

## ALLPLAN & FRILO OPEN BIM workflow for structural analysis

This White Paper from ALLPLAN and FRILO is a guideline that offers you an integrated BIM workflow. It describes and explains step by step, how to get from the building model in Allplan to the analytical model in FRILO and which specifications have to be considered.

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## Part 1: The Building Model within Allplan

Concerning BIM compliant project development, one of the most common use cases is the handover of the architectural model to the structural engineer to perform the structural analysis. Looking at the data exchange between Allplan and FRILO, the IFC format is used for this task.

Thus, an IFC model that is aligned to the special needs and requirements of the FRILO BIM-Connector® (FBC), forms the basis for efficient collaboration. It is necessary to pay attention to some specific parameters when creating the model as well as adapt the export options in accordance with them. They are based on the overall principles for the creation of IFC compliant building models with and in Allplan.

### Data structure

Concerning the structure of the data means, that it is necessary to use a building structure (BWS). All model components intended to be exchanged are stored in drawing files included in the **left** side of the structure. The hierarchical order of the structure must be correct and it divides the building into single storeys. They have to be arranged in ascending order (foundation at the bottom). The height definition of each of the storeys should be **direct** if possible, which means that the levels from the level manager are assigned to the corresponding structural levels.

Building structure		Building structure <input checked="" type="checkbox"/>	
Building structure		Elevation at bottom	Elevation at top
webinar Allplan-Frilo			
Liegenschaft		-2.0000	16.0000
Gebäude		-	-
1 axis grid		-2.0000	16.0000
▶ <input checked="" type="checkbox"/> Erdgeschoss		-0.1000	3.4000
▶ <input checked="" type="checkbox"/> 1. Geschoss		3.6000	6.9500
▶ <input checked="" type="checkbox"/> 2. Geschoss		7.1500	10.5000
▶ <input checked="" type="checkbox"/> 3. Geschoss		10.7000	14.0500
▶ <input checked="" type="checkbox"/> Dachgeschoss		14.2500	15.2500
▶ <input checked="" type="checkbox"/> Dach-Aufbau		14.2500	15.2500

Figure 1: Height definition of the storeys in the building structure (BWS)

It makes sense to store slabs and beams in a separate drawing file with a different level reference. For the transfer to FRILO it is necessary to assign these files as **slab above** the respective storey, as each of the storeys is considered as a separate static system.

▶	✓	Edgeschoss		-0.1000	3.4000
▼	✓	1. Geschoss		3.6000	6.9500
		21	column, wall		
		22			
		23			
		24	slab	6.9500	7.1500
		25			
▼	✓	2. Geschoss		7.1500	10.5000
		31	column, wall		
		32			
		33			
		34	slab	10.5000	10.7000
		35			
▶	✓	3. Geschoss		10.7000	14.0500

Figure 2: Slab drawing file with different level assignment

As far as possible objects and model components should be placed directly within the storey they belong to. Building components spanning above more than one storey are either split or, analogous to more general objects such as axis grids, stored in the drawing files in the structural level of the building.

## Modeling

The overall principle when creating the building model is that basically everything is modeled in the same way as it would be built in reality. First and foremost, this is the case concerning the intersection and delimitation of the components and **not** that much the detailing. For these a reasonable level of abstraction should be chosen instead, adapted to the respective planning phase and the intended use.

All components of the building model have to be classified as wall, slab, beam or footing according to their intended function, otherwise they will not be recognized as such in the FRILO BIM-Connector®. The easiest way to do so is in using the appropriate Allplan tool.

If objects are created either in using free modeling or tools in a different way than they are intended (for example a slab to model a footing), than classification is carried out by assigning the attribute IFC Object type and selecting the appropriate entry from the pull-down list.

Relevant for the structural analysis and the handover to FRILO are only particular objects:

- IfcWall
- IfcBeam
- IfcColumn
- IfcSlab
- IfcFooting
- IfcRoof
- IfcMember (vertical bar-shaped component)

It is **not sufficient** to just name free modeled components in using the attribute object name or name for example, as only when using the IFC Object type they will be really converted. There is also a possibility of a deeper classification using an ObjectSub-type, but this could not be interpreted by the FRILO BIM-Connector® and therefore is not necessary.

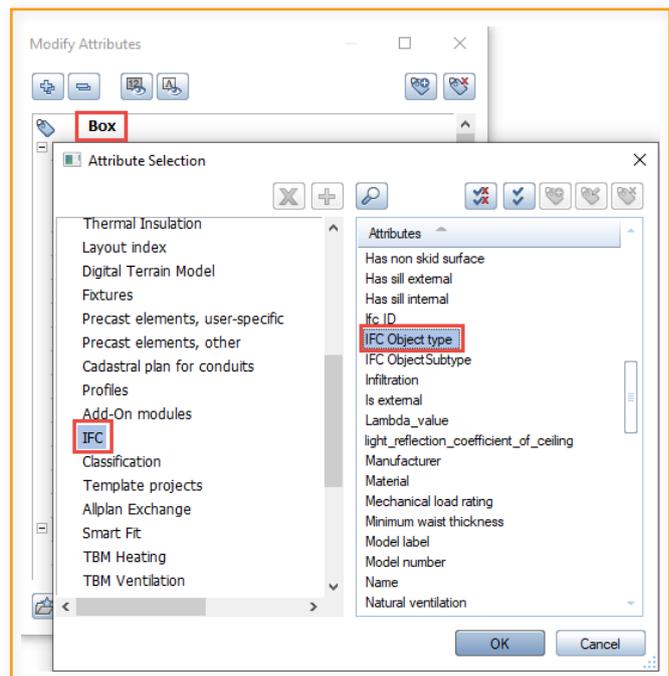


Figure 3: Classification by the attribute IFC Object type

Each individual object has to be modeled exactly and without any overlap or intersection. To create openings and recesses it is recommended to preferably use the appropriate Allplan tools, Boolean operations or Area deductions should only be used if necessary. In order to be able to transfer only a pure building shell it is necessary to assign the single components of multi-layer objects to different Allplan layers.

The tools Collision Check and Mark Critical Model Data (Fig. 5) can be used to check the quality of the model directly in Allplan before transferring it. This way it can be ensured that it is free of errors and overlapping, etc.

Number	Thick...	Height	R	Material/qualities	Trade
1	0.1200	3.5300	↕	rock wwool	Ext. insulation finish systems
2	0.1750	3.3500	↕	C25/30	Concreting work

Number	Pen	Line	Color	Layer
1	0.70	1	146	AR_DAEMMU
2	0.50	1	1	AR_WD

Figure 4: Single layers with different layer assignment

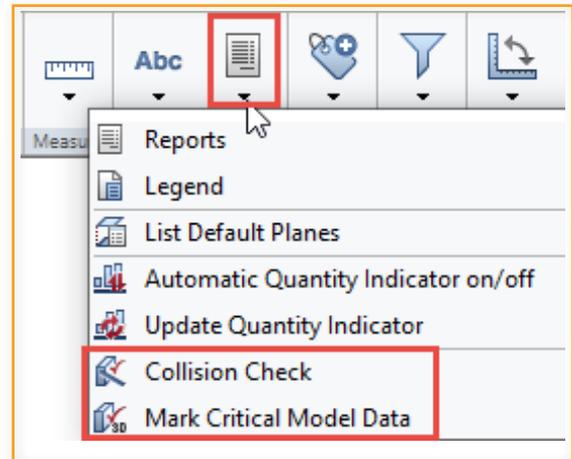


Figure 5: Allplan intern tools for quality control

## Attribute assignment

Based on the exact modeling and correct classification all building components should be provided with the set of „common properties“ (PSetCommon) given in the IFC definition. These sets contain information about the location (interior/exterior), building alteration status or category, fire behaviour, load-bearing capacity, etc.

Of particular importance for the transfer to the analytical model is the attribute „load-bearing“ (Fig. 6), which should be assigned to and filled in all objects intended to be exported. With this all objects not statically relevant can be directly identified and filtered out during import into the FRIL0 BIM-Connector®.

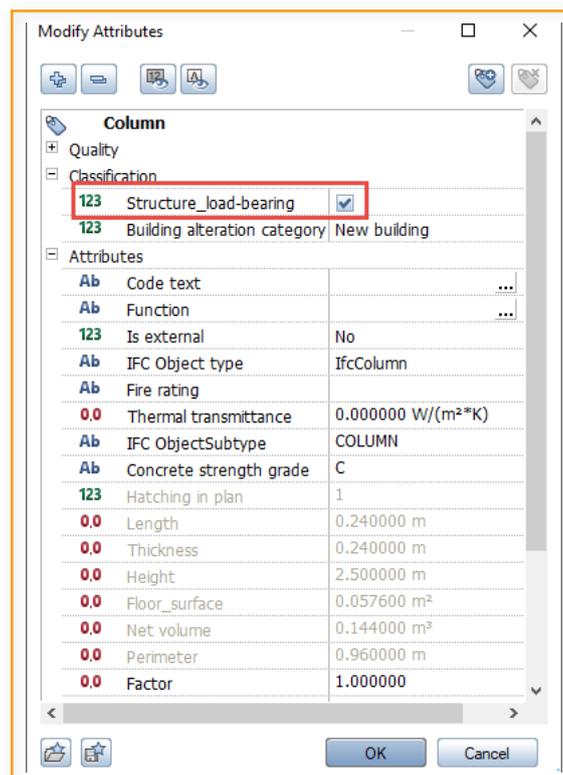


Figure 6: Attribute load-bearing defines the load-bearing capacity

Beyond that, the specification of the material is mandatory, even if this is not a property defined as „common“ in IFC. It is recommended to use the attribute from the Allplan standard with the similar name, the value should be specified as precisely as possible. For that matter preferably common descriptions and abbreviations should be used.

As with the object types, in case of the material also only some of them are relevant for the statics and structural analysis:

- (reinforced) concrete
- timber
- masonry
- construction steel
- (aluminium)

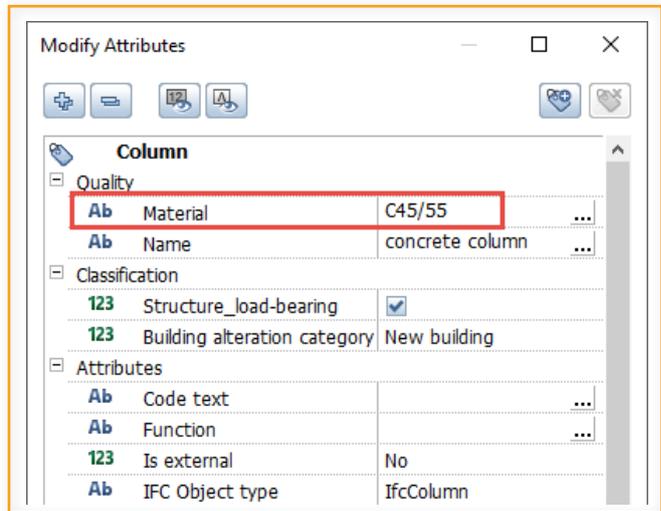


Figure 7: Input of the precise material descriptions

The precise material descriptions have been predefined as a catalogue in the FRILO BIM-Connector® and can be adopted directly, if the value corresponds to one of its entries. Otherwise a manual assignment is necessary. The table in the appendix gives an overview, which descriptions are taken into account for which materials.

## IFC Export

Currently the format IFC 4 is recommended for the export. As only load-bearing components or component layers and no finishes or furnishing objects are relevant for the analytical model the export of a pure building shell is recommended as well. It allows to reduce the size of the IFC file to the necessary extent and minimize the effort needed for the data import into the FRILO BIM-Connector®. If the single components of multi-layer objects have been assigned to different Allplan layers, the not relevant ones (insulation, cladding, ...) must be hidden **before** starting the export, as the current layer visibility is taken into account.

In contrast, the current drawing file selection is not relevant, as they could be chosen in a separate dialog window during the export.

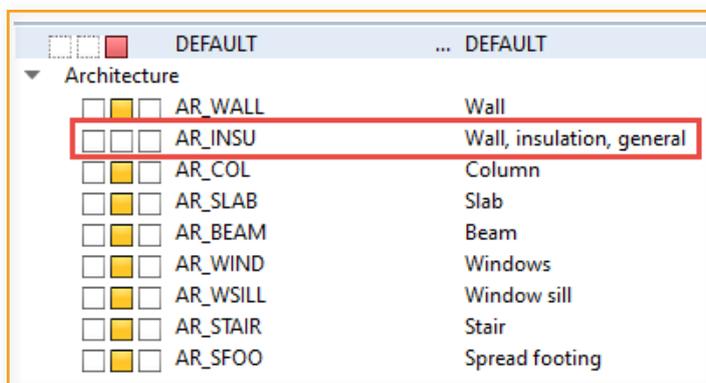


Figure 8: Setting the layer visibility for export

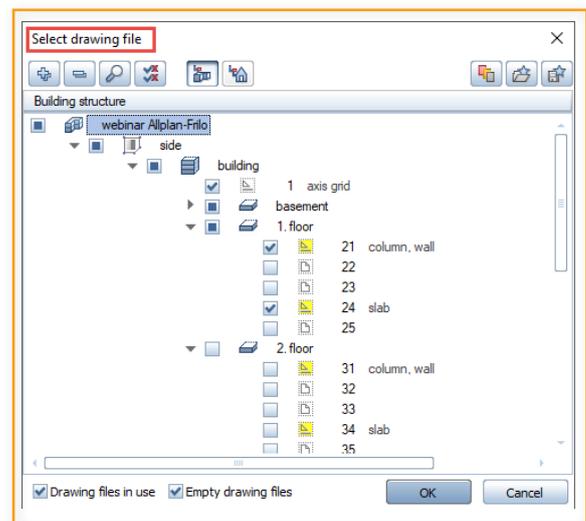


Figure 9: Selection of export partial images

The second filter possibility results from the object filter in the export options (Fig.10). Here, only shell objects should be ticked and the finishing as well as door and window objects should be deactivated. In addition, the separation of walls into individual layers must be set in the „**advanced options**“, but the grouping must be suppressed.

Only objects that are correctly classified as individual building components could be recognized and imported into the FRILO BIM-Connector®. On the other hand, groups of building components cannot be interpreted or desintegrated. For this reason it is mandatory to set „**supress grouping**“ here (Fig.11).

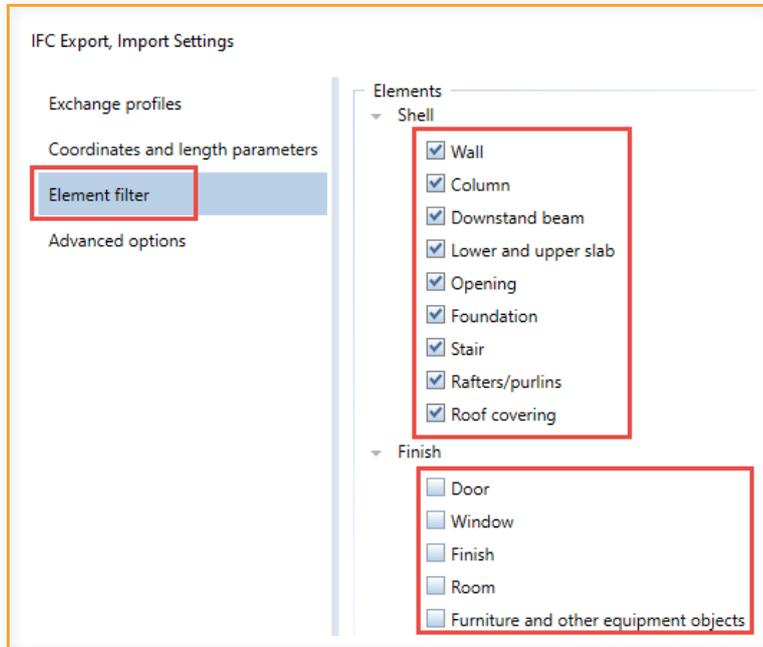


Figure 10: Filtering of object types for export

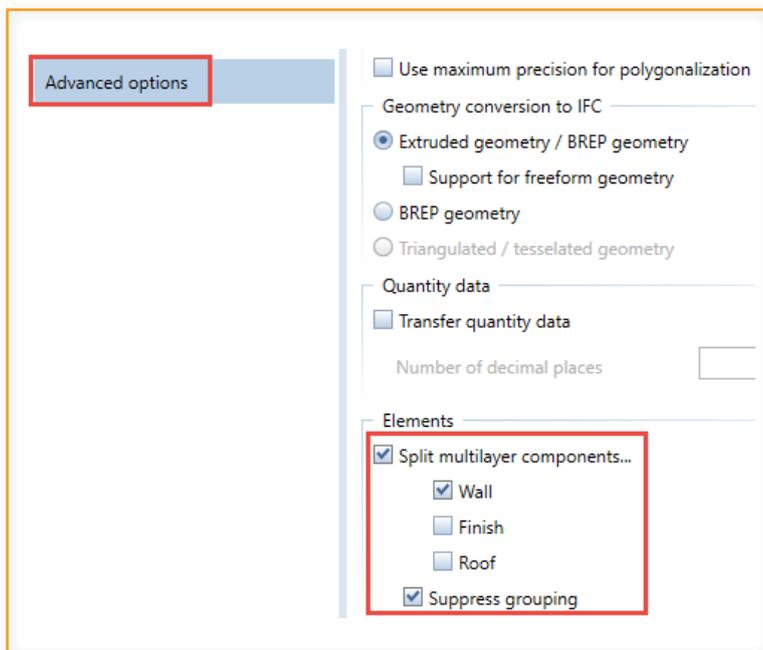


Figure 11: Option to split multilayer components

If all these parameters and specifications are applied correctly from the beginning, the entire workflow and data exchange between Allplan and FRILO can be optimized to achieve the best possible result for everyone involved.

## Part 2: Analytical Model in FRILO

The workflow in the FRILO BIM-Connector®

If all the steps mentioned above have been followed in Allplan, the structural engineer receives a well-structured building model that has been reduced to the shell. Now it is time to import the generated IFC file into the BIM-Connector® (FBC) and check it.

### IFC Import

Start by opening a new **File ▶ New (from IFC/SAF)**

The Physical model of the imported IFC file opens (Fig. 12).

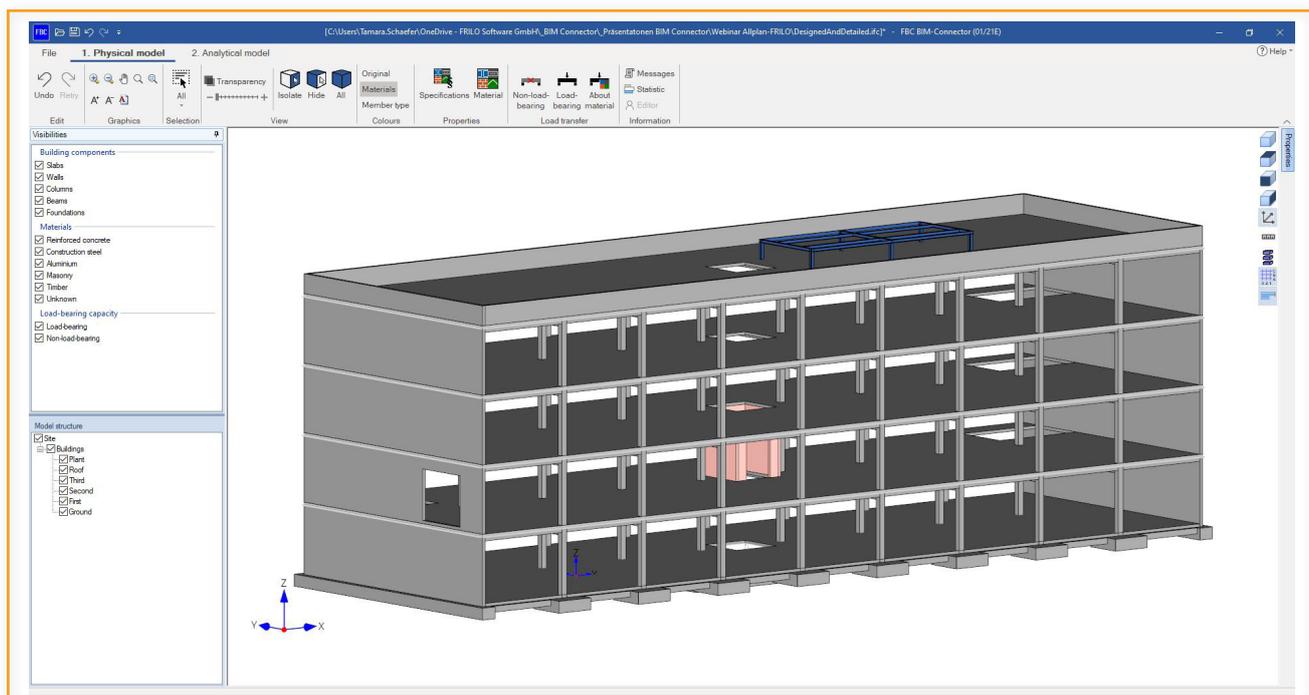


Figure 12: The imported Physical model

After you have opened the Physical model, it must first be adapted and prepared so that the export to the FRILO programs works correctly.

## Adjust the Physical Model

The Physical model for component design is prepared in the FRILO BIM-Connector® (FBC). For this purpose, certain adjustments have to be done.

### 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 as „**load-bearing**“ and all components-irrelevant for load transfer as „**non-load-bearing**“.

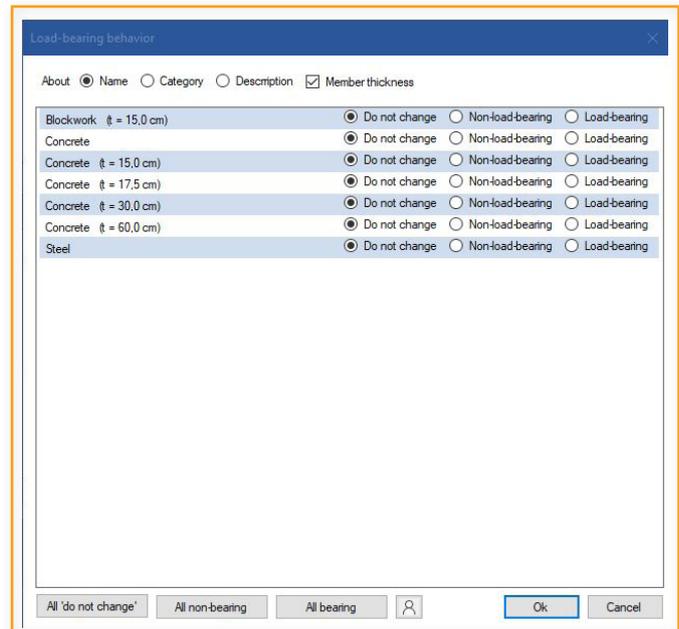


Figure 13: Relevant and non-relevant components

### Assign the material:

Next, it is advisable to assign the correct materials and their material grades to the components, if these are not yet set in the IFC file. The materials used are shown in different colors.

Gray components, for example, consist of concrete, 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.

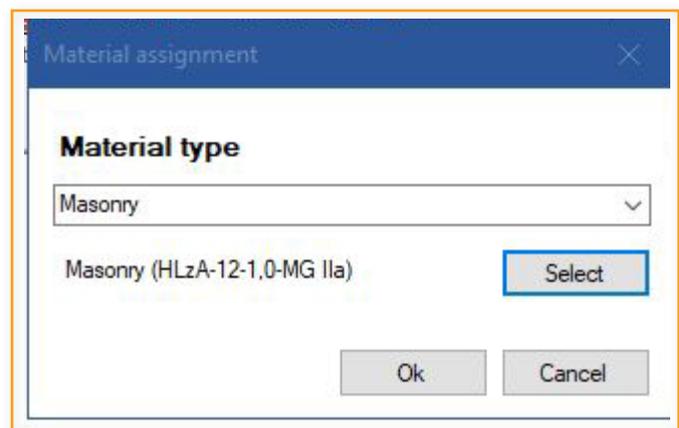


Figure 14: Assignment of the material

As soon as all components have the correct materials assigned and the non-load-bearing components have been removed, you can switch to the Analytical model. Only the load-bearing components are displayed there.

## Adapt the Analytical Model

In the second step, the analytical model is adapted. Various functions serve as the basis for this:

### Join – connect centre lines

Due to the derivation of the Analytical model from the Physical model, the components are not yet joined. The „**Join automatically**“ function is suitable for this. 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 lot of data is processed with this function.

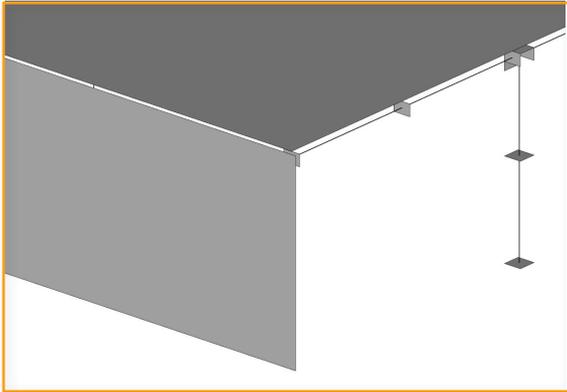


Figure 15: Unconnected components

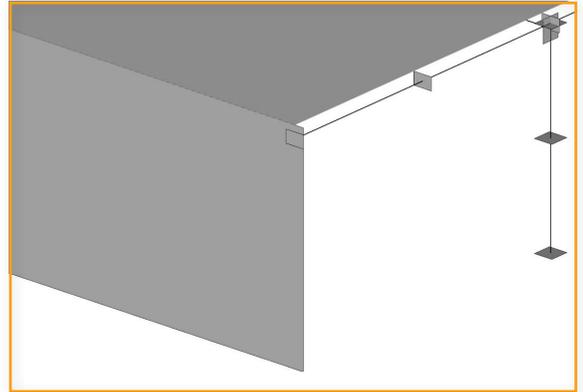


Figure 16: Connected components

### Wall splitting / Openings

With the function „**wall editing**“, either all walls at once or only the selected walls can be edited in different ways with regard to their openings. This means that existing openings can be considered in the Analytical model.

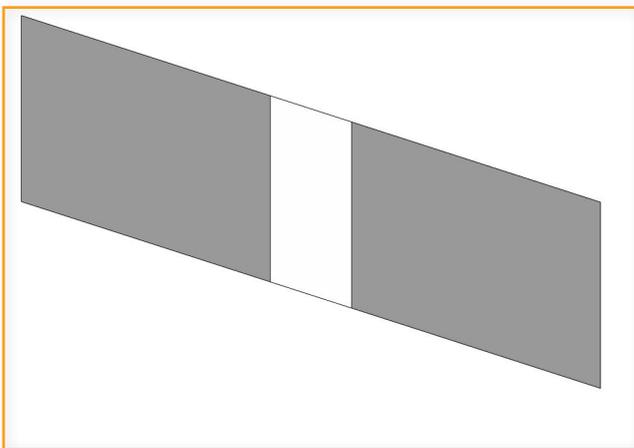
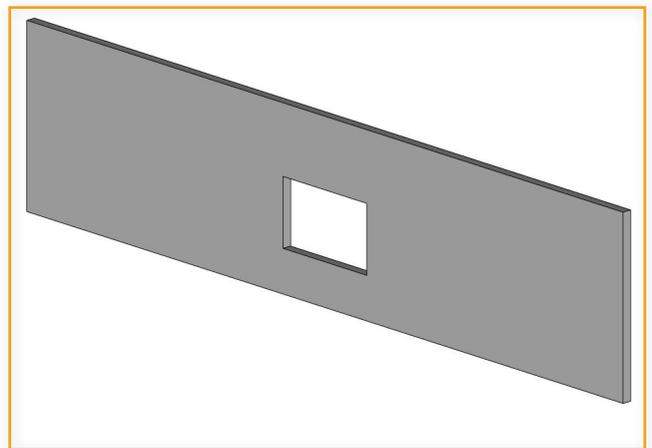


Figure 17: Split into wall strips



### Calculated thickness

Using the „**Thickness**“ function, surface elements (walls, floors) can be assigned a new calculated thickness.

## Export to the FRILO Programs

After adjusting the Physical model and preparing the Analytical model, a component can be selected in the next step and transferred:

1. either by the Export button
2. or by a right-click - Export to FRILO design program.

# Appendix

## Frequently asked questions

### Which FRILO programs are linked to the BIM-Connector®?

In the 2021-1 release, the BIM-Connector® is connected to the slab program PLT and the reinforced concrete column B5 +.

### Should further programs be connected to the BIM-Connector®?

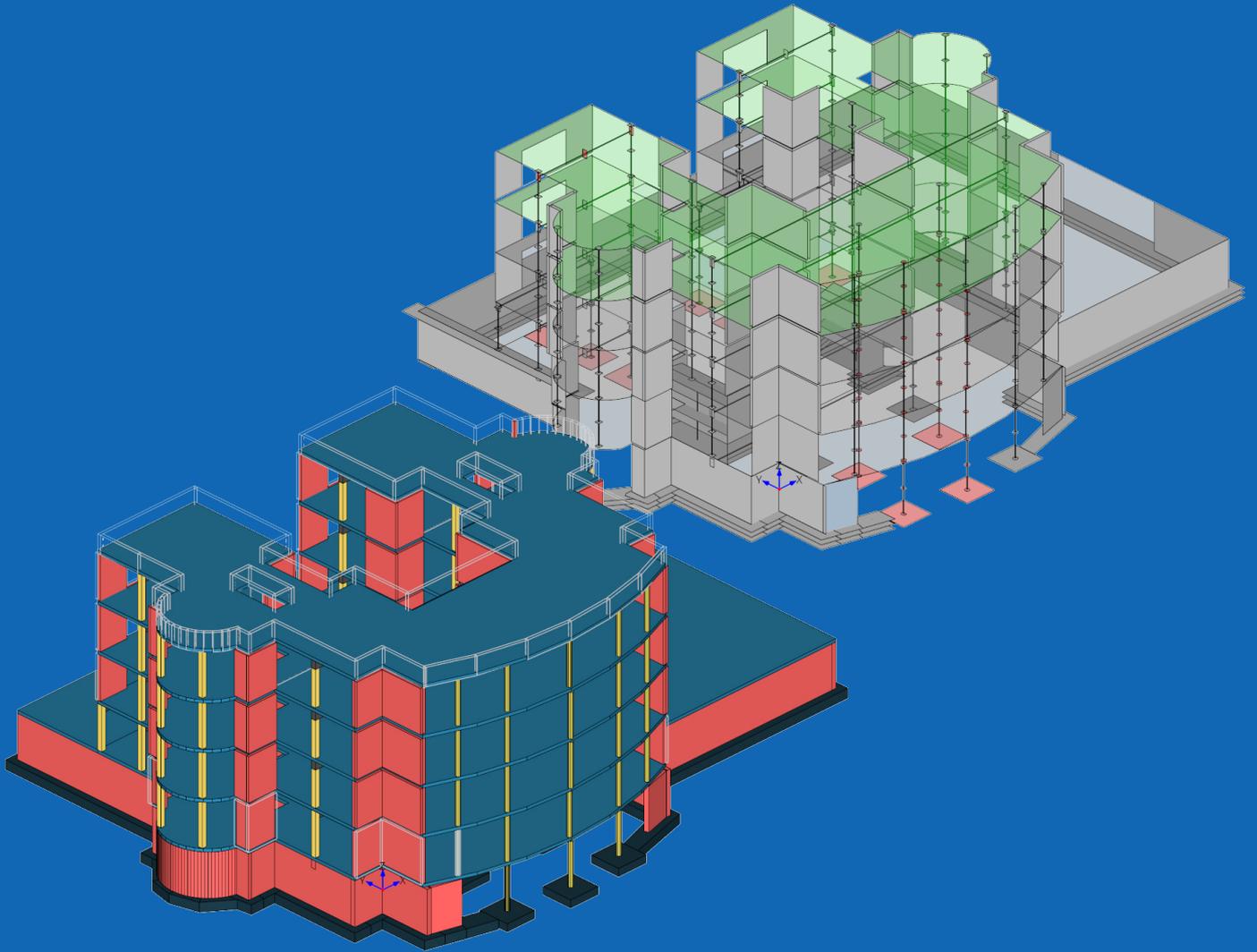
In the following releases, in addition to the building model GEO, the continuous beam DLT + and the masonry programs will be connected.

### Which file formats can the BIM-Connector® read in?

The BIM-Connector® can import both IFC files (IFC 2x3 and IFC4) and SAF files.

## Material table

Material	Name components	Concrete material description
Reinforced Concrete	„concrete“	Naming scheme: Cxx/xx bzw. LCxx/xx e.g. C25/30 oder LC20/22 (all common material grades)
Masonry	„masonry“ „brick“ „blockwork“ „clinker“ „aerated concrete“ „poroton“ „bisotherm“	
Steel	„steel“	Naming scheme: Sxxx e.g.. S235 (all common material grades)
Timber	„timber“ „glulam“ „osb“	
(Aluminium)	„aluminium“	non



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