



BIM based quality assurance and efficiency design

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www.built2spec-project.eu



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The BIM methodology

Definition

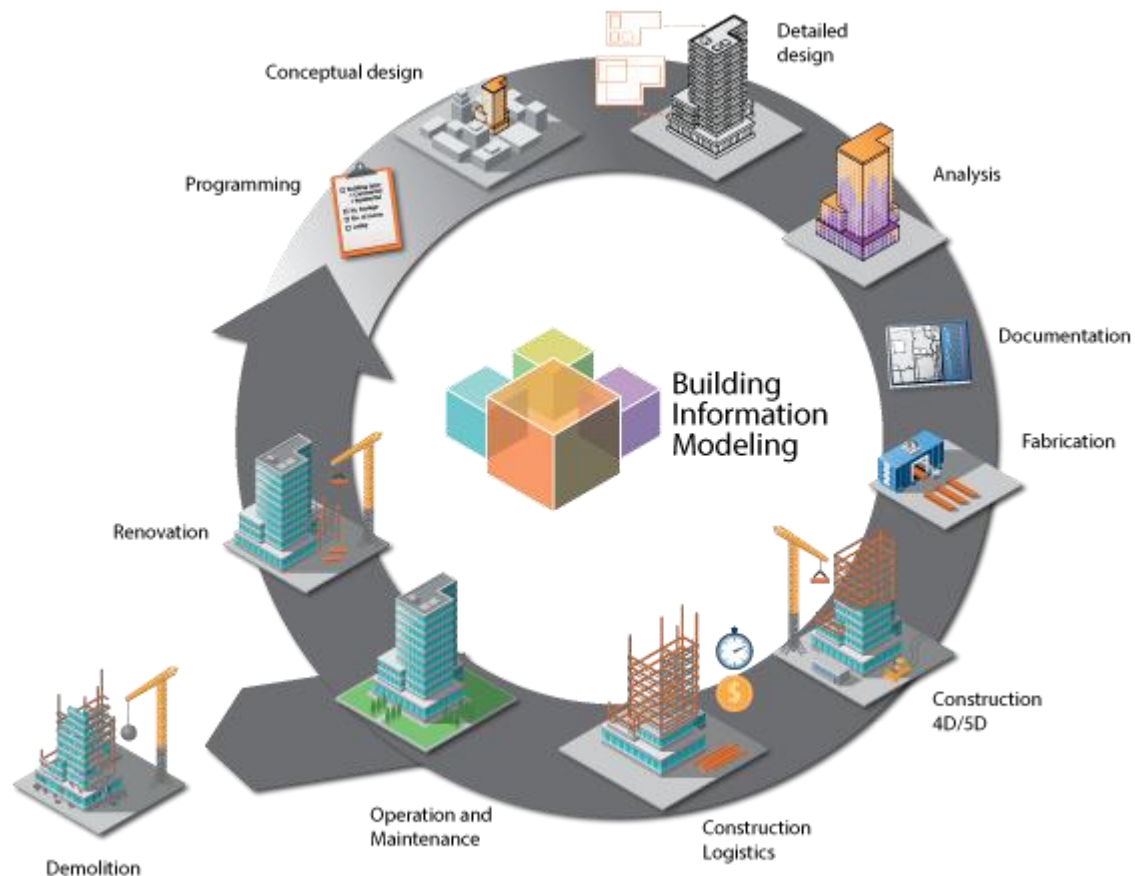
BIM is a new technology supporting construction during its whole life-cycle.

It eases:

- Collaboration between specialists;
- Final Building Quality controls;
- Cost and time management.

BIM is:

- 80% process;
- 20% tools.





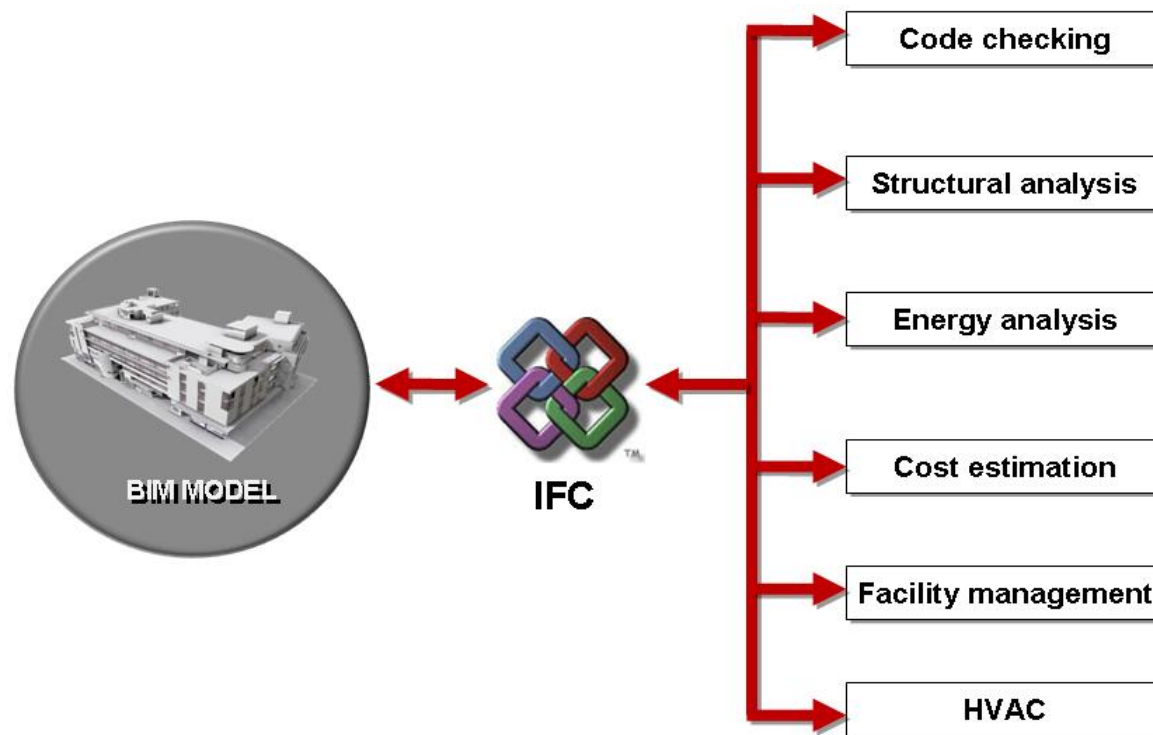
The BIM methodology

The Industry Foundation Classes (IFC)

Interoperability: the ability to exchange information through applications.

IFC (*Industry Foundation Class*) is a neutral data format (developed by *buildingSMART*) freely distributed in order to facilitate interactions in the AEC industry. IFC structure is based on:

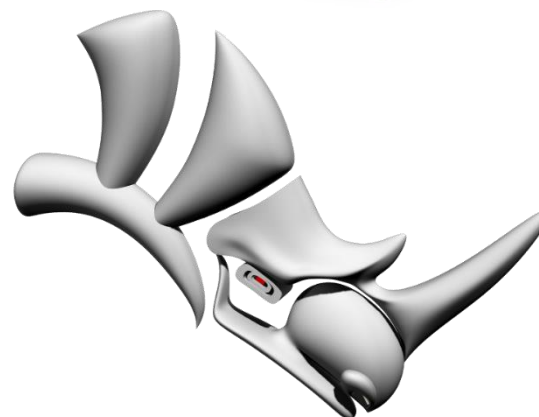
- Semantics;
- Relations;
- Features.





Data sources

Various BIM applications





Data sources

One common format





The Passive House Planning Package (PHPP)

A Reliable Energy Efficiency Design



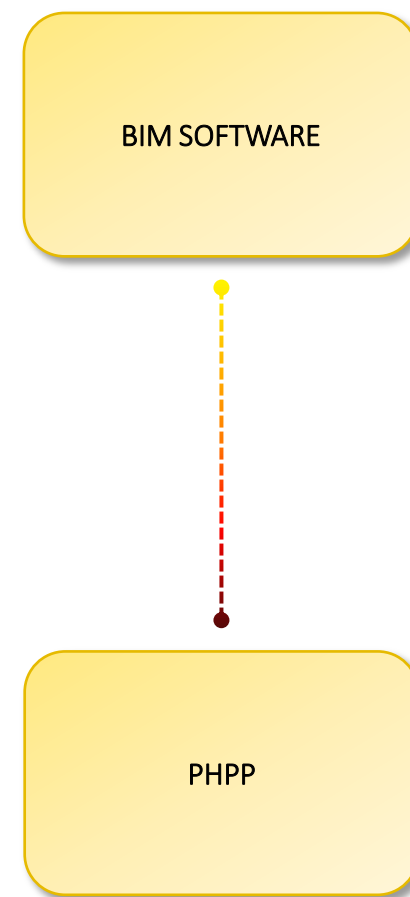
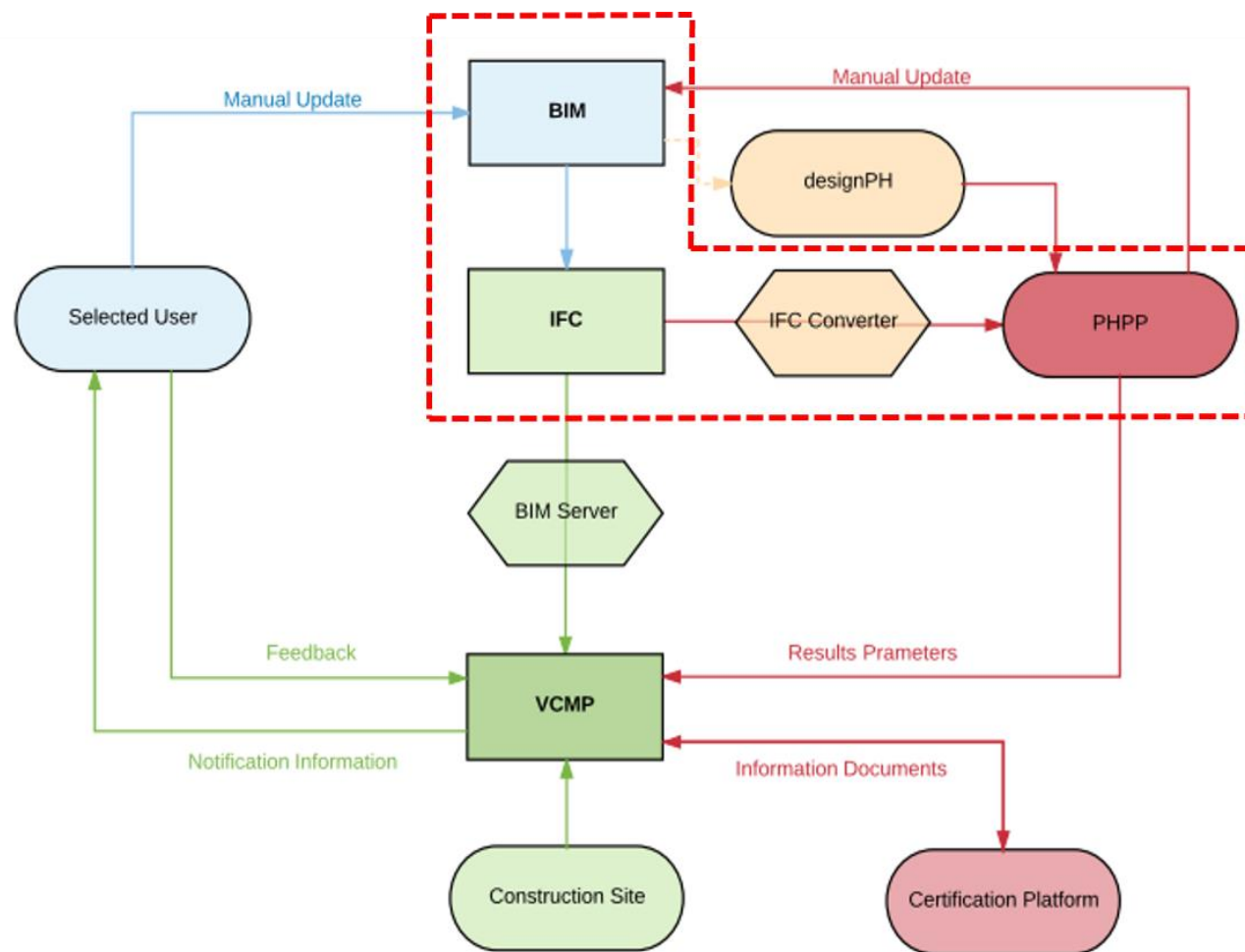
Specific building demands with reference to the treated floor area				
	Treated floor area	272.1 m ²	Requirements	Fulfilled?*
Space heating	Heating demand	10 kWh/(m ² a)	15 kWh/(m ² a)	yes
	Heating load	15 W/m ²	10 W/m ²	-
Space cooling	Overall specif. space cooling demand	kWh/(m ² a)	-	-
	Cooling load	W/m ²	-	-
	Frequency of overheating (> 25 °C)	0.0 %	-	-
Primary energy	Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances	72 kWh/(m ² a)	120 kWh/(m ² a)	yes
	DHW, space heating and auxiliary electricity	17 kWh/(m ² a)	-	-
	Specific primary energy reduction through solar electricity	kWh/(m ² a)	-	-
Airtightness	Pressurization test result n ₅₀	0.6 1/h	0.6 1/h	yes

* empty field: data missing; '-': no requirement



The B2S process

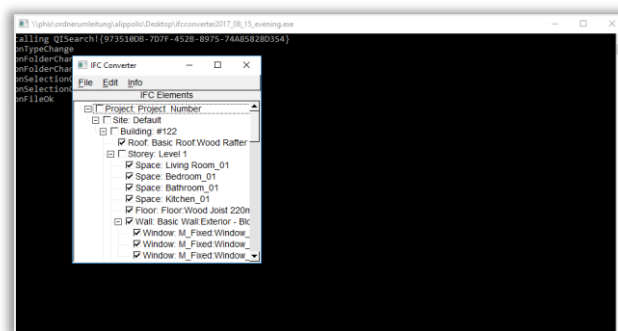
PHPP export in the VCMP process





How does it work?

General scheme



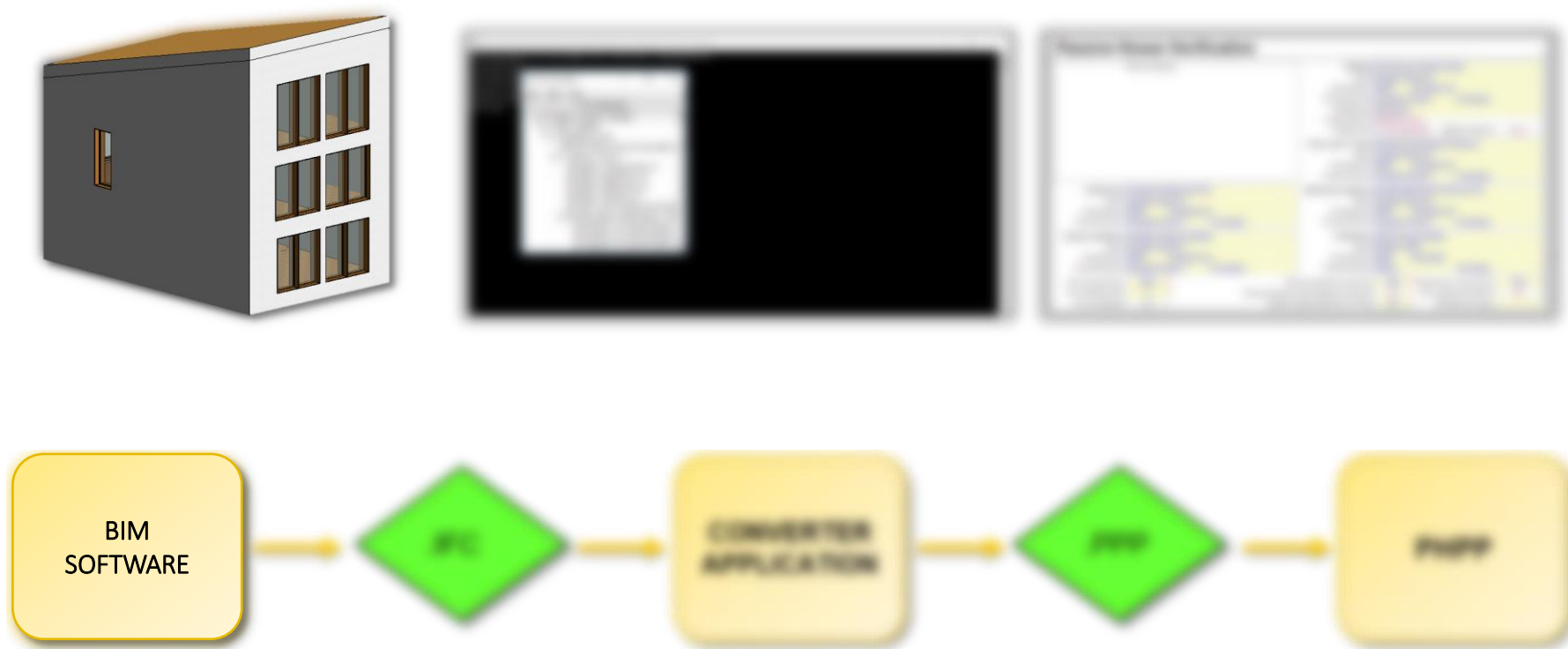
Passive House Verification	
Photo or Drawing	
Building: End of terrace Passive House	
Street: Example Street 99	
Postcode/City: 99999 Example City	
Province/Country: Example Province DE Germany	
Building type: Row house	
Climate data set: DE 6002a-Hessen	
Climate zone: 3: Cool temperate	
Altitude of location: 50 m	
Home owner / Client: Passivhaus Association of Owners	
Street: Example Street 99	
Postcode/City: 99999 Example City	
Province/Country: Example Province DE Germany	
Mechanical engineer: Example Mechanical Services Firm	
Street: Example Street 99	
Postcode/City: 99999 Example City	
Province/Country: Example Province DE Germany	
Certification: Passive House Institute	
Street: Rhineland 44-46	
Postcode/City: 64289 Darmstadt	
Province/Country: Hessen DE Germany	
Year of construction: 2015	
Interior temperature winter [°C]: 20.0	
Interior temp. summer [°C]: 25.0	
Internal heat gains (IHG) heating case [W/m²]: 2.6	
IHG cooling case [W/m²]: 2.6	
No. of dwelling units: 1	
No. of occupants: 2.2	
Specific capacity [W/m² TFA]: 60	
Mechanical cooling	





How does it work?

General scheme





How does it work?

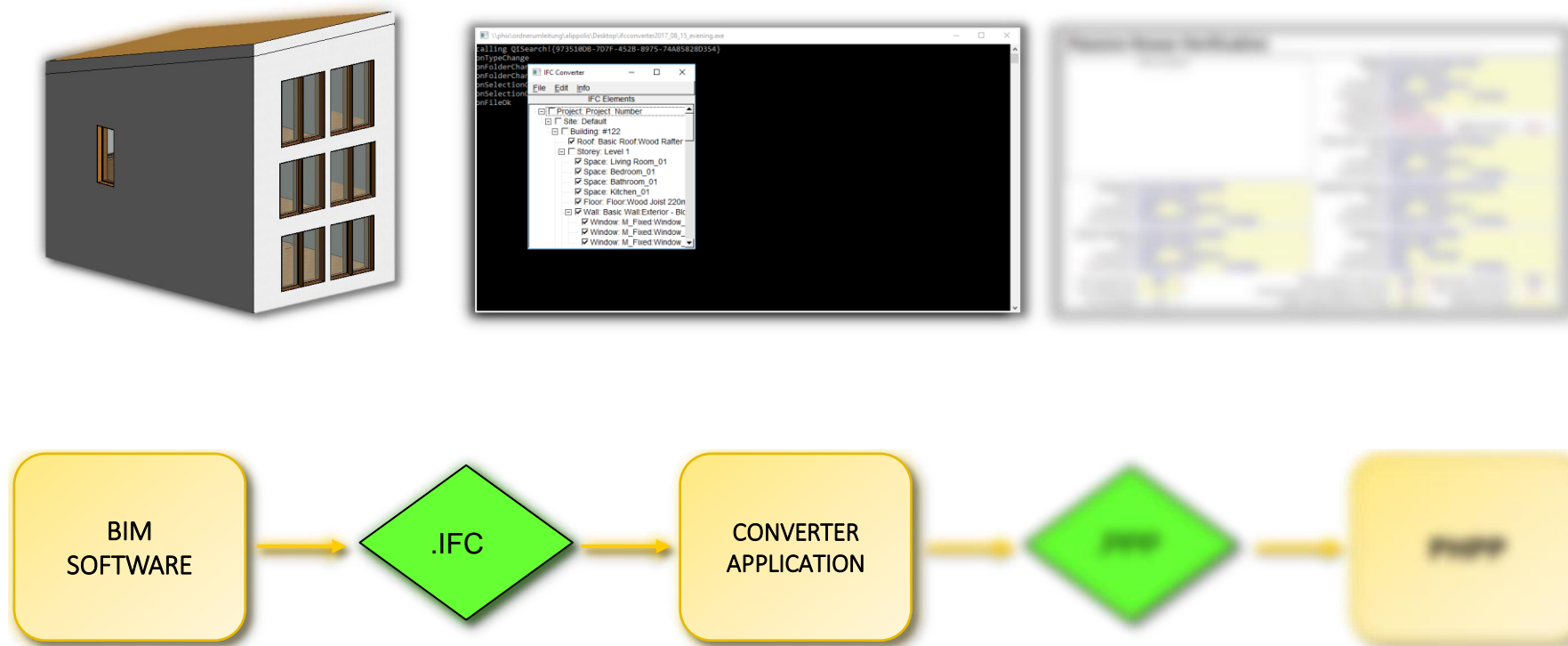
General scheme





How does it work?

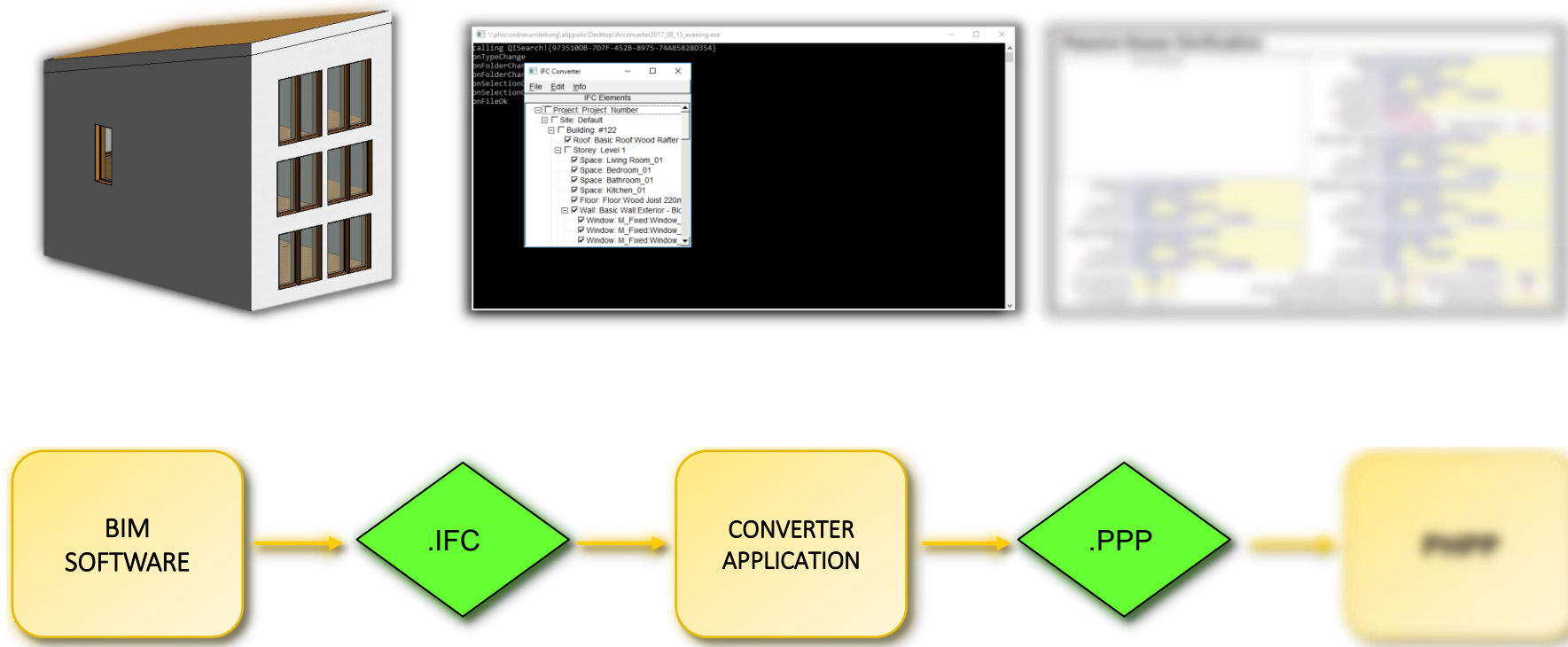
General scheme





How does it work?

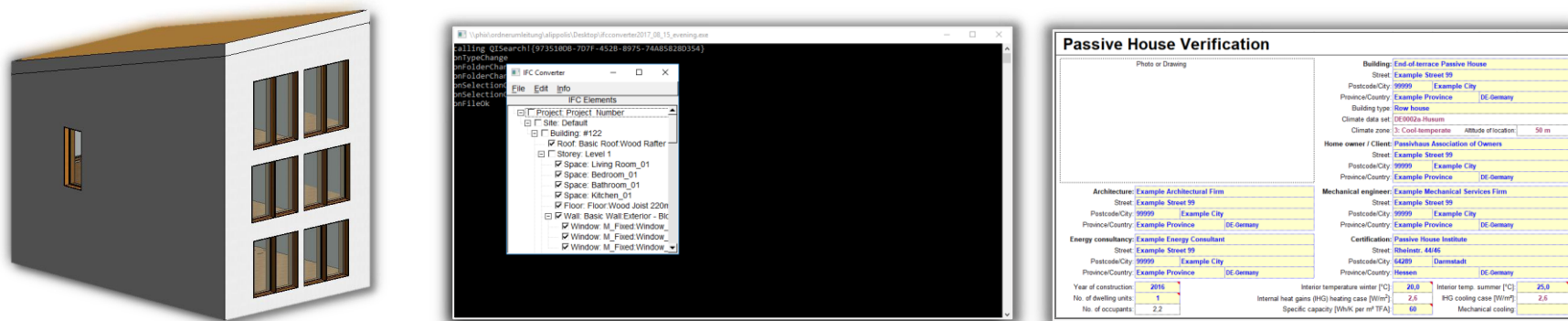
General scheme





How does it work?

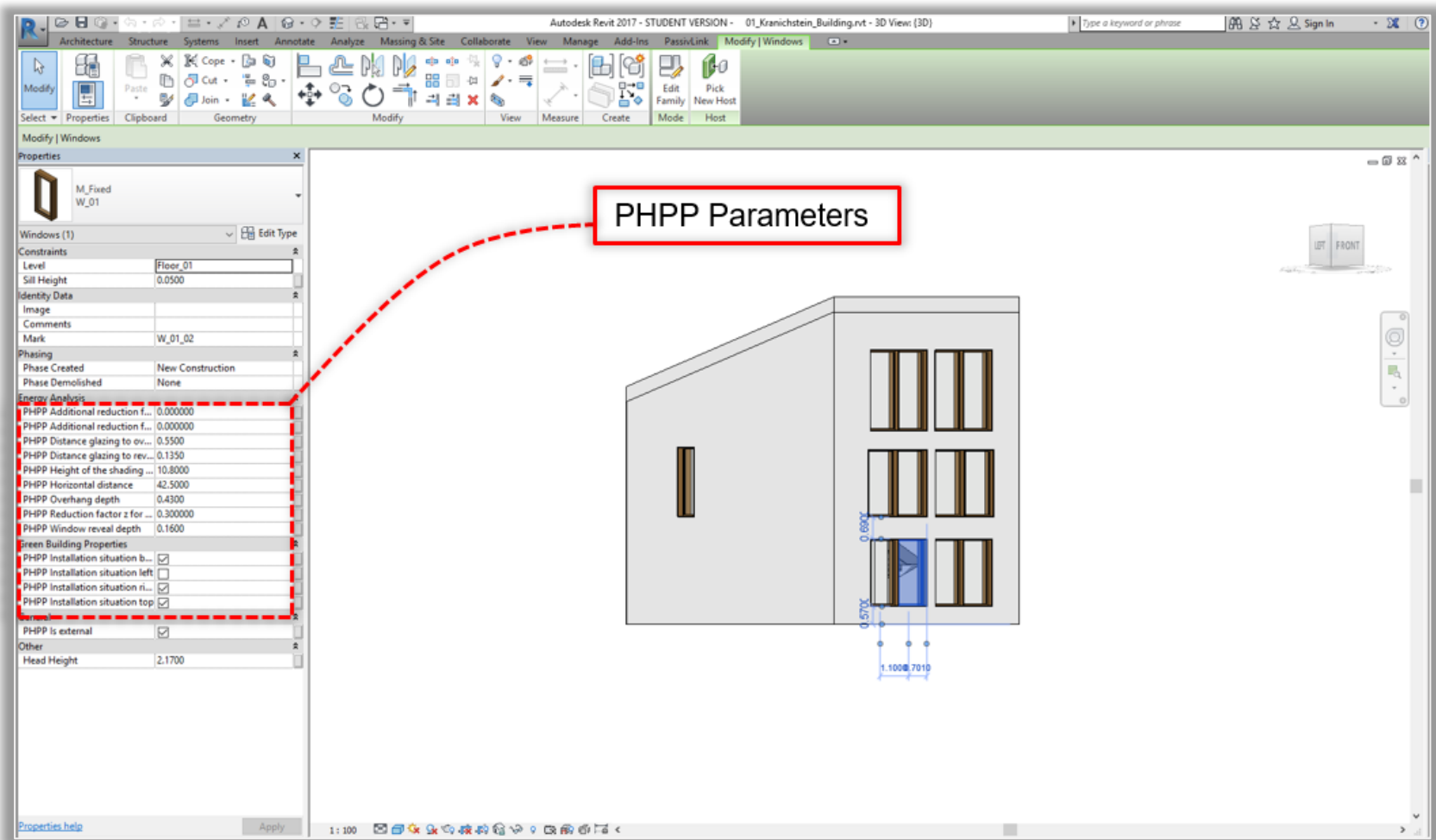
General scheme





How does it work?

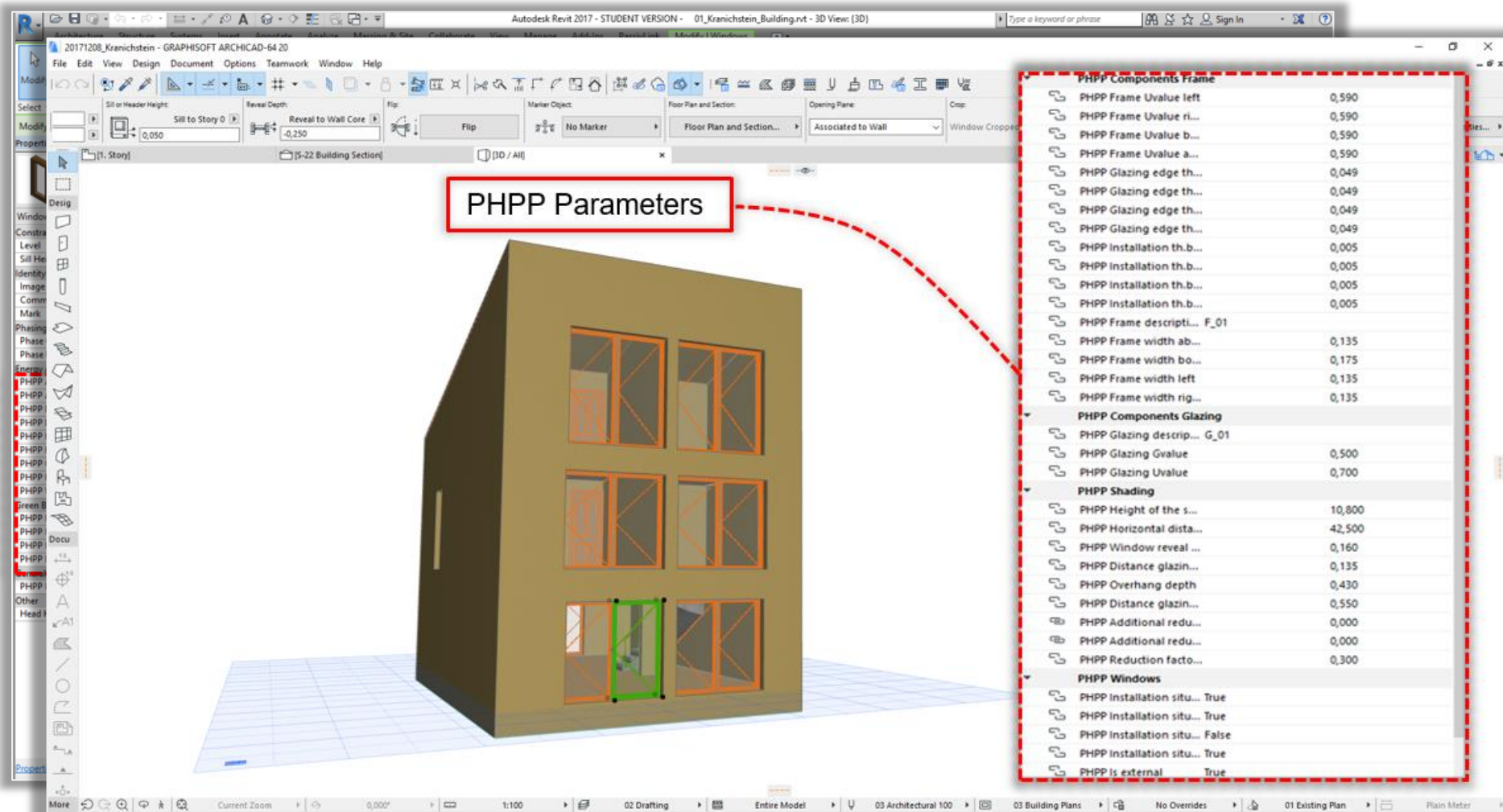
User Templates





How does it work?

User Templates



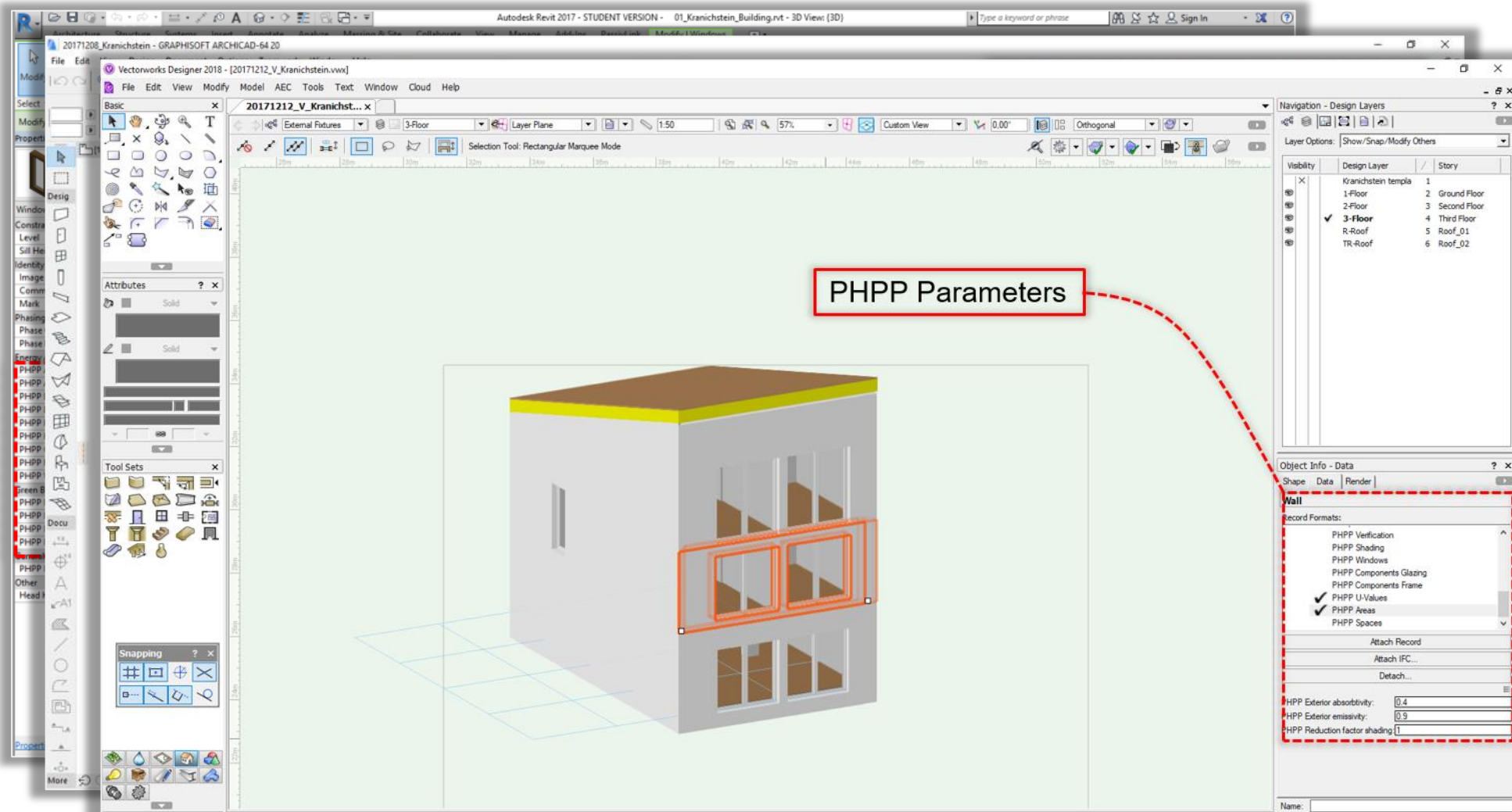
The screenshot displays the Autodesk Revit 2017 interface. In the center is a 3D model of a building with a brown facade and several windows. A red box labeled "PHPP Parameters" points to a window on the right side of the screen. This window lists various parameters for the building's energy performance, categorized into PHPP Components Frame, PHPP Components Glazing, PHPP Shading, and PHPP Windows. A red dashed line connects the "PHPP Parameters" label to the list of parameters.

PHPP Components Frame	
PHPP Frame Uvalue left	0,590
PHPP Frame Uvalue ri...	0,590
PHPP Frame Uvalue b...	0,590
PHPP Frame Uvalue a...	0,590
PHPP Glazing edge th...	0,049
PHPP Glazing edge th...	0,049
PHPP Glazing edge th...	0,049
PHPP Glazing edge th...	0,049
PHPP Installation th.b...	0,005
PHPP Installation th.b...	0,005
PHPP Installation th.b...	0,005
PHPP Installation th.b...	0,005
PHPP Frame descripti... F_01	
PHPP Frame width ab...	0,135
PHPP Frame width bo...	0,175
PHPP Frame width left	0,135
PHPP Frame width rig...	0,135
PHPP Components Glazing	
PHPP Glazing descrip... G_01	
PHPP Glazing Gvalue	0,500
PHPP Glazing Uvalue	0,700
PHPP Shading	
PHPP Height of the s...	10,800
PHPP Horizontal dista...	42,500
PHPP Window reveal ...	0,160
PHPP Distance glazin...	0,135
PHPP Overhang depth	0,430
PHPP Distance glazin...	0,550
PHPP Additional redu...	0,000
PHPP Additional redu...	0,000
PHPP Reduction facto...	0,300
PHPP Windows	
PHPP Installation situ...	True
PHPP Installation situ...	True
PHPP Installation situ...	False
PHPP Installation situ...	True
PHPP is external	True



How does it work?

User Templates





How does it work?

Modeling entering PHPP parameters

Parameters typology:

- Geometry parameters
- Standard parameters
- Custom parameters



Project Information

Family: System Family: Project Information Load...

Type: Edit Type...

Instance Parameters - Control selected or to-be-created instance

Parameter	Value
Energy Analysis	
PHPP Architecture 1 Name	Example Architectural Firm
PHPP Architecture 2 Street	Example Street 99
PHPP Architecture 3 Postcode	99999
PHPP Architecture 4 City	Example City
PHPP Architecture 5 Province	Example Province
PHPP Architecture 6 Country	DE-Germany
PHPP Building 1 Name	End-of-terrace Passive House
PHPP Building 2 Street	Example Street 99
PHPP Building 3 Postcode	99999
PHPP Building 4 City	Example City
PHPP Building 5 Province	Example Province
PHPP Building 6 Country	DE-Germany
PHPP Building 7 Type	Row house
PHPP Certification 1 Name	Passive House Institute
PHPP Certification 2 Street	Rheinstr. 44/46
PHPP Certification 3 Postcode	64289
PHPP Certification 4 City	Darmstadt
PHPP Certification 5 Province	Hessen
PHPP Certification 6 Country	DE-Germany
PHPP Client 1 Name	Passivhaus Association of Owners
PHPP Client 2 Street	Example Street 99

OK Cancel

Type Properties

Family: System Family: Basic Wall Load...

Type: Exterior - Brick and Block on MSE, Stud Duplicate... Rename...

Type Parameters

Parameter	Value
Model	
Manufacturer	
Type Comments	
URL	
Description	
Assembly Description	
Assembly Code	
Type Mark	
Fire Rating	
Cost	
Energy Analysis	
PHPP Exterior absorptivity	0.700000
PHPP Exterior emissivity	0.800000
PHPP Reduction factor shading	0.900000
Other	
PHPP Adjacent to Ground	<input checked="" type="checkbox"/>
PHPP Adjacent to Outdoor Air	<input checked="" type="checkbox"/>
PHPP Adjacent to Ventilated	<input checked="" type="checkbox"/>

Type Properties

Family: PH window average quality Load...

Type: PH frame average thermal quality Duplicate... Rename...

Type Parameters

Parameter	Value
Code Name	
Code Name	
Energy Analysis	
Frame U-value B	0.750000
Frame U-value L	0.750000
Frame U-value T	0.750000
Glazing G-value	0.500000
Glazing U-value	0.8000 W/(m²·K)
Glazing edge thermal bridge left	0.040000
Glazing edge thermal bridge right	0.040000
Glazing edge thermal bridge top	0.040000
Glazing edge thermal bridge bottom	0.040000
Installation thermal bridge left	0.040000
Installation thermal bridge right	0.040000
Installation thermal bridge top	0.040000
Installation thermal bridge bottom	0.040000
PHPP Frame description	
PHPP Frame U-value above	
PHPP Frame U-value bottom	
PHPP Frame U-value left	
PHPP Frame U-value right	



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PHPP Building 7 Type	Row house
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Cost	
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Installation thermal bridge bottom	0.040000
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PHPP Frame U-value above	
PHPP Frame U-value bottom	
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PHPP Frame U-value right	



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Glazing edge thermal bridge bottom	0.040000
Installation thermal bridge left	0.040000
Installation thermal bridge right	0.040000
Installation thermal bridge top	0.040000
Installation thermal bridge bottom	0.040000
PHPP Frame description	
PHPP Frame U-value above	
PHPP Frame U-value bottom	
PHPP Frame U-value left	
PHPP Frame U-value right	



How does it work?

IFC aspect

```
#186= IFCWALLSTANDARDCASE('1b8pKXqT58j9ZBKrZWwvE',#42,'Basic Wall:Generic -  
200mm:199460',$,'Basic Wall:Generic-200mm:249',#147,#180,'199460',.EXTERNAL.);  
#...  
#372= IFCPROPERTYSINGLEVALUE('Reductionfactorshading',$,IFCREAL(0.7,$));  
#373= IFCPROPERTYSINGLEVALUE('Exteriorabsorptivity',$,IFCREAL(0.,$));  
#374= IFCPROPERTYSINGLEVALUE('Exterioremisivity',$,IFCREAL(0.9,$));  
#375= PROPERTYSET('3nNpFmGXCKvXcA39MFnNF',#42,'PHPP_Area',$,(#372,#373,#374));  
#...  
#383= IFCRELDEFINESBYPROPERTIES('2DU8zPrHPCFwOdbN0zW9sH',#42,$,$,(#186),#375);  
  
#1342= IFCWALLSTANDARDCASE('1A02V$k_n0SPqXarzTD8JA',#42,'Basic Wall:underground  
walls:211697',$,'Basic Wall:underground walls',#1306,#1338,'211697',.EXTERNAL.);  
#...  
#1345= IFCQUANTITYLENGTH('Height',$,$,3.,$);  
#1346= IFCQUANTITYLENGTH('Length',$,$,6.749999999999999,$);  
#1347= IFCQUANTITYLENGTH('Width',$,$,0.5,$);  
#1348= IFCQUANTITYAREA('GrossFootprintArea',$,$,3.25,$);  
#1349= IFCQUANTITYAREA('GrossSideArea',$,$,20.25,$);  
#1350= IFCQUANTITYVOLUME('GrossVolume',$,$,9.75,$);  
#1351=IFCELEMENTQUANTITY('28F0eIeEX6oCwCPJAqcd',#42,'BaseQuantities',$,$,(#1345,#1346  
#1347,#1348,#1349,#1350));  
#...  
#1353= IFCRELDEFINESBYPROPERTIES('39Rd7aAX57ShFyBN_jKVK6',#42,$,$,(#1342),#1351);
```

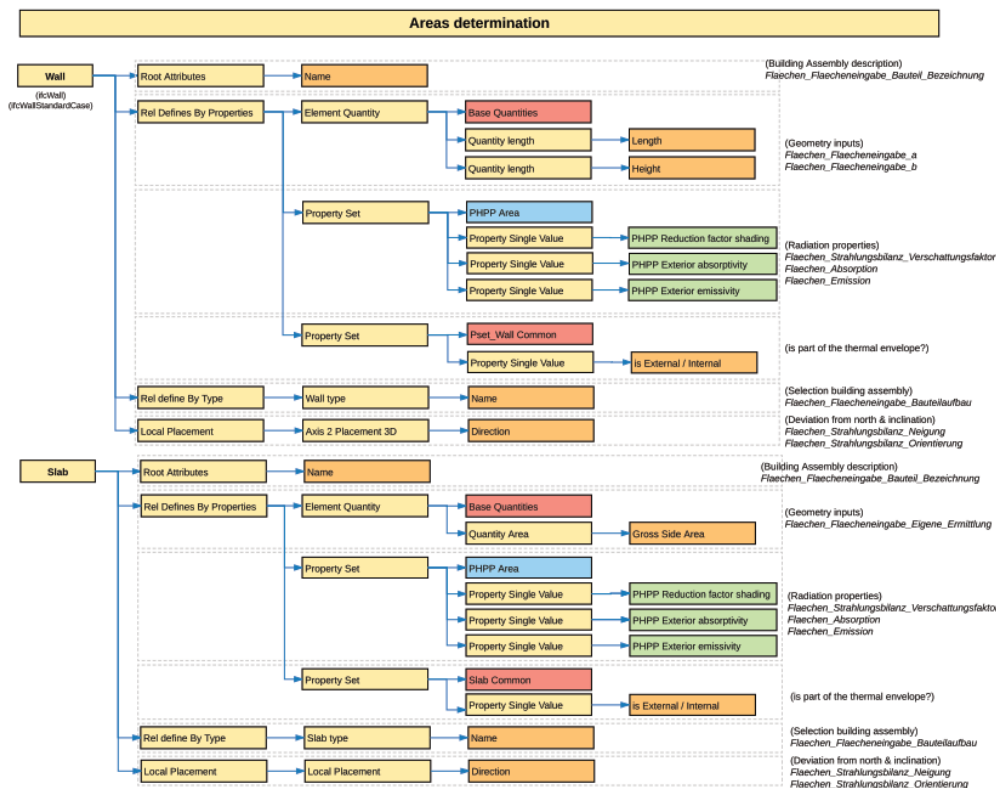


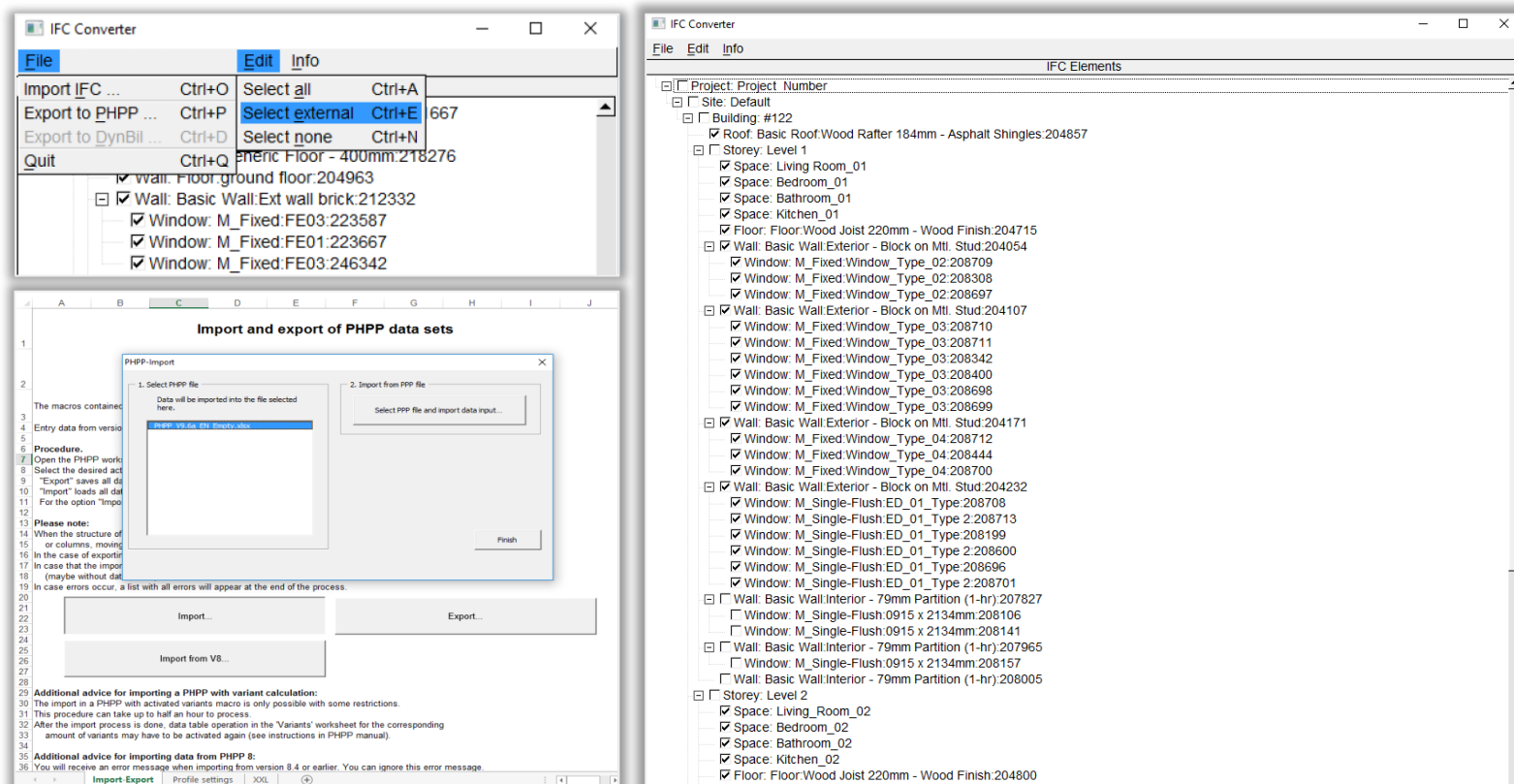
Fig.04: IFC Layout and Chart used for data communication



How does it work?

IFC Converter Application

The converter application achieves the interoperability between the BIM model and PHPP through the export into an IFC file and the generation of a PPP interface file for PHPP.





How does it work?

PHPP results

Passive House Verification

Photo or Drawing

Building: End-of-terrace Passive House
Street: Example Street 99
Postcode/City: 99999 Example City
Province/Country: Example Province DE-Germany
Building type: Row house
Climate data set: DE0002a-Husum
Climate zone: 3: Cool-temperate Altitude of location: 50 m

Home owner / Client: Passivhaus Association of Owners
Street: Example Street 99
Postcode/City: 99999 Example City
Province/Country: Example Province DE-Germany

Mechanical engineer: Example Mechanical Services Firm
Street: Example Street 99
Postcode/City: 99999 Example City
Province/Country: Example Province DE-Germany

Certification: Passive House Institute
Street: Rheinstr. 44/46
Postcode/City: 64289 Darmstadt
Province/Country: Hessen DE-Germany

Architecture: Example Architectural Firm
Street: Example Street 99
Postcode/City: 99999 Example City
Province/Country: Example Province DE-Germany

Energy consultancy: Example Energy Consultant
Street: Example Street 99
Postcode/City: 99999 Example City
Province/Country: Example Province DE-Germany

Year of construction: 2016
No. of dwelling units: 1
No. of occupants: 2.2

Interior temperature winter [°C]: 20.0
Interior temp. summer [°C]: 25.0
Internal heat gains (IHG) heating case [W/m²]: 2.6
IHG cooling case [W/m²]: 2.6
Specific capacity [Wh/K per m² TFA]: 60
Mechanical cooling:

Passive House Institute

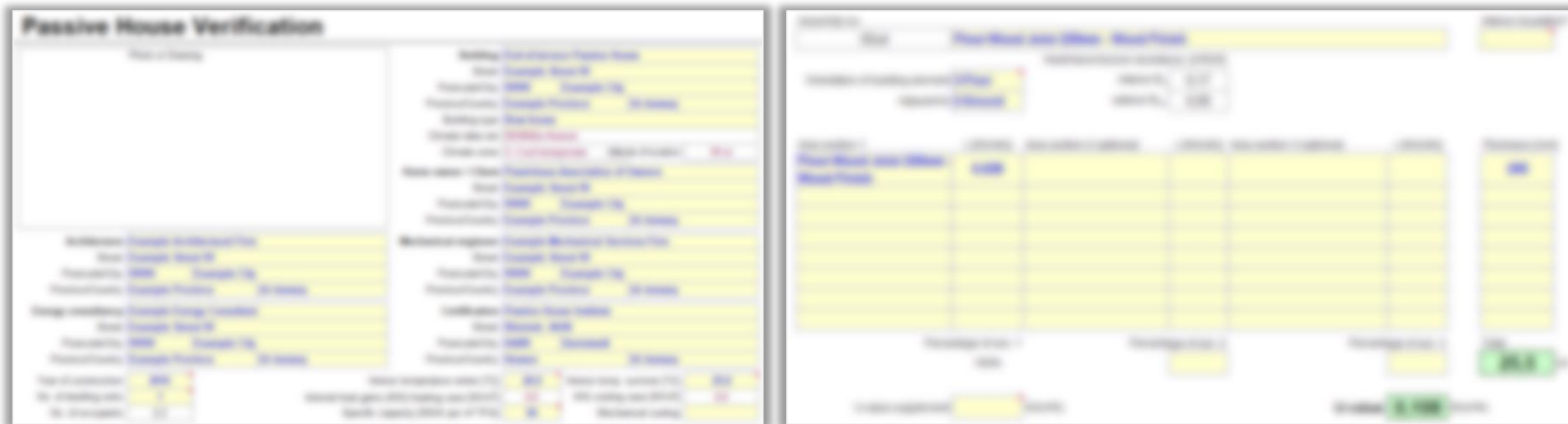


Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099
1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	



How does it work?

PHPP results



Quantity	Description	Deviation from north	Angle of inclination from the horizontal	Orientation	Width	Height	Selection from 'Areas' worksheet	Selection from 'Components' worksheet	Selection from 'Components' worksheet	Perpendicular radiation	Glazing	Frames (avg.)	$\Psi_{glazing}$ (Avg.)	left	right	bottom	top	$\Psi_{transmission}$ (Avg.)	Window Area	Glazing area	U _g installed	Glazed fraction per window
					m	m		1-Sorting: LIKE LIST	1-Sorting: LIKE LIST		W(m ² K)	W(m ² K)	W(m ² K)	W(m ² K) or 1/0				W(m ² K)	m ²	m ²	W(m ² K)	%
1	28.0	0	90	North	1,500	1,000	7-V_04	01ud-Window_Glazing_02	01ud-Window_Frame_02	0,63	0,74	0,75	0,135	1	1	1	1	0,135	1,5	1,35	1,62	90%
1	29.0	270	90	West	0,800	1,000	8-V_03	02ud-Window_Glazing_03	02ud-Window_Frame_03	0,65	0,75	0,80	0,098	1	1	1	1	0,098	0,8	0,70	1,61	87%
1	30.0	270	90	West	0,800	1,000	8-V_03	02ud-Window_Glazing_03	02ud-Window_Frame_03	0,65	0,75	0,80	0,098	1	1	1	1	0,098	0,8	0,70	1,61	87%
1	31.0	0	90	North	1,200	1,000	9-V_02	03ud-Window_Glazing_04	03ud-Window_Frame_04	0,66	0,77	0,80	0,197	1	1	1	1	0,197	1,2	1,07	2,18	89%
1	20.0	0	90	North	1,500	1,000	7-V_04	01ud-Window_Glazing_02	01ud-Window_Frame_02	0,63	0,74	0,75	0,135	1	1	1	1	0,135	1,5	1,35	1,62	90%
1	21.0	270	90	West	0,800	1,000	8-V_03	02ud-Window_Glazing_03	02ud-Window_Frame_03	0,65	0,75	0,80	0,098	1	1	1	1	0,098	0,8	0,70	1,61	87%
1	22.0	270	90	West	0,800	1,000	8-V_03	02ud-Window_Glazing_03	02ud-Window_Frame_03	0,65	0,75	0,80	0,098	1	1	1	1	0,098	0,8	0,70	1,61	87%
1	23.0	0	90	North	1,200	1,000	9-V_02	03ud-Window_Glazing_04	03ud-Window_Frame_04	0,66	0,77	0,80	0,197	1	1	1	1	0,197	1,2	1,07	2,18	89%
1	24.0	0	90	North	1,500	1,000	7-V_04	01ud-Window_Glazing_02	01ud-Window_Frame_02	0,63	0,74	0,75	0,135	1	1	1	1	0,135	1,5	1,35	1,62	90%
1	25.0	270	90	West	0,800	1,000	8-V_03	02ud-Window_Glazing_03	02ud-Window_Frame_03	0,65	0,75	0,80	0,098	1	1	1	1	0,098	0,8	0,70	1,61	87%
1	26.0	270	90	West	0,800	1,000	8-V_03	02ud-Window_Glazing_03	02ud-Window_Frame_03	0,65	0,75	0,80	0,098	1	1	1	1	0,098	0,8	0,70	1,61	87%
1	27.0	0	90	North	1,200	1,000	9-V_02	03ud-Window_Glazing_04	03ud-Window_Frame_04	0,66	0,77	0,80	0,197	1	1	1	1	0,197	1,2	1,07	2,18	89%
1	ED_05	44,999996	90	North	0,915	2,134	10-V_01	04ud-Door_Panel_01	04ud-Door_Frame_01	0,00	0,95	0,65	0,115	0	1	1	1	0,115	2,0	1,72	1,49	88%
1	ED_06	44,999996	90	North	0,915	2,134	10-V_01	05ud-Door_Panel_02	05ud-Door_Frame_02	0,65	0,95	0,65	0,115	0	1	1	1	0,115	2,0	1,72	1,49	88%
1	ED_01	44,999996	90	North	0,915	2,134	10-V_01	04ud-Door_Panel_01	04ud-Door_Frame_01	0,00	0,95	0,65	0,115	0	1	1	1	0,115	2,0	1,72	1,49	88%
1	ED_02	44,999996	90	North	0,915	2,134	10-V_01	05ud-Door_Panel_02	05ud-Door_Frame_02	0,65	0,95	0,65	0,115	0	1	1	1	0,115	2,0	1,72	1,49	88%
1	ED_03	44,999996	90	North	0,915	2,134	10-V_01	04ud-Door_Panel_01	04ud-Door_Frame_01	0,00	0,95	0,65	0,115	0	1	1	1	0,115	2,0	1,72	1,49	88%
1	ED_04	44,999996	90	North	0,915	2,134	10-V_01	05ud-Door_Panel_02	05ud-Door_Frame_02	0,65	0,95	0,65	0,115	0	1	1	1	0,115	2,0	1,72	1,49	88%

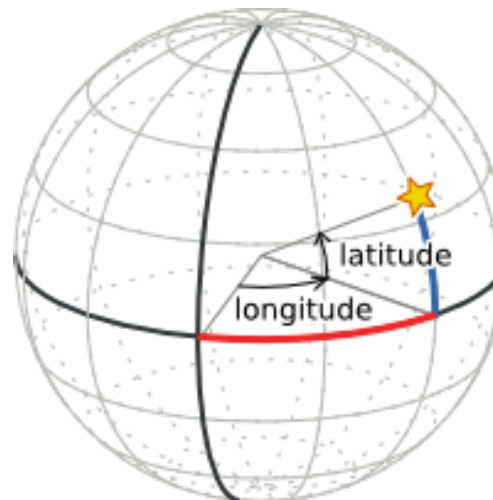


Conclusions

What can be exported?

Imported Data

- Longitude, Latitude and Altitude
- Materials
- Orientation
- Surfaces
- TFA
- Volume
- Windows/Doors geometry
- Shading properties
- Thermal Bridges





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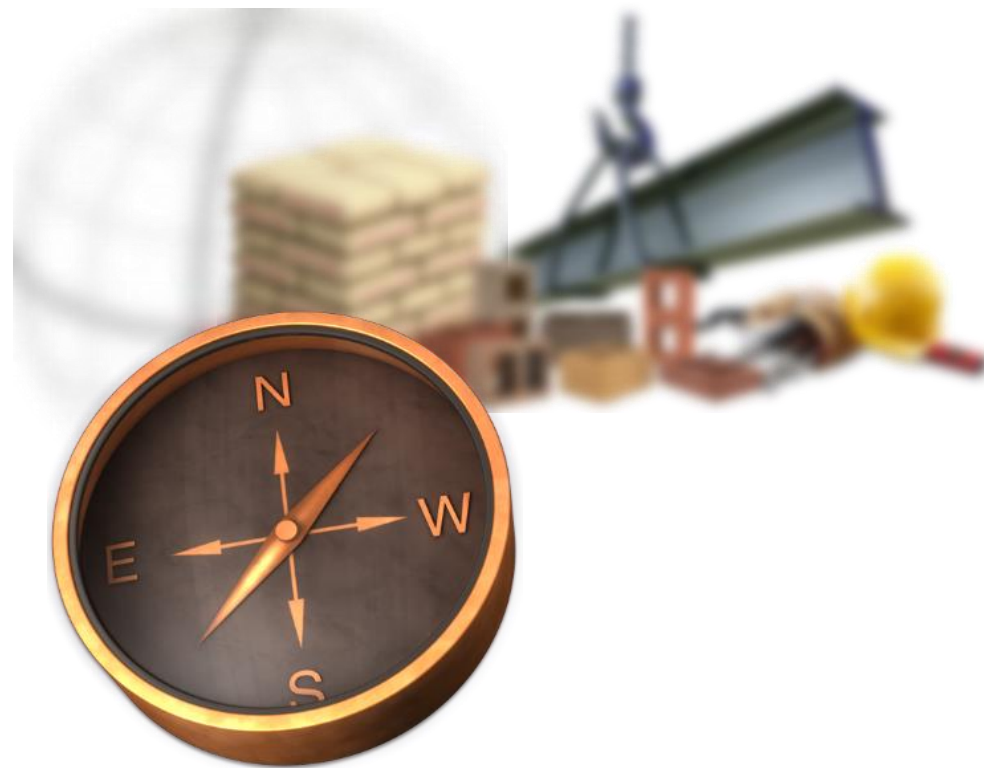


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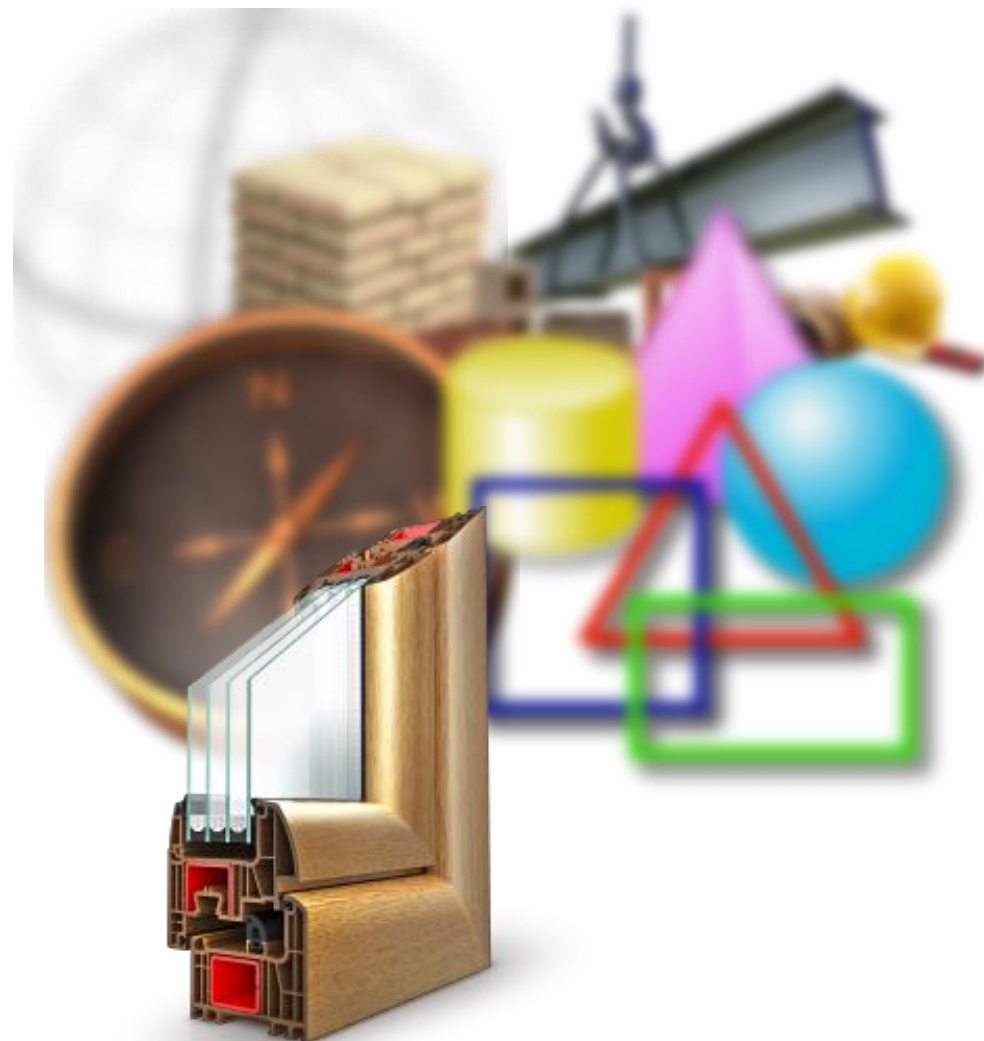


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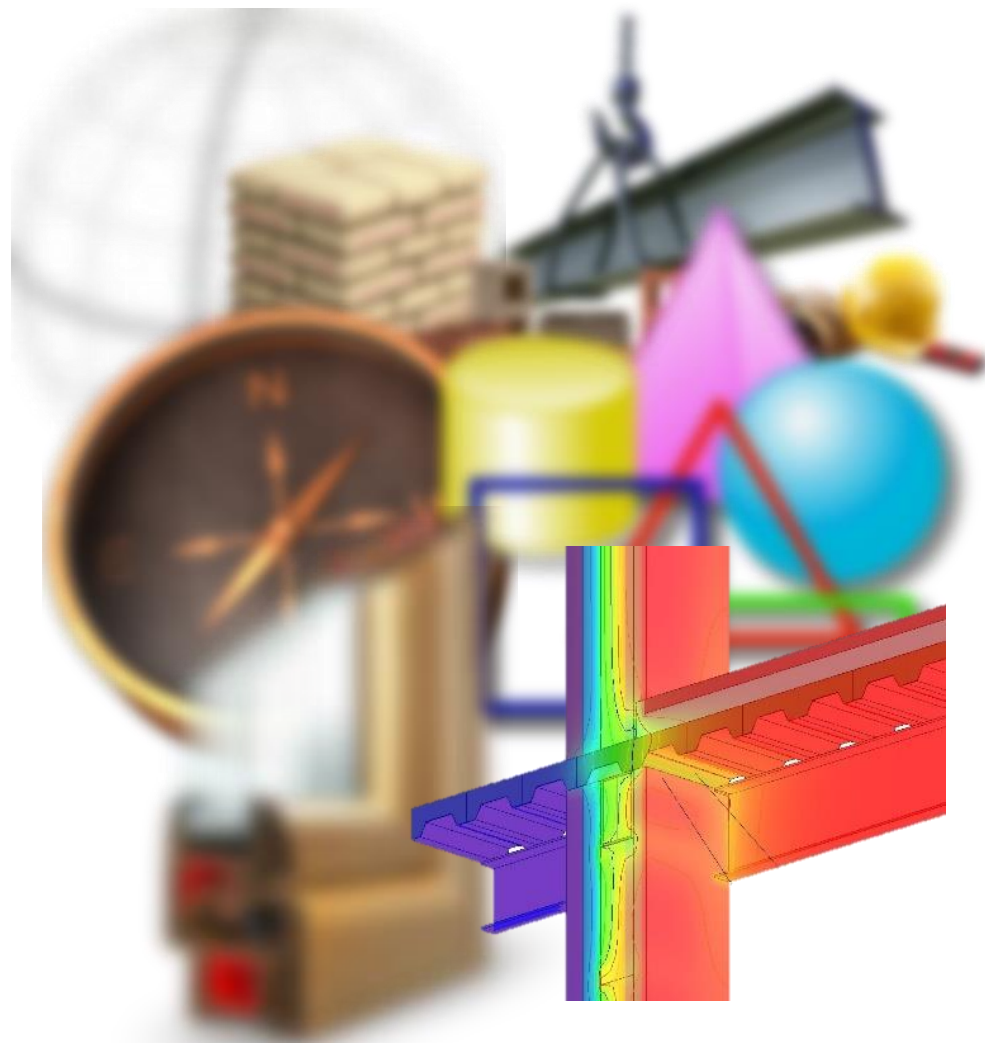


Conclusions

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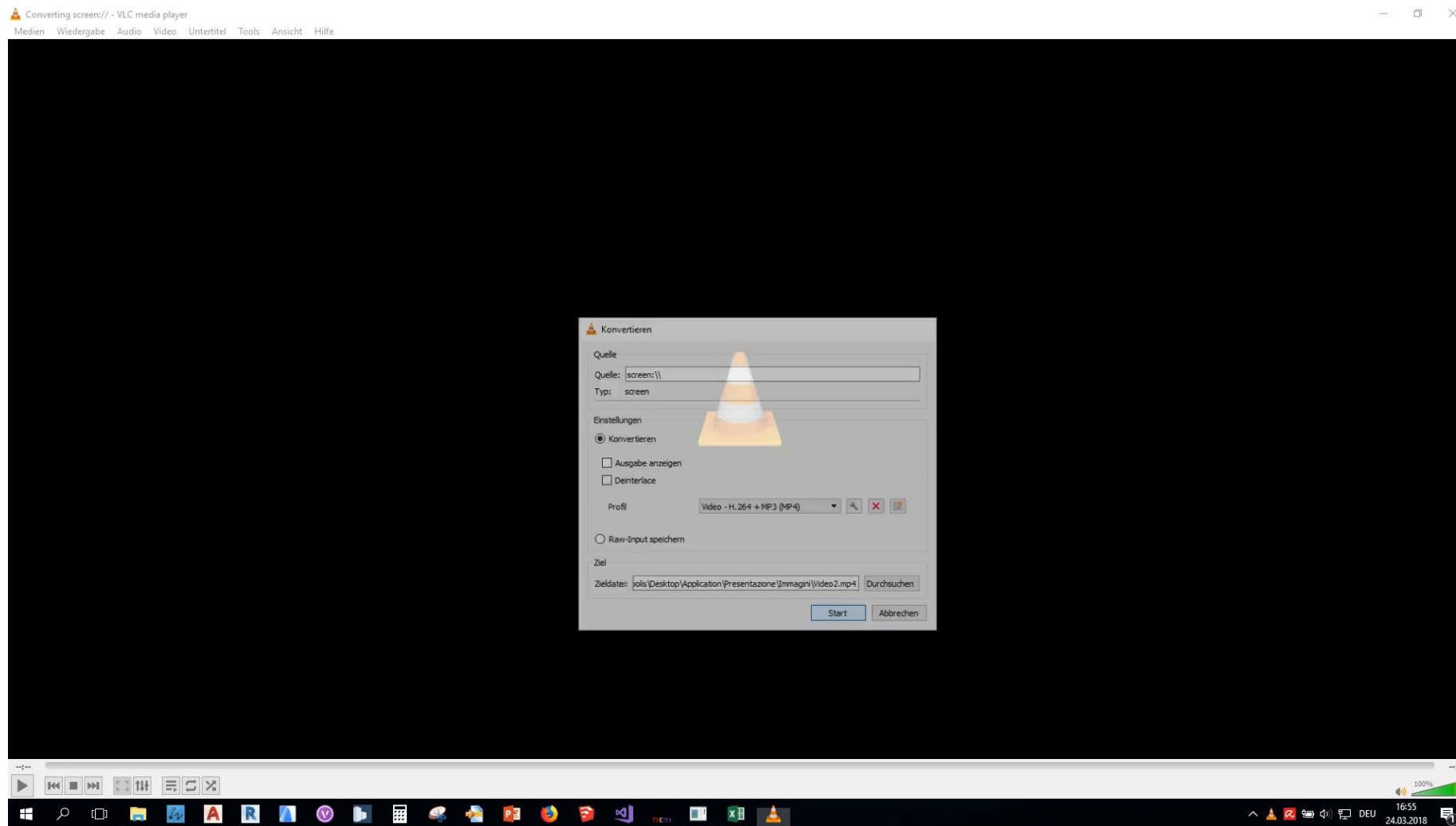
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Conclusions

Let's have a look!





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