8100.00	0.300	78.50	1.2000E-05	1.100	Isotropi	Baustahl S 235
5	Metall - Stahl - 345 MPa	20000.00	7751.90	0.290	77.00	1.1700E-05	1.660	Isotropi	Metall - Stahl - 345 MPa

Nodes | Lines | Materials | Surfaces | Solids | Openings | Nodal Supports | Line Supports | Surface Elastic Foundations | Line Releases | Cross-sections | Member Releases | Member Eccentricities

Comment ([...] to retain comment from a list of default comments).

Figure 4.1: Table 1.3 *Materials*



1.13 Cross-sections

Section No.	A Cross-section Description	B Material No.	C Moments of Inertia [cm⁴] Torsion I_T	D Bending I_y	E Bending I_z	F Cross-sectional Areas [cm²] Axial A	G Shear A_y	H Shear A_z	I Principal Axes α [°]	J Rotation α' [°]	K Comment
4	Rectangle 300/600	3	370777.49	540000.01	135000.00	1800.00	1500.00	1500.00	0.00	0.00	300 x 600 mm
5	HE-B 300	4	186.00	25170.00	8560.00	149.00	95.05	28.63	0.00	0.00	HE300B
6	HE-M 300	4	1410.00	59200.00	19400.00	303.00	202.24	58.75	0.00	0.00	HE300M
7	IPE 300	4	20.20	8360.00	604.00	53.80	26.83	19.79	0.00	0.00	IPE300
8	WRF 1000X210	5	100000000.	100000000.	100000000.	10000.00	10000.00	10000.00	0.00	0.00	WRF1000x210

Nodes | Lines | Materials | Surfaces | Solids | Openings | Nodal Supports | Line Supports | Surface Elastic Foundations | Line Releases | Cross-sections | Member Releases | Member Eccentricities

Comment ([...] to retain comment from a list of default comments).

Figure 4.2: Table 1.13 *Cross-sections*

4.1 Materials

In addition to the transfer of materials from Revit Structure to RSTAB/RFEM, it is possible to consider standards by creating your own material conversion.

In the following, you find a description on how to convert material.

First, find out where the material conversion file is stored. Select "Import" on the RSTAB/RFEM "File" menu to open the "Import" dialog box. Then click the "Details" button to open another dialog box. In the "All Formats" tab, the appropriate file directory is shown.

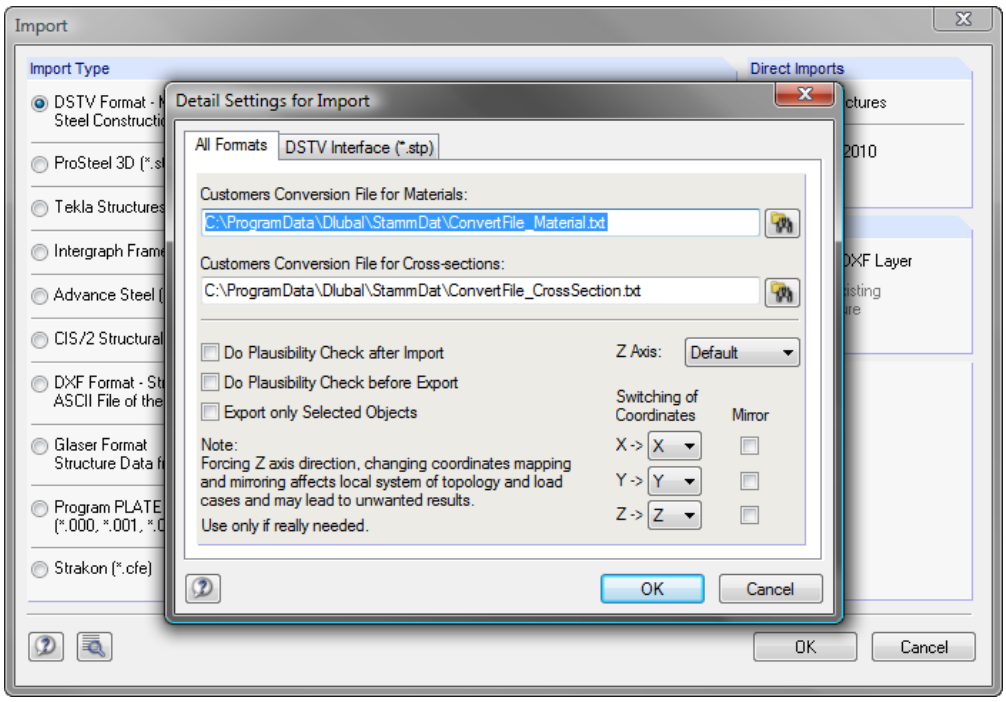


Figure 4.3: RFEM directory for material conversion file

Open the file "ConvertFile_Material.txt", for example by using the editor.

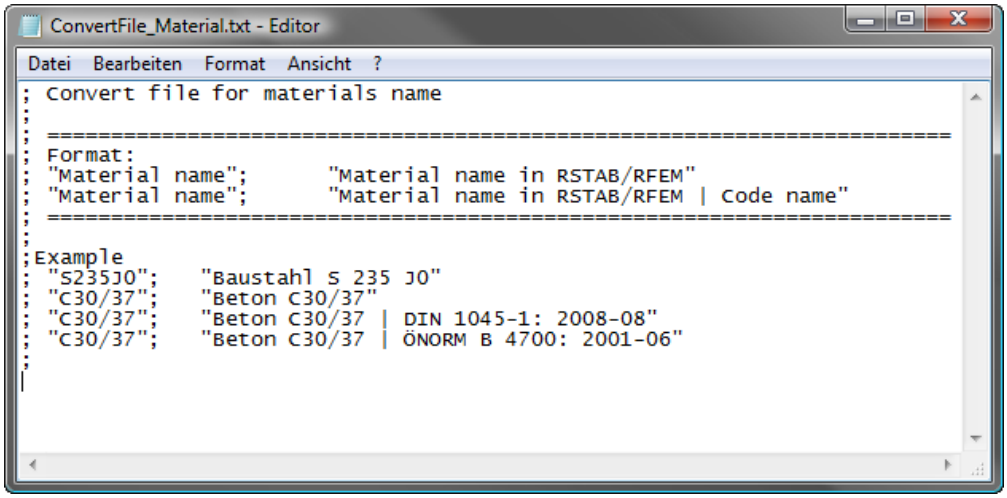


Figure 4.4: Material conversion file

Now you can define your own conversion settings by entering the accurate Revit Structure name and the right name including standard from RSTAB/RFEM as shown in the example above.

Please take care to avoid semicolons in front of the line containing the material name, as otherwise the complete line will be evaluated as a "comment" and therefore will lose its influence on the conversion.

Save the conversion file by clicking "Save as" on the "File" menu. In the next dialog box, select "UTF-8" in the coding field and overwrite it with the present file.

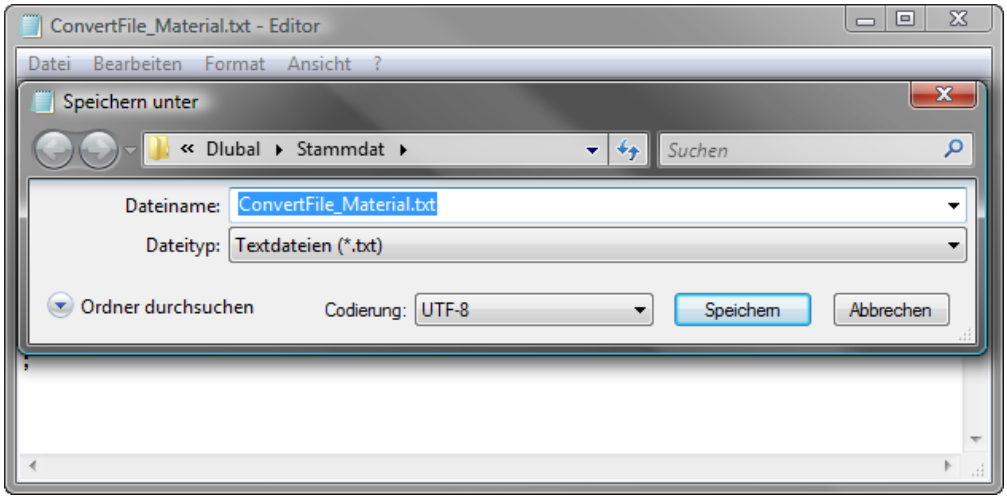


Figure 4.5: Material conversion file

4.2 Cross-sections

The conversion for cross-sections is similar to the conversion of materials. It is possible to create an appropriate cross-section conversion file, for example to recognize directly cross-sections created in SHAPE (add-on module) when transferring data from Revit Structure to RSTAB/RFEM.

In the following, you find a description on how to convert cross-sections.

First, find out where the cross-section conversion file is stored. Select "Import" on the RSTAB/RFEM "File" menu to open the "Import" dialog box. Then click the "Details" button to open another dialog box. In the "All Formats" tab, the appropriate file directory is shown.

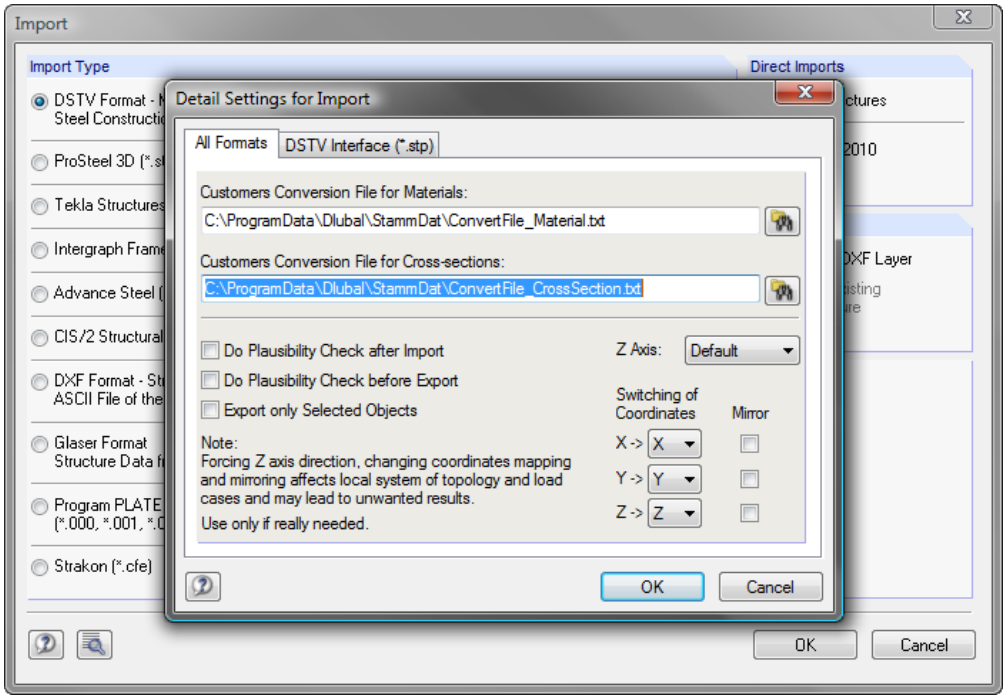


Figure 4.6: RFEM directory for cross-section conversion file

Open the file "ConvertFile_CrossSection.txt" by using the editor, for example.

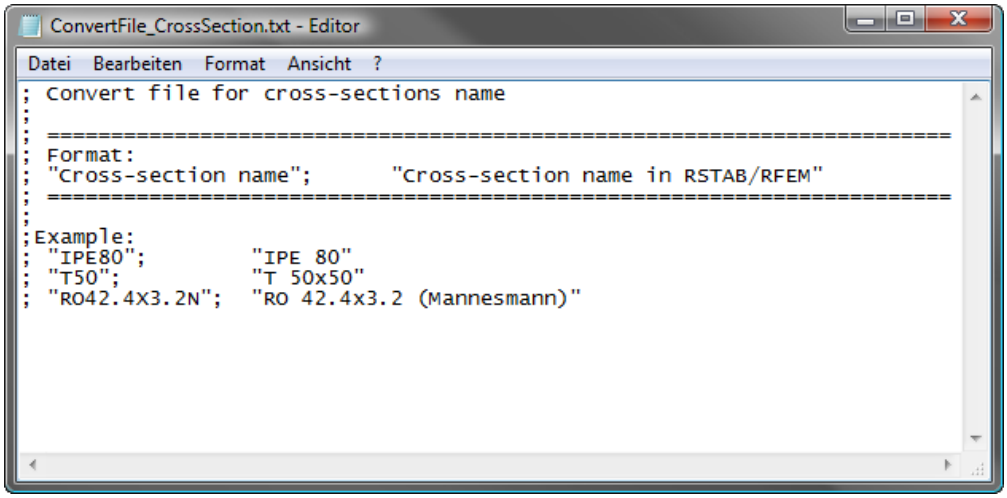


Figure 4.7: Cross-section conversion file

Now you can define your own conversion settings by entering the accurate Revit Structure name and the right name from RSTAB/RFEM as shown in the example above.

Please take care to avoid semicolons in front of the line containing the cross-section name, as otherwise the complete line will be evaluated as a "comment" and therefore will lose its influence on the conversion.

Save the conversion file by clicking "Save as" on the "File" menu. In the next dialog box, select "UTF-8" in the coding field and overwrite it with the present file.

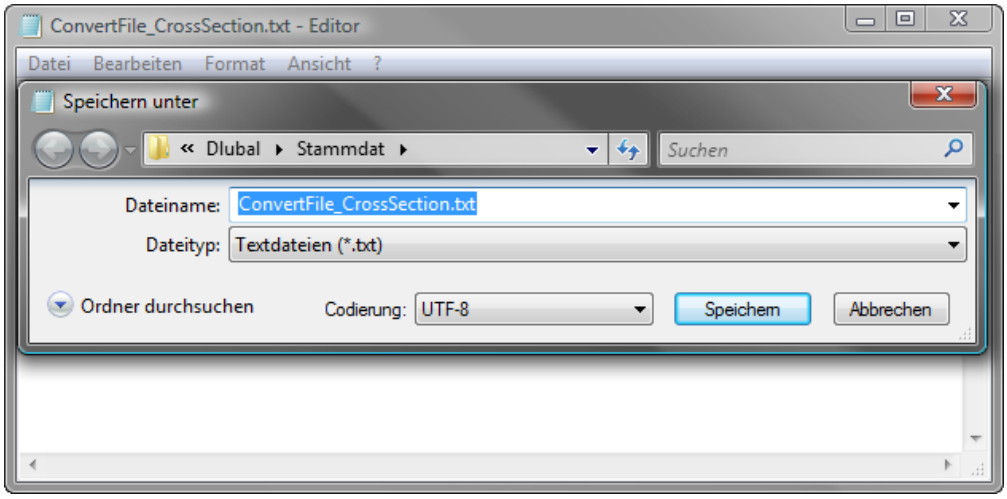


Figure 4.8: Cross-section conversion file

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