VECTORWORKS & FRILO
Workflow for structural analysis

This White Paper from Vectorworks and FRILO is a guideline that offers you an integrated BIM workflow. You will learn how to gradually move from the Architectural model in Vectorworks to the Analytical model in FRILO.

Inhalt

OPEN BIM connects

OPEN BIM is an advanced, future-proof approach to AEC/O collaboration. It helps to connect stakeholders such as software vendors, software users (architects, engineers and building owners) and builders to create great buildings.

Challenges for architects and civil engineers

Architects and civil engineers depend on each other in their day-to-day work. They are usually so busy with their areas of responsibility that there is little time left for the challenges of the other project participants.

That is why all actors in the construction industry struggle with recurring difficulties. Long communication channels, constant planning changes and new coordination are just a few of the points that rob you of time in everyday life. Time that you normally don't have. This creates more and more time pressure, which at the end of the day gives you little freedom for your actual work: the preparation of a high-quality statics model and a thorough verification.

The OPEN BIM approach

The OPEN BIM approach should enable users to exchange data from building models regardless of the software solution used. With continuous work processes over the entire life cycle of a building, project participants should work together in a goal-oriented and efficient manner. One of the most important exchange formats here is the IFC file, which also plays an elementary role in the subsequent workflow between Vectorworks and FRILO.

One thing is very clear: not all users react to the OPEN BIM approach with cheers. Many doubt the suitability of this solution for everyday use and wonder whether the workflows advertised actually work and help to optimize data exchange and save time.

Recognize & understand working methods

An important prerequisite for the OPEN BIM approach is that architects and structural engineers learn from each other, tackle common challenges and recognize and understand new work processes. For this reason, Vectorworks and FRILO have decided to provide users with guidelines that will guide them step by step through an OPEN BIM process. We will show you how you can gradually move from the Architectural model in Vectorworks to the Analytical model in FRILO.

Our solution approach

Record the planning changes immediately

You know this situation yourself. There are constant corrections and innovations in every planning process. With the OPEN BIM approach, however, these changes are recorded immediately and communicated to the various project participants.

Avoid manual transmission errors

When transferring from the Architectural model to the Analytical model, you as a structural engineer can make manual transfer errors. The workflow between Vectorworks and FRILO transfers relevant building data directly, which increasingly minimizes sources of error.

Shorten communication channels

Every communication costs time and energy. Thanks to a consistent workflow, you can shorten these communication paths, leaving you more time for the actual work: structural planning.

Faster project execution

A good project location should actually make every architect and structural planner happy. However, this mood is often clouded by time pressure in complex construction projects. The OPEN BIM approach is intended to support you in making your project management more efficient and profitable again.

More time for the essentials

You chose your job because you enjoy developing the load-bearing structure of a building and understanding static problems. You actually like to dive into complex reinforcement problems and exciting static solutions. Unfortunately, manual processing processes, long communication channels and inefficient project processes rob you of the time for the essentials. With the approach between Vectorworks and FRILO, we would like to give you this freedom back.

The workflow in Vectorworks

A guide for creating a well-structured architectural model as a basis for transfer to the FRILO structural analysis software.

kokliang1981 - stock.adobe.com

Structure the Building model

A basic requirement for the successful export of a structural model from Vectorworks is a well-structured architectural model. Make sure that the building model is built up on a floor-by-floor basis. Make also sure that all load-bearing components are stored in classes in such a way that you can filter for the statically relevant elements before exporting. You can use your own standard for this or structure it according to an existing standard, such as according to the eBKP-H standard (building cost plan building construction), which has up to four standardized levels with cost and reference value definitions.

With the component properties "**Load-bearing**" or "**Outside**" (e.g. for walls and slabs), you can provide the structural engineer with additional information that serves as a basis for his work (dialog window "**Wall Settings**" or "**Slab/Ceiling Settings**", "**Data**" tab).

Prepare architectural model for export

With the help of the structural means in Vectorworks, levels and classes, a shell model can now be created with just a few clicks. The classes required for the design layers can be filtered by simply hiding the classes that are not required. The part of the model that is now visible can then be exported as an IFC file with the option **Export Visible Objects Only**.
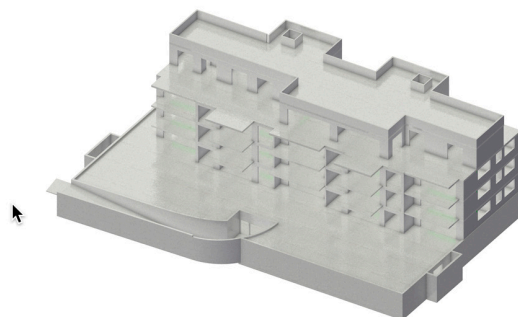
Classes and design layers can either be hidden via the navigation palette (called via the ▸ Window ▸ Pallets ▸ Navigation) or the "Organization" dialog window (opened via Tools ▸ Organization). To do this, click in the corresponding Visibility column next to the relevant class or level.

Design layers that are not required, such as the property, are now hidden, as are the classes that should not be included in the shell model, such as windows and doors, finishing elements or insulation.

With the help of the Save View command (View menu), the visibilities of classes and design layers can be saved and called up for the structural analysis export.

With the Data Visualization, you can check before the export whether the components for the shell model are defined as "load-bearing".
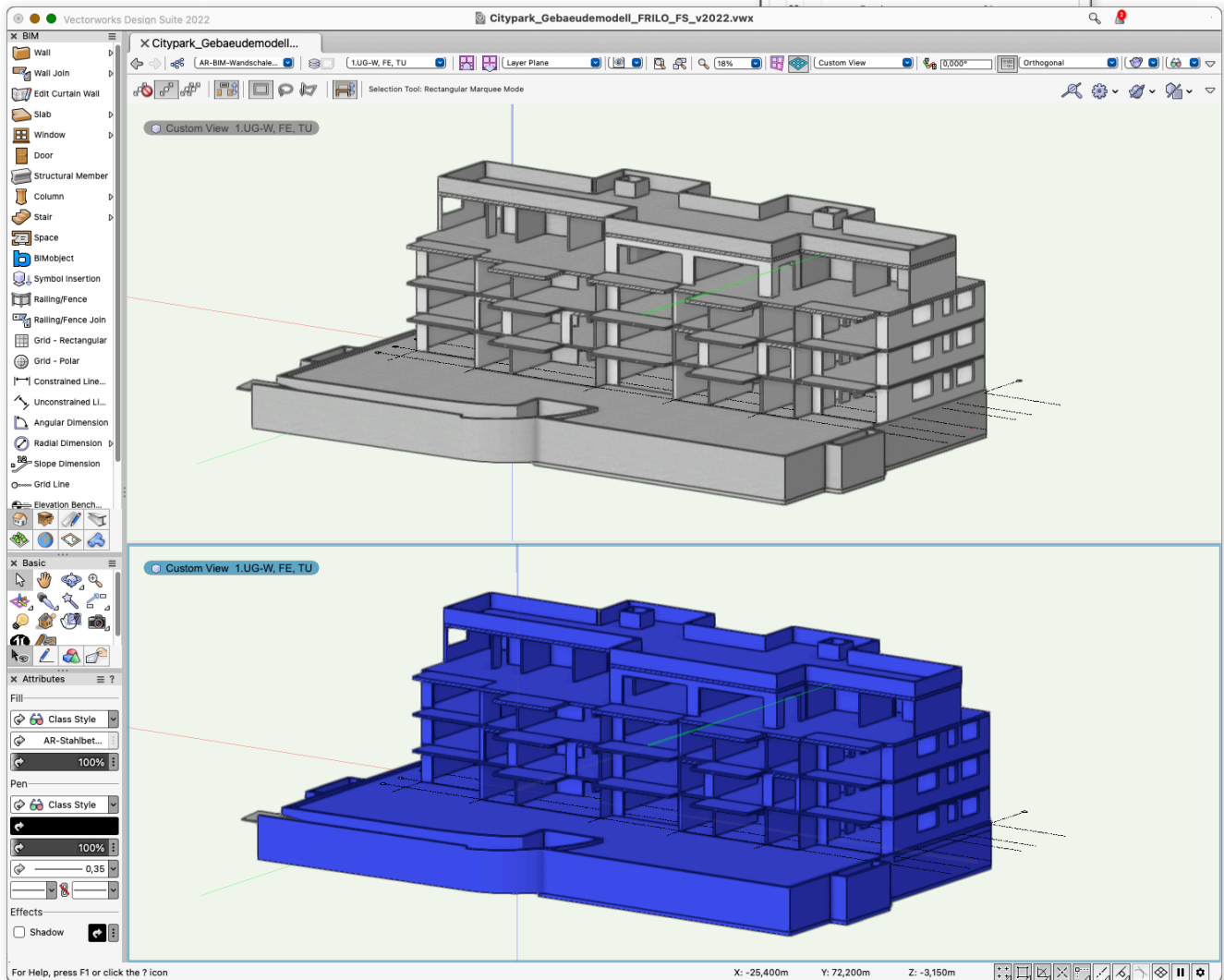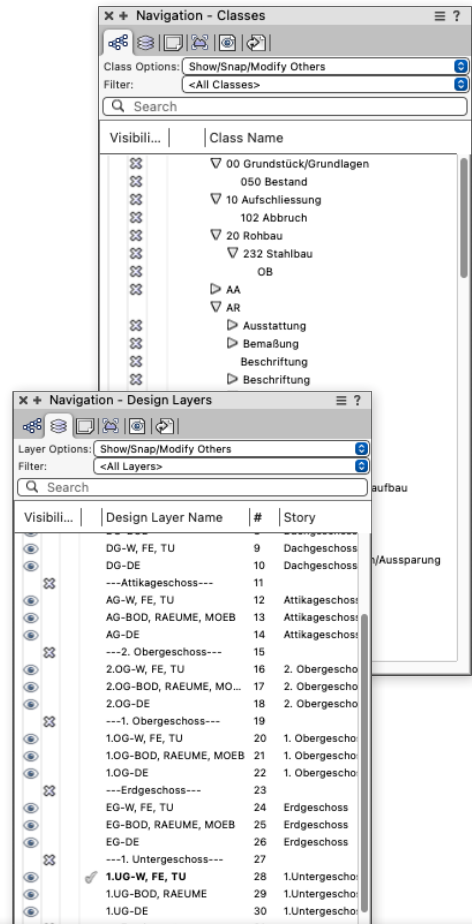
Custom IFC data mapping

Before the physical model is transferred to the FRI-LO structural analysis software, user-defined assignments are assigned to the load-bearing components in Vectorworks. In consultation with the structural engineer, it was decided to enter the architect's material proposal in the "Component 1" field of the IFC "Material" pset. This enables the building materials of the building model to be filtered quickly in the structural analysis software.

With the data manager you can assign the required IFC information to the components. As an example, we will show this in the following using the wall, slab, column and structural member.

If you have already created individual assignments in the data manager, save these under your own assignment scheme.

To do this, open the data manager dialog window (Tools ▸ Data Manager) and assign your own name.

Wall

The IFC property "Material" is assigned to the component. If you are working with the IFC version 2x3, the Pset "Material" must be added to both the "IfcWall-StandardCase" and "IfcWall" entities (IfcWallStandardCase is not applicable for IFC version 4).

The assignment takes place via the name of the core shell of the created wall style.

See the images on the right.

Note: *establish the designation with your structural engineer in advance.*
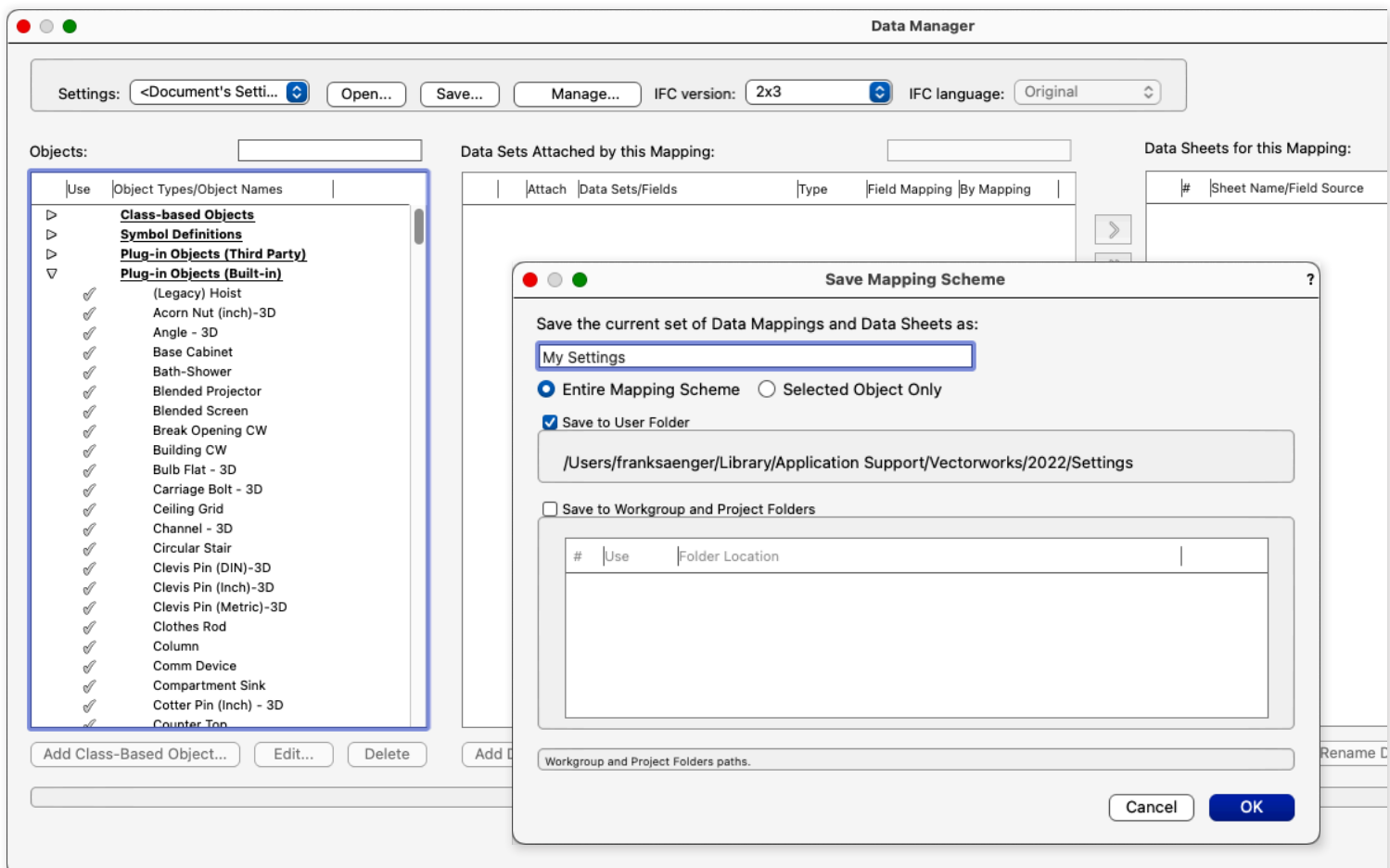*See also page 12, Material assignment.*
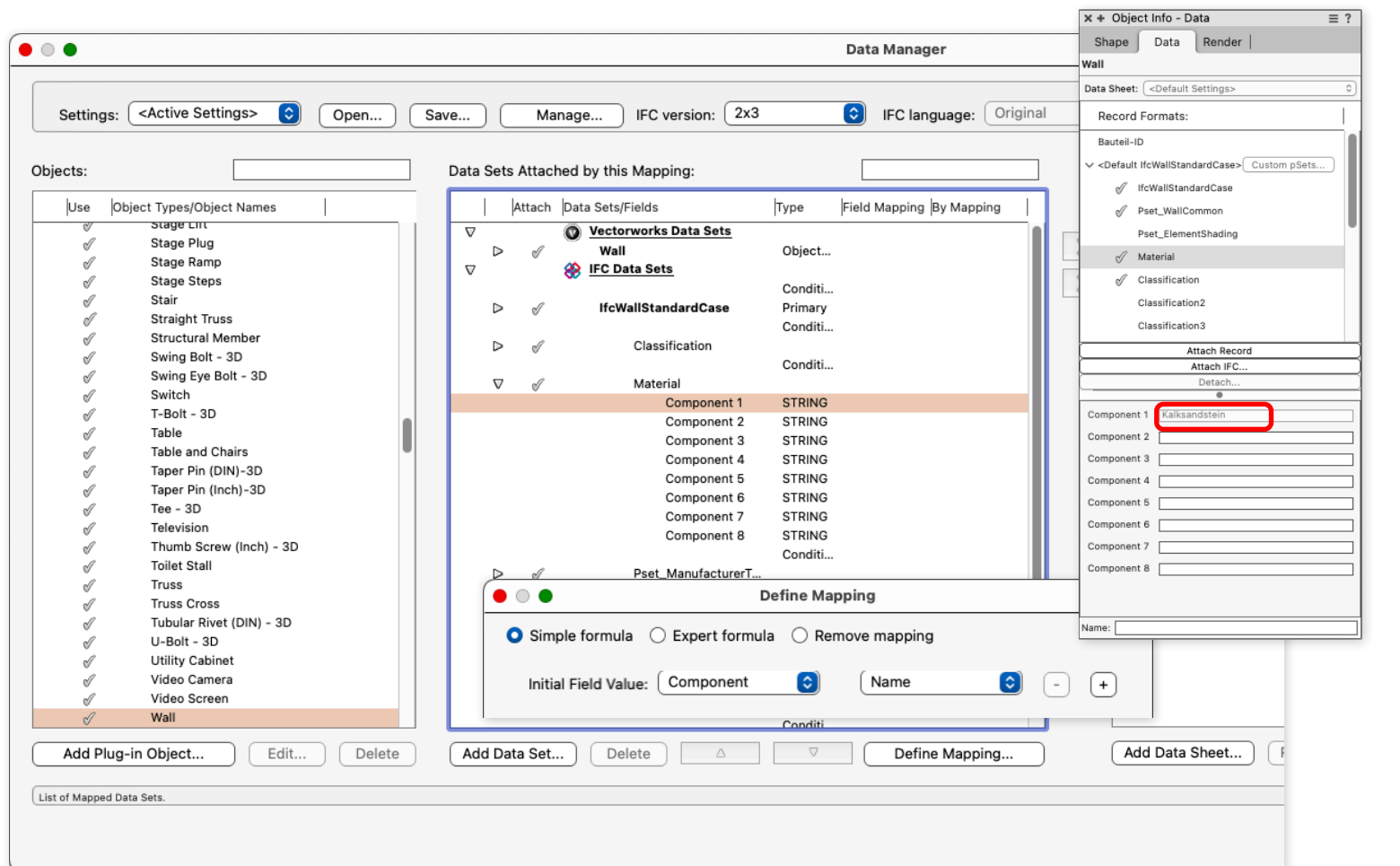

Fig.: Save your own mapping scheme
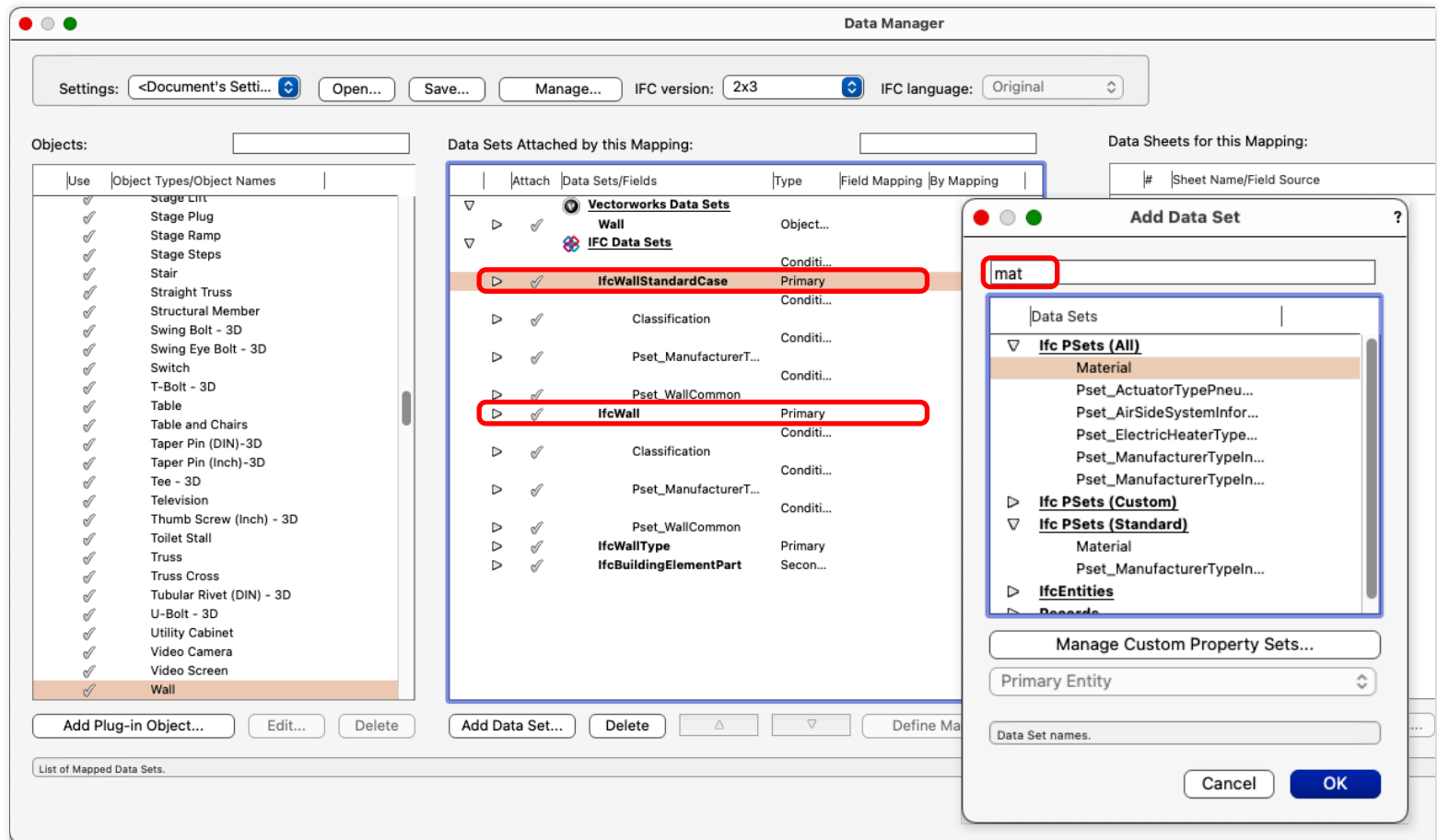
Fig.: Wall data mapping

Floor-/Slab elements

The assignment takes place via the name of the component of the created floor/slab style.

Column

The assignment takes place via the class name of the component.

Structural member

The assignment takes place via the class name of the component for the IFC entities "**IfcMember**" and "**IfcBeam**".

You can save the settings made as a user-defined data set.

Fig.: Save FRILO Mapping scheme

Fig.: Data mapping slab

Fig.: Data mapping Column

Top screenshot — Data Manager / Define Mapping / Object Info - Data (Slab)

Data Manager ?

2x3   IFC language: Original
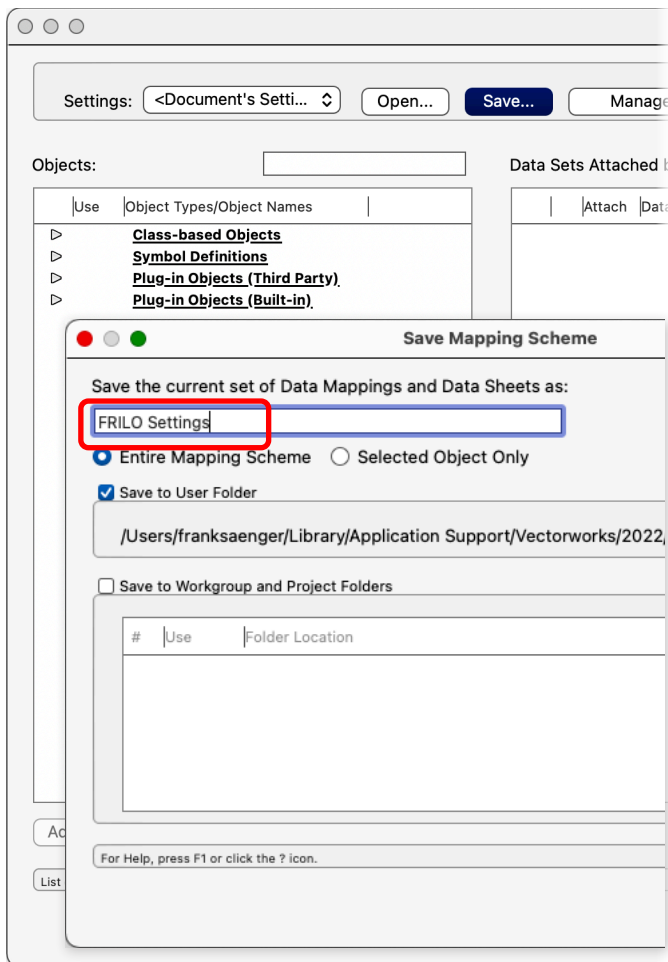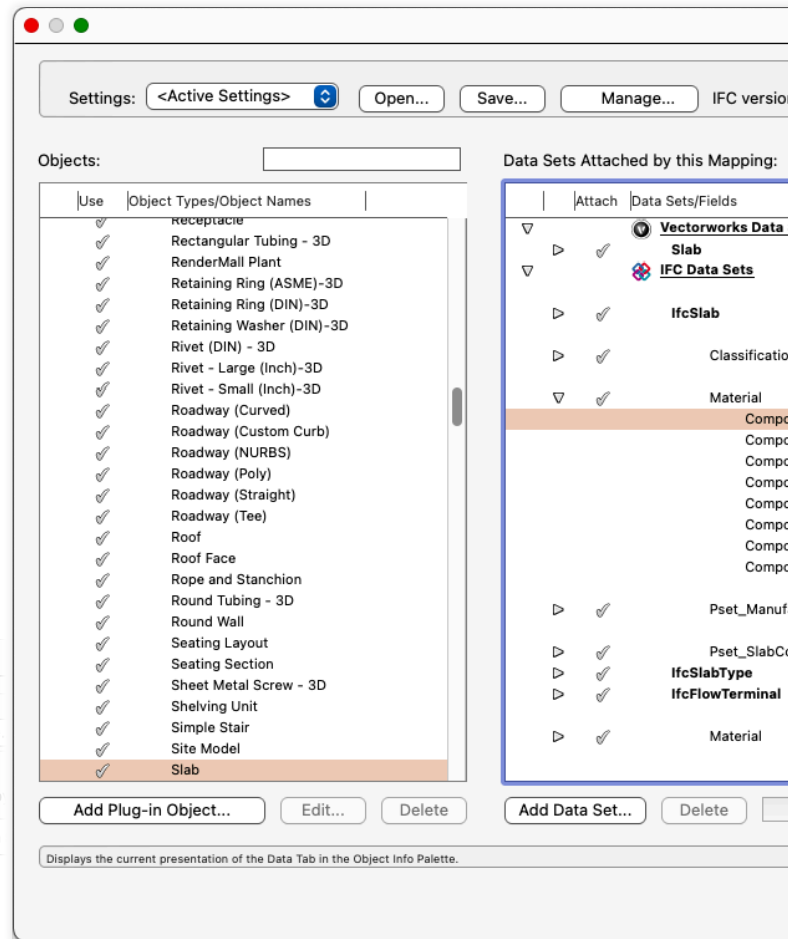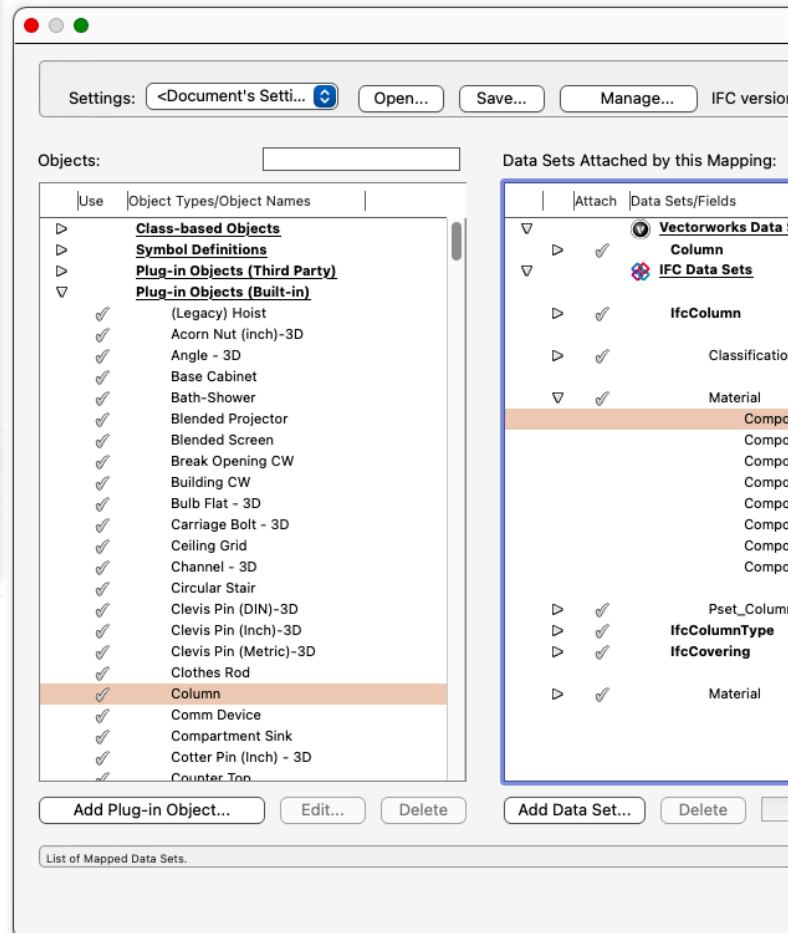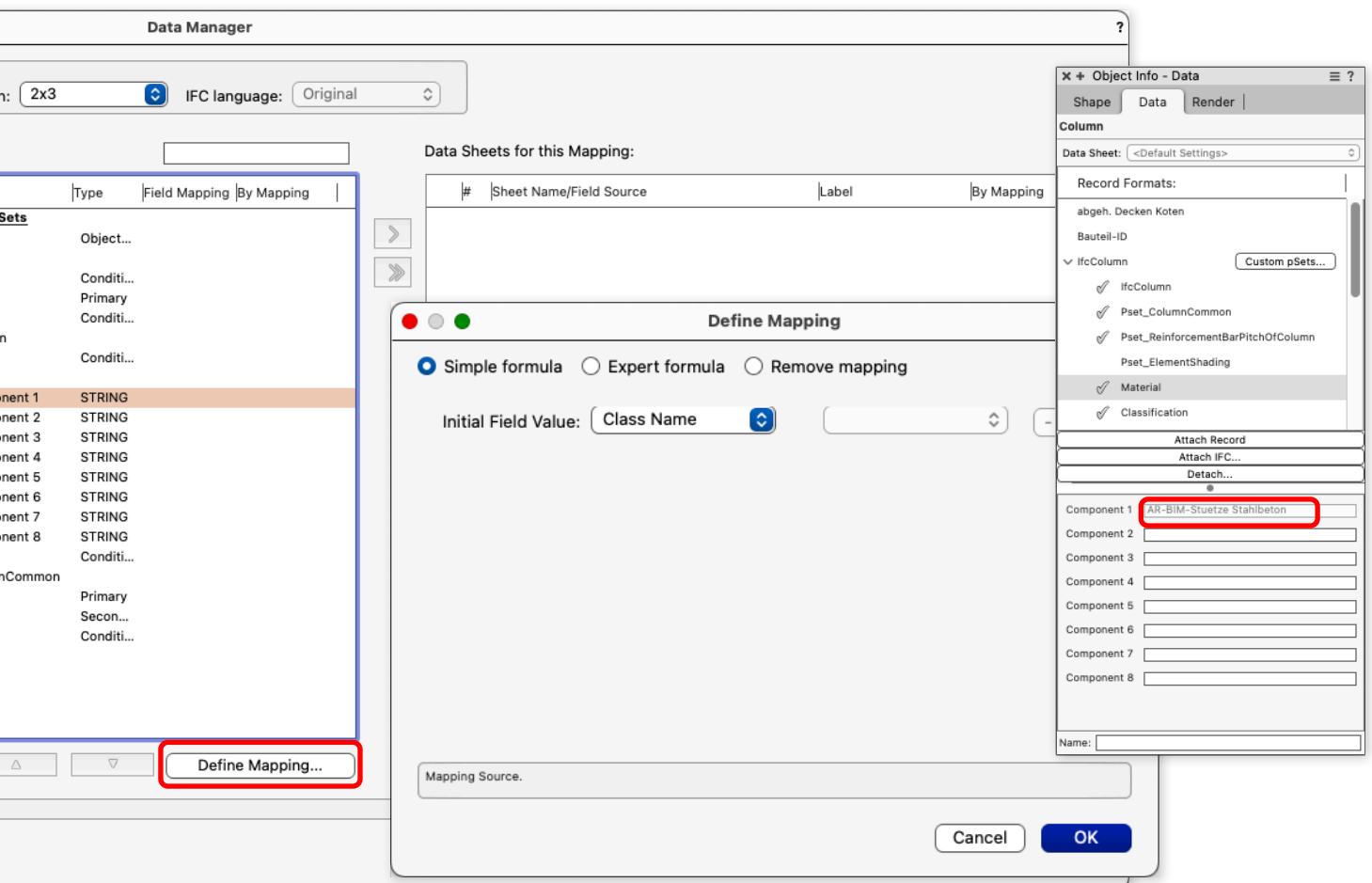
Data Sheets for this Mapping:

#	Sheet Name/Field Source	Label	By Mapping

Type	Field Mapping	By Mapping
Sets		
Object...		
Conditi...		
Primary		
Conditi...		
Conditi...		
...nent 1	STRING	=COMPON...
...nent 2	STRING	
...nent 3	STRING	
...nent 4	STRING	
...nent 5	STRING	
...nent 6	STRING	
...nent 7	STRING	
...nent 8	STRING	
Conditi...		
...acturerT...		
Conditi...		
...ommon		
Primary		
Secon...		
Conditi...		

Define Mapping...

Define Mapping

○ Simple formula   ○ Expert formula   ○ Remove mapping

Initial Field Value: Component   Name   -

Cancel   OK

Object Info - Data   ?
Shape Data Render

Slab

Data Sheet: <Default Settings>

Record Formats:

Bauteil-ID
∨ <Default IfcSlab>   Custom pSets...
  IfcSlab
  Pset_ReinforcementBarPitchOfSlab
  Pset_SlabCommon
  Pset_ElementShading
  Material
  Classification
  Classification2

Attach Record
Attach IFC...
Detach...

Component 1   Stahlbeton
Component 2
Component 3
Component 4
Component 5
Component 6
Component 7
Component 8

Name:

Cancel   OK

Bottom screenshot — Data Manager / Define Mapping / Object Info - Data (Column)

Data Manager ?

2x3   IFC language: Original

Data Sheets for this Mapping:

#	Sheet Name/Field Source	Label	By Mapping

Type	Field Mapping	By Mapping
Sets		
Object...		
Conditi...		
Primary		
Conditi...		
Conditi...		
...nent 1	STRING	
...nent 2	STRING	
...nent 3	STRING	
...nent 4	STRING	
...nent 5	STRING	
...nent 6	STRING	
...nent 7	STRING	
...nent 8	STRING	
Conditi...		
...nCommon		
Primary		
Secon...		
Conditi...		

Define Mapping...

Define Mapping

○ Simple formula   ○ Expert formula   ○ Remove mapping

Initial Field Value: Class Name   -

Mapping Source.

Cancel   OK

Object Info - Data   ?
Shape Data Render

Column

Data Sheet: <Default Settings>

Record Formats:

abgeh. Decken Koten
Bauteil-ID
∨ IfcColumn   Custom pSets...
  IfcColumn
  Pset_ColumnCommon
  Pset_ReinforcementBarPitchOfColumn
  Pset_ElementShading
  Material
  Classification

Attach Record
Attach IFC...
Detach...

Component 1   AR-BIM-Stuetze Stahlbeton
Component 2
Component 3
Component 4
Component 5
Component 6
Component 7
Component 8

Name:
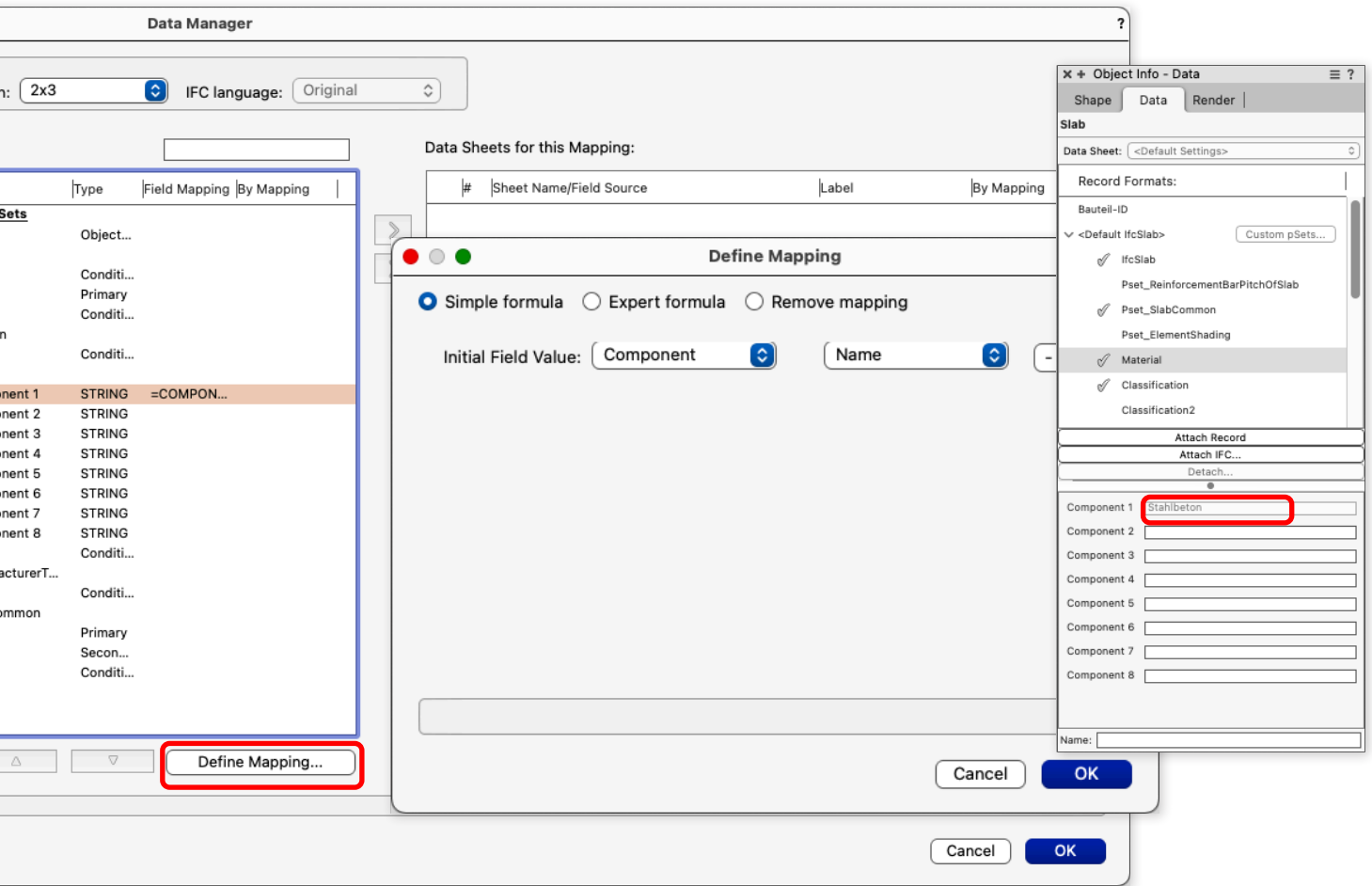
Cancel   OK

IFC export from VECTORWORKS

If the model is properly filtered, it can be passed on to the structural engineer as an IFC file for further processing. All visible objects are exported with the **Export IFC project** command. Follow these steps:

1. Select **File ▸ Export ▸ Export IFC Project**.

2. Make the following settings in the "IFC export settings" dialog box:
   - Select the model view "**Simplified Geometry**".
   - Activate the option **Export Visible Objects Only**. This ensures that only the objects of the layers and classes that are now visible are exported.
   - *Note: the decisive factor is not the current visibility of an object, but the visibility of the design layer or class in which the object is located.*

3. If required, enter the project data in the other categories of the dialog window.

4. Check the assignment of the design layer of the model to the IFC Storeys in the "**Layer Mapping**" tab. So it should make e.g. the design layers and walls of the ground floor assigned to the ground floor Storey.

5. If you click OK, the model is exported as an IFC file.
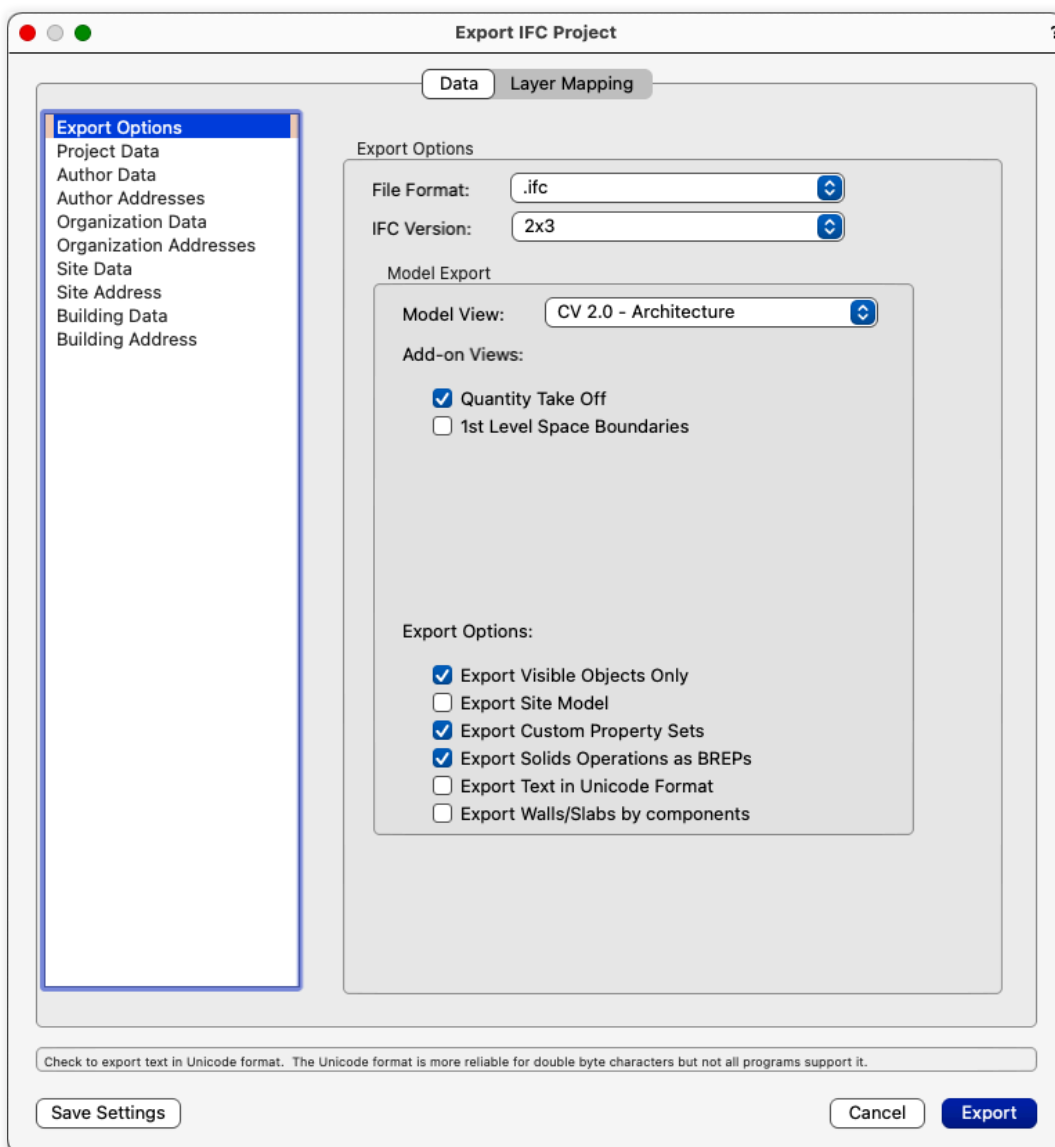
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The workflow in FRILO

From the Architectural model to the Analytical model

IFC import from VECTORWORKS

The basis for working with the FRILO BIM-Connec-tor® (FBC) is a well-structured architectural model that has been reduced to the shell. In the case of a shell model, windows and doors were also hidden in addition to the site. Ideally, the finishing elements and the insulation are no longer available.

Start by opening a File ▸ New (from IFC/SAF).
The physical model of the imported IFC file of the architect opens (*Fig. 1*).

After you have opened the physical model, two important steps follow so that the export to the FRILO programs works correctly.

Step 1: Clean up the Physical model

The physical model for component design is prepared in the FRILO BIM-Connector® (FBC). To do this, it has to be cleaned up.

1. **Remove non-relevant components**
   After the IFC file has been imported, the Physical model should first be cleared of all components that are irrelevant for the calculation. The fastest way to do this is to use the "Load transfer via material" function in the group of functions for load transfer. Here all components relevant for load transfer can be set to *"load-bearing"* and all components irrelevant for load transfer to *"non-load-bearing"* (*Fig. 2*).

2. **Specifications for calculation and material**
   The „Specifications" function offers a convenient way of specifying material qualities. The "Specifications" function can be used to specify material qualities that are to be used if the components have not been explicitly assigned a material quality. Furthermore, the corresponding design standards can be specified here (see *Fig. 3*).

3. **Assign the material**
   Another option for defining materials or quality of material is offered by the „Material" function in the ribbon bar. The materials used are shown in different colors. Gray components consist, for example, of concrete or pink components of masonry. The red components are still missing any material assignment. With the help of the various selection and display options (visibility, model structure, etc.), for example, all walls can be selected in no time at all. With the help of the „Material" (properties) function, all selected walls can be assigned the appropriate material and the associated material quality with one click (*Fig. 4*).
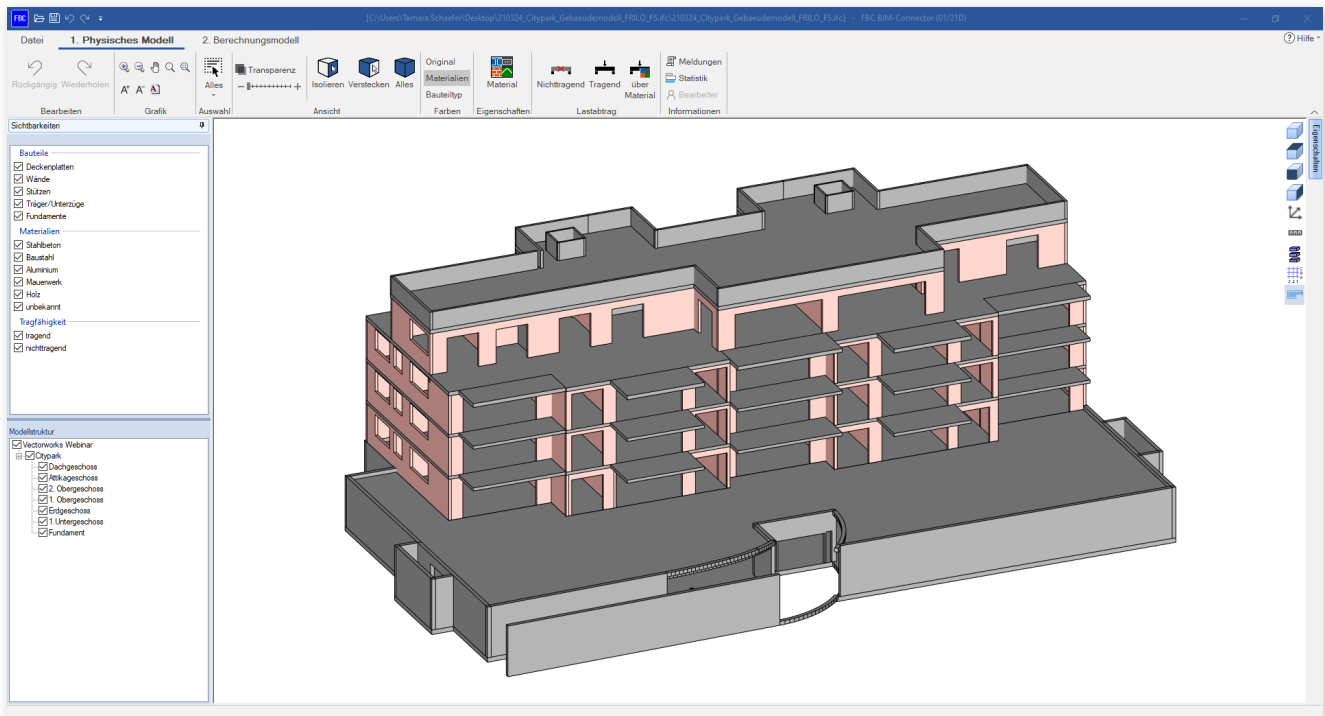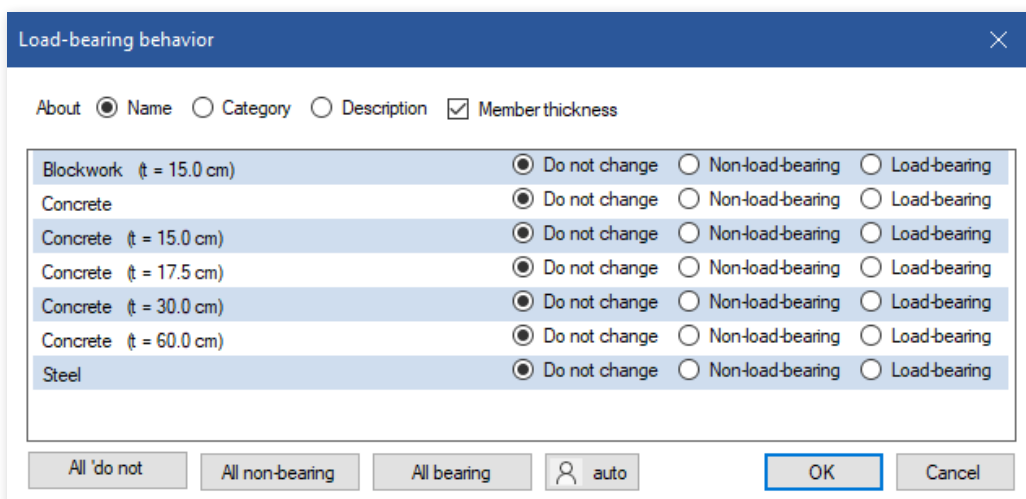
Fig.1: The imported Physical model

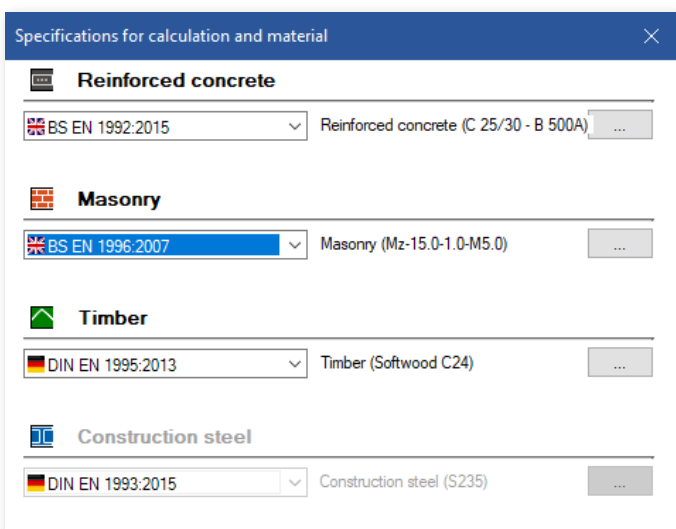Fig. 2: Set non-relevant components to „non-load-bearing"

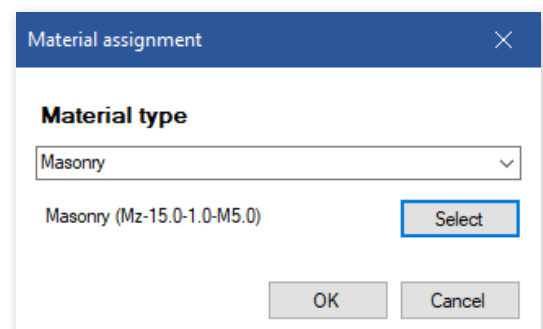Fig. 3: Define material qualities

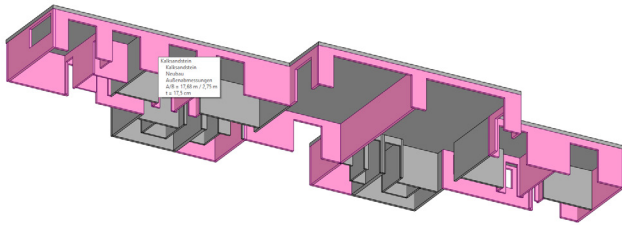Fig. 4: Assign the material

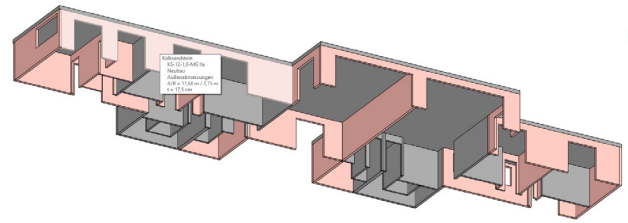Fig. 5: Components without material quality

Fig. 6: Components with assigned material grades

As soon as all components have the correct materials (*Fig. 5 and 6*) and the model has been cleared of the non-load-bearing components, you can switch to the Analytical model. Only the load-bearing components are shown there.

Step 2: Adapt the Analytical model
In the second step, the Analytical model is adapted. Various functions serve as the basis for this:

1. Join - intersect gravity lines
Finally, all that remains is to cut the components together. The "Join automatically" function is suitable for this (*Fig. 7*). Depending on the size and complexity of the building, it is also advisable to use the "Join" function only for the floor in question, as a great deal of data is processed with this function.

2. Move components
Axis-related modeling is particularly important for vertical load transfer. With the „Move components" function, the component axes can be pushed over one another so that the loads can be passed on.
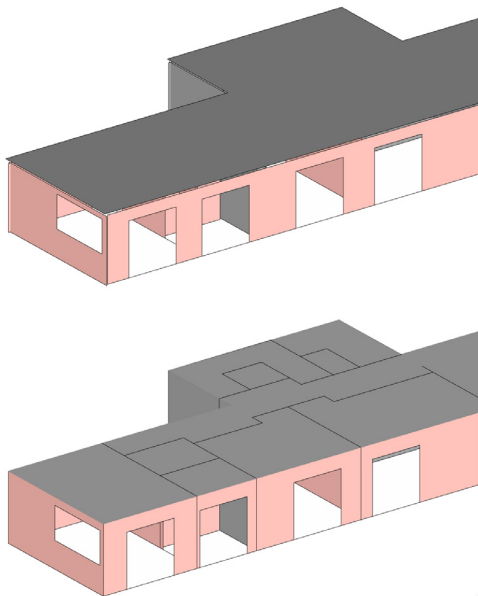
3. Disassemble walls
Using the "Disassemble walls" function, either all walls at once or only the selected walls can be divided into strips or individual components according to their openings (function "... into wall strips", *Fig. 8*). This means that existing openings can be taken into account in the Analytical model.
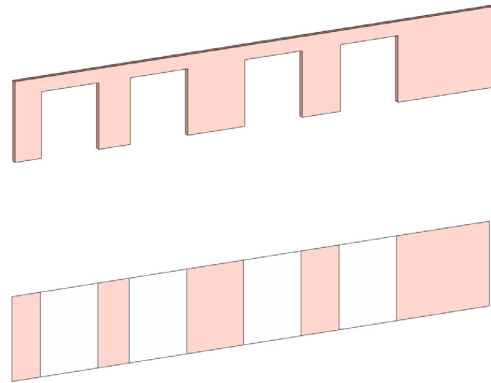

Fig. 8: Division into wall strips

4. Calculated thickness
Using the "Thickness" function, surface elements (walls, floors) can be assigned a new calculated thickness.

5. Conversion
With the „Conversion" function, flat components can be converted into rod-shaped components and vice versa.

6. Clean up the geometry
With the „Reset geometry" function, small recesses and openings as well as small beam sections, columns, walls and slabs, which should not be taken into account in the static calculation, can be removed.

Fig. 7: Unconnected (above) and connected components (below)

Step 3: Export to the FRILO programs

After clearing of the Physical model and preparing the Analytical model, a component can be selected in the next step and either transferred to FRILO dimensioning program

1. via the **export button** or

2. via right-click ▶ **Export**.
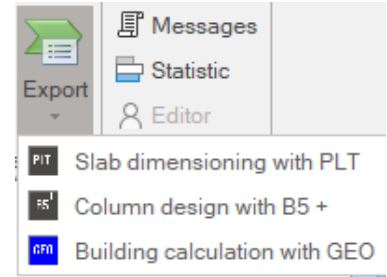
If no component is selected, all components from the Analytical model are automatically transferred to the GEO Building model. The component design then takes place in the Analytical program.

Frequently asked questions

▪ **Which FRILO design programs are linked to the BIM-Connector®?**

In the 2021-1 release, the BIM-Connector® is connected to the PLT Panel Program and the Reinforced Concrete Column B5+. With the 2022-1 release, the FRILO Building model GEO will also be connected.

▪ **Which file formats can the BIM-Connector® import?**
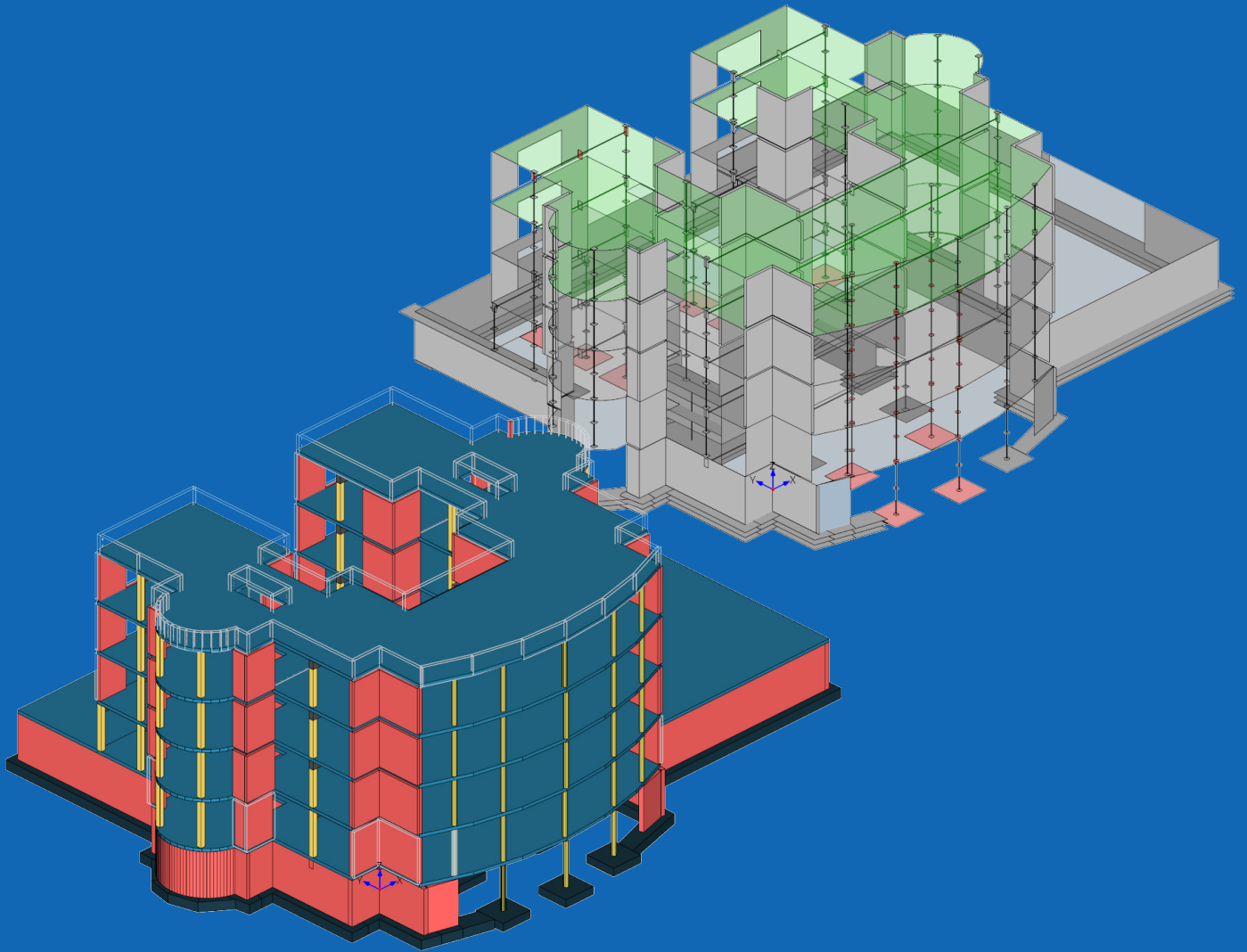
The BIM-Connector® can import both IFC files (IFC 2x3 and IFC4) and SAF files.

▪ **Which settings when exporting the IFC models from a CAD program favor the import into the BIM-Connector® FBC?**

The quality of the derived Analytical model depends heavily on the underlying IFC model.
The best results are obtained when the model:
- only includes the shell (e.g. IFC Design Transfer View, IFC Reference View)
- is well structured
- uses the relevant component types
- the components have assigned a material (at least material name)