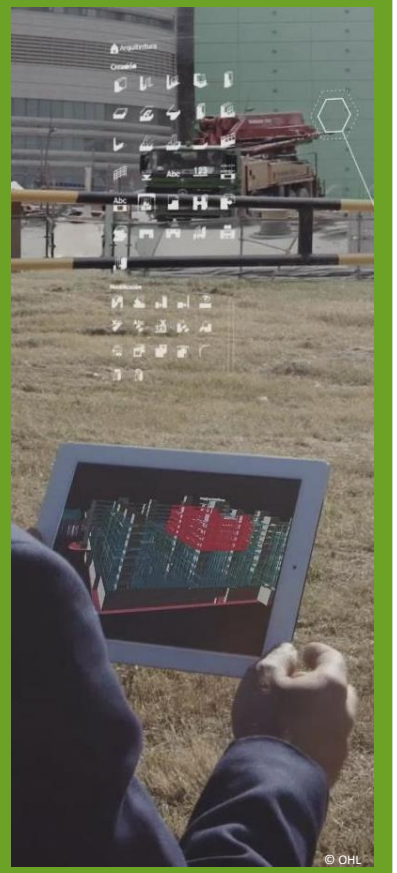

BUILT2SPEC

Tools for the 21st Century Construction Worksite

BIM based quality assurance and efficiency design

Aurelia Lippolis

27.06.2018 | Aix-les-Bains | Workshop

www.built2spec-project.eu

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The BIM methodology

Definition

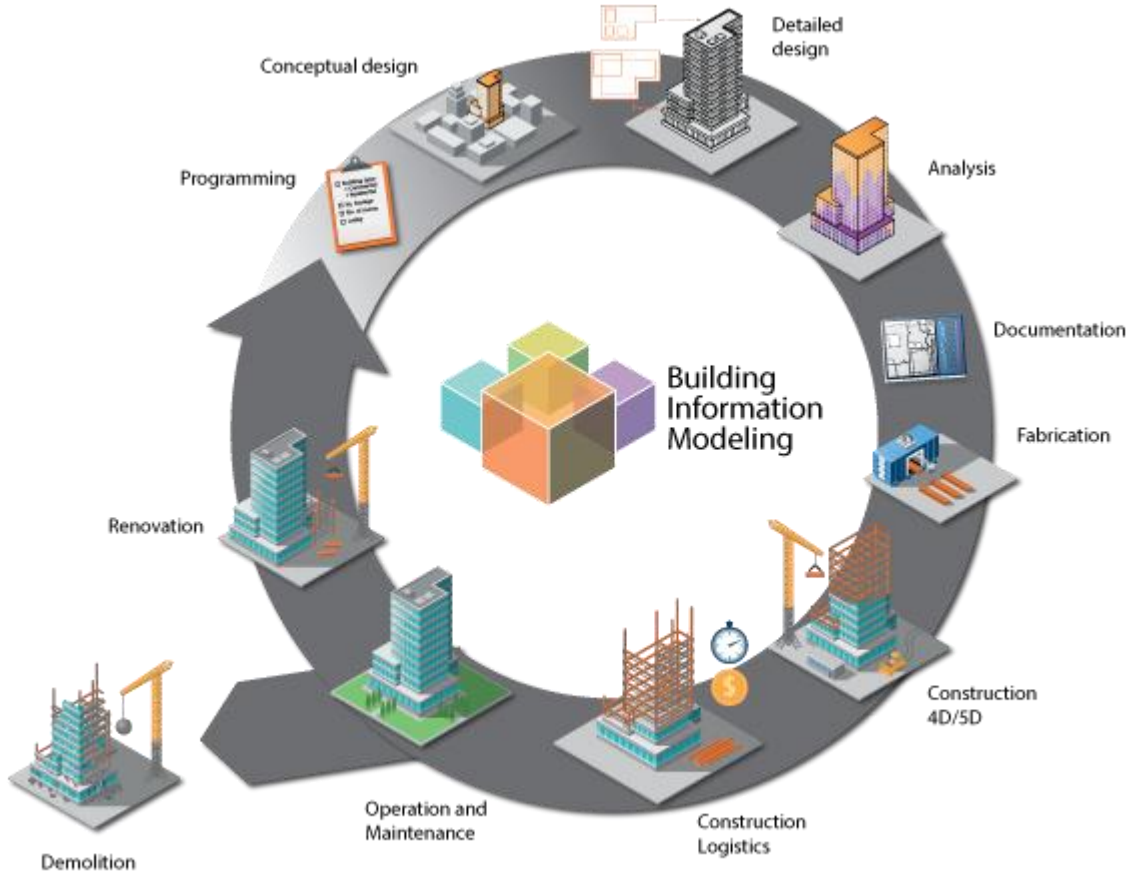
BIM is a new technology supporting construction during its whole life-cycle.

It eases:

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

BIM is:

- 80% process;
- 20% tools.



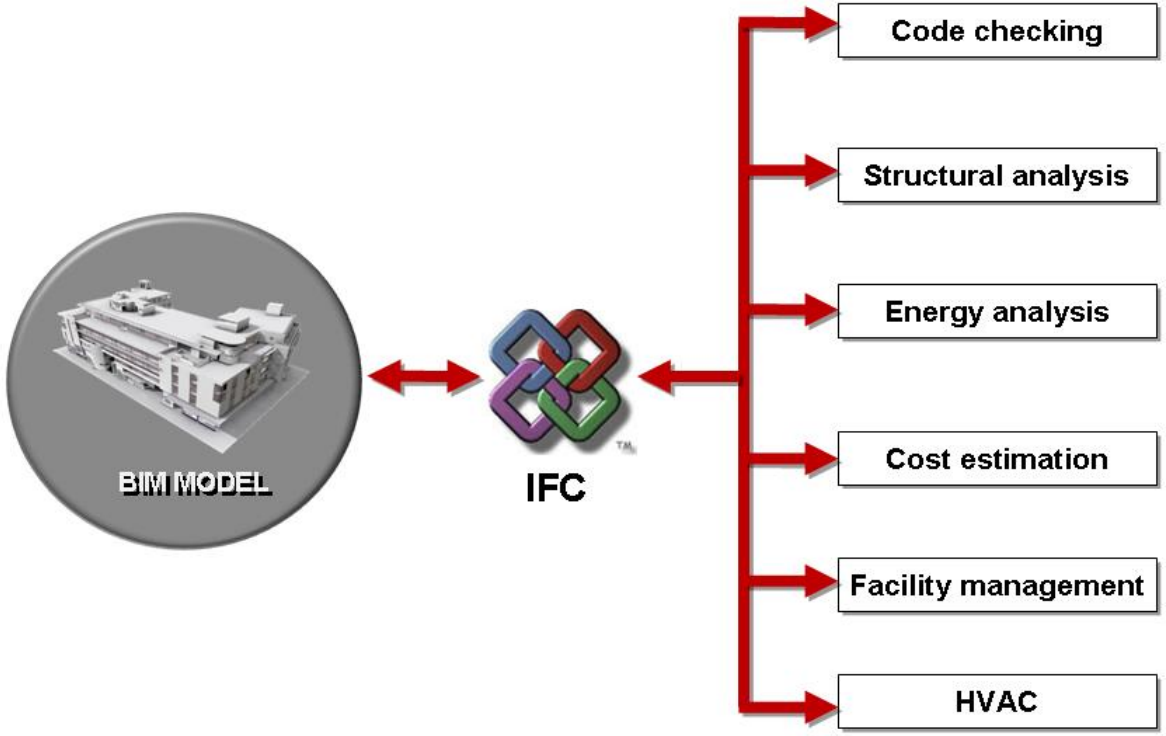
The BIM methodology

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

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Tools for the 21st Century Construction Worksite

The Passive House Planning Package (PHPP)

A Reliable Energy Efficiency Design

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	272.1	m²		
Space heating	Heating demand	**10**	**kWh/(m²a)**	15 kWh/(m²a)	**yes**
	Heating load	**15**	**W/m²**	10 W/m²	**-**
Space cooling	Overall specif. space cooling demand		**kWh/(m²a)**	-	**-**
	Cooling load		**W/m²**	-	**-**
	Frequency of overheating (> 25 °C)	0.0	%	-	**-**
Primary energy	Heating, cooling, auxiliary electricity, dehumidification, DHW, lighting, electrical appliances	**72**	**kWh/(m²a)**	120 kWh/(m²a)	**yes**
	DHW, space heating and auxiliary electricity	17	kWh/(m²a)	-	**-**
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	**-**
Airtightness	Pressurization test result n_{50}	**0.6**	**1/h**	0.6 1/h	**yes**

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

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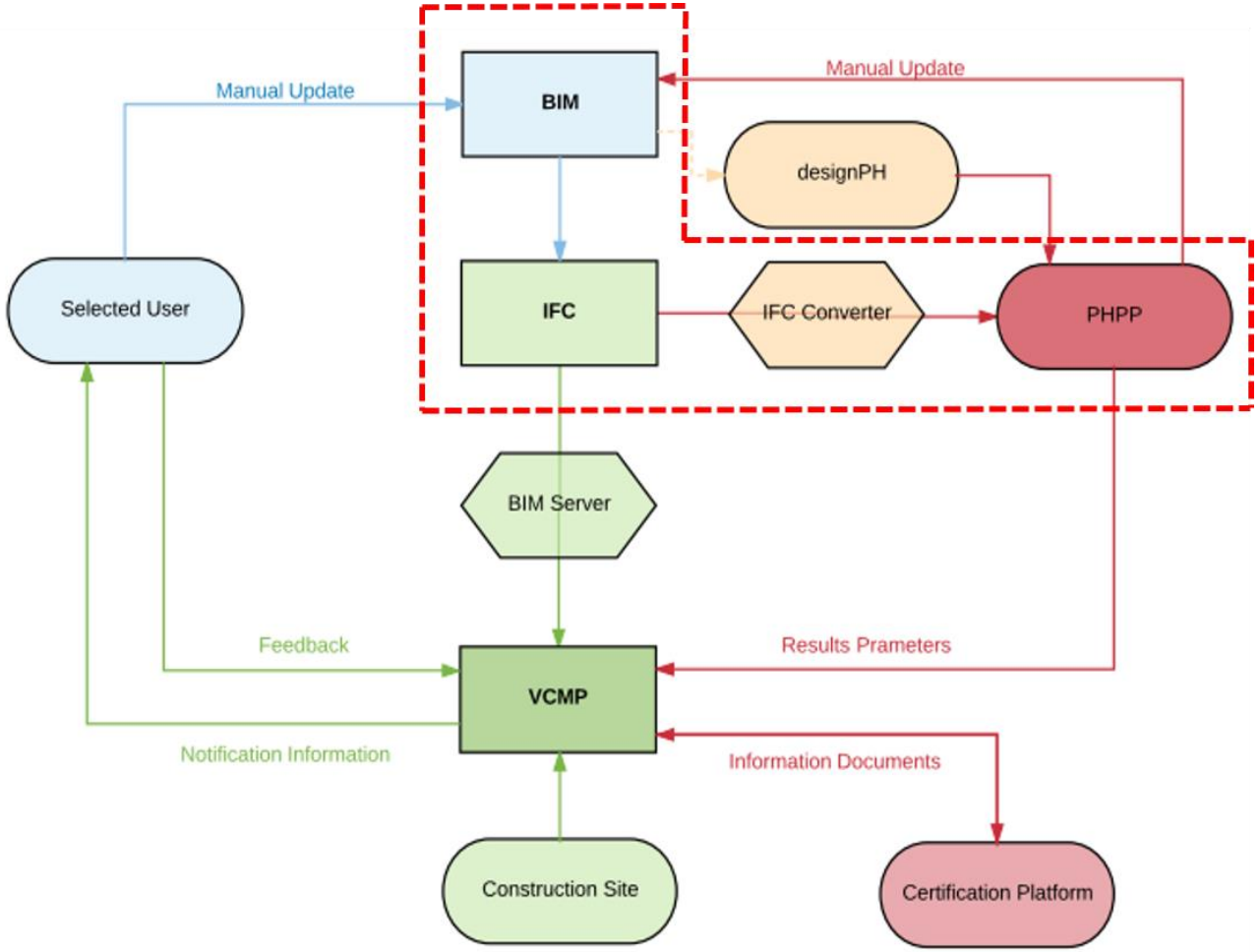
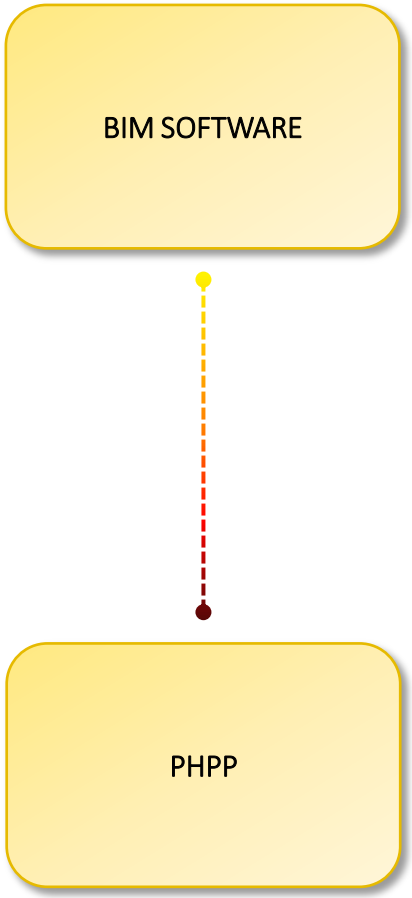
Tools for the 21st Century Construction Worksite

The B2S process

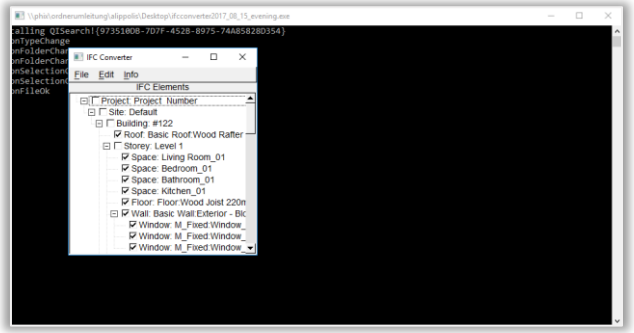
PHPP export in the VCMP process

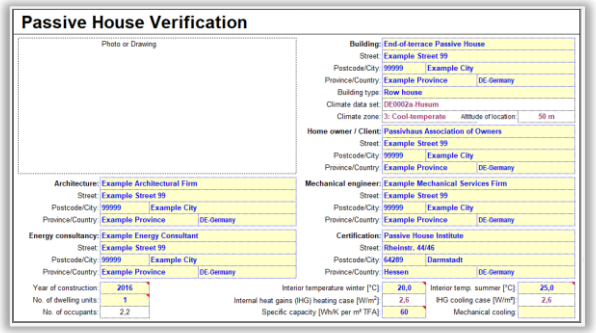




How does it work?

General scheme





How does it work?

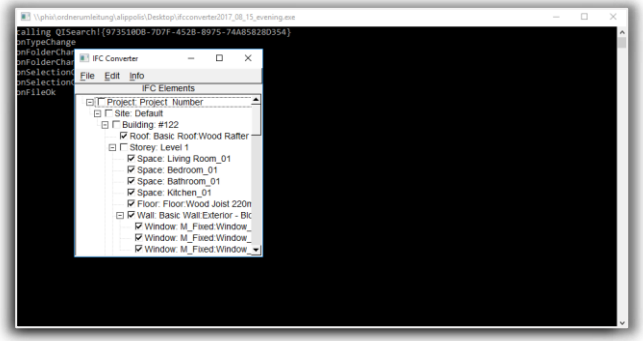
General scheme

How does it work?

General scheme

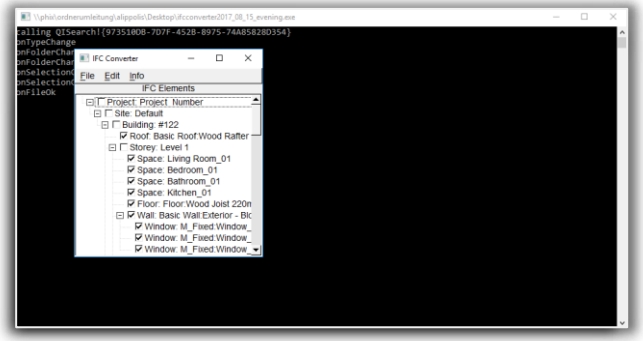
How does it work?

General scheme



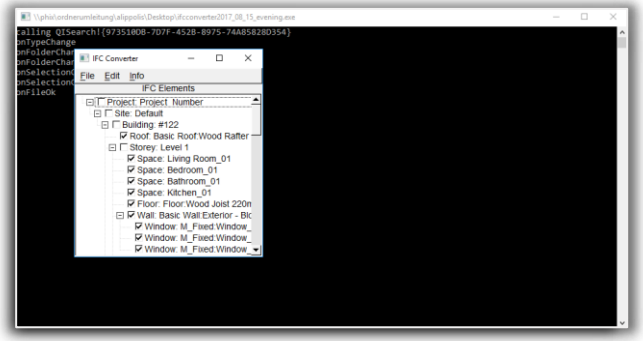
How does it work?

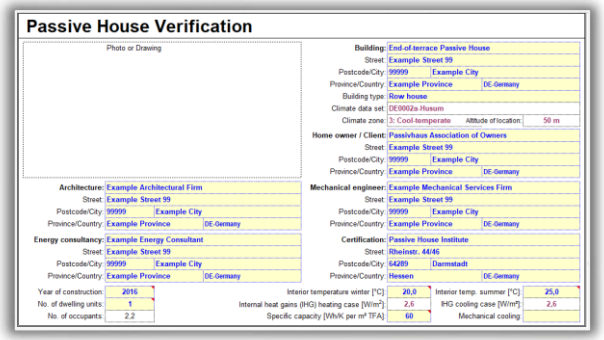
General scheme



How does it work?

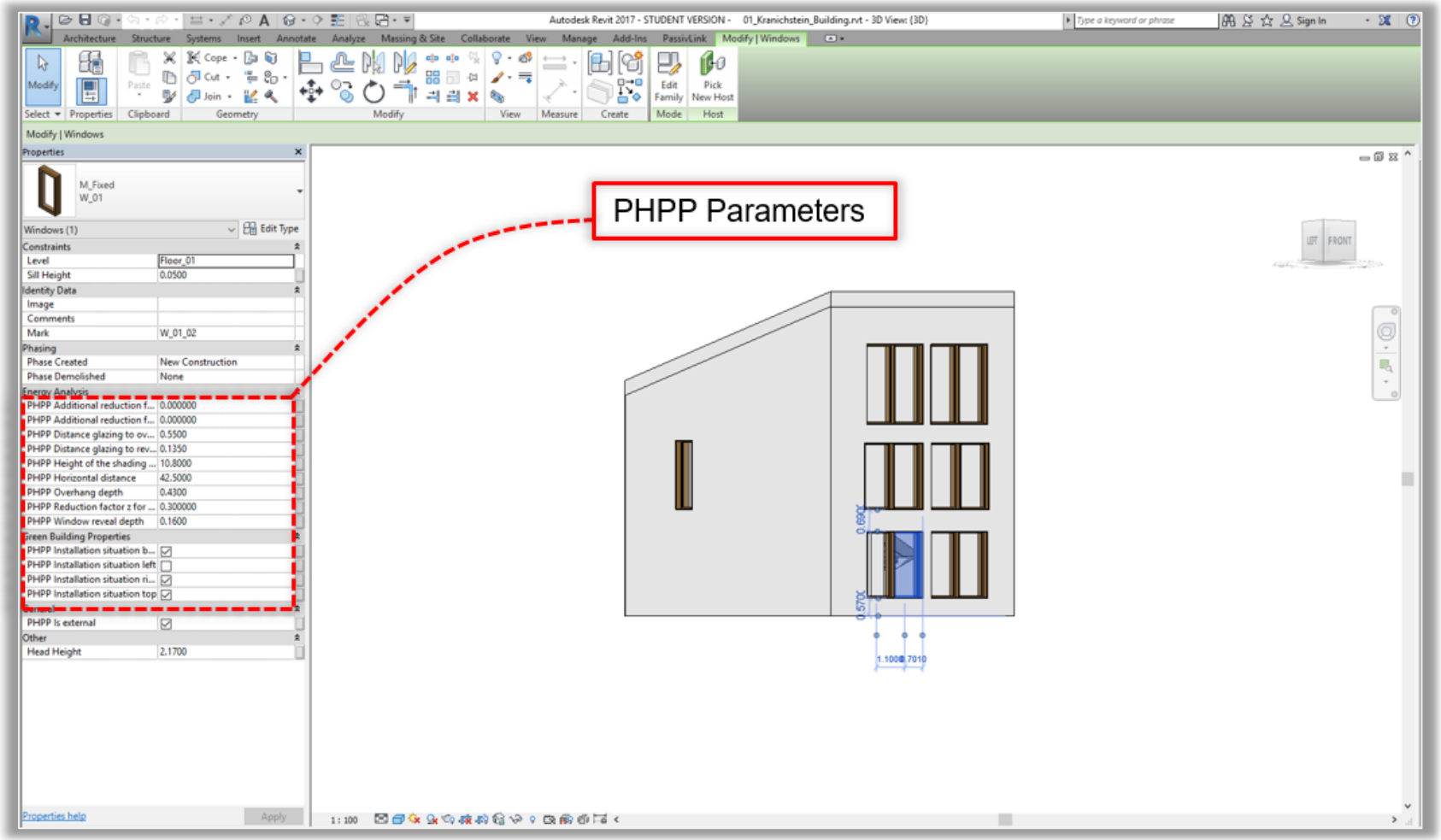
General scheme





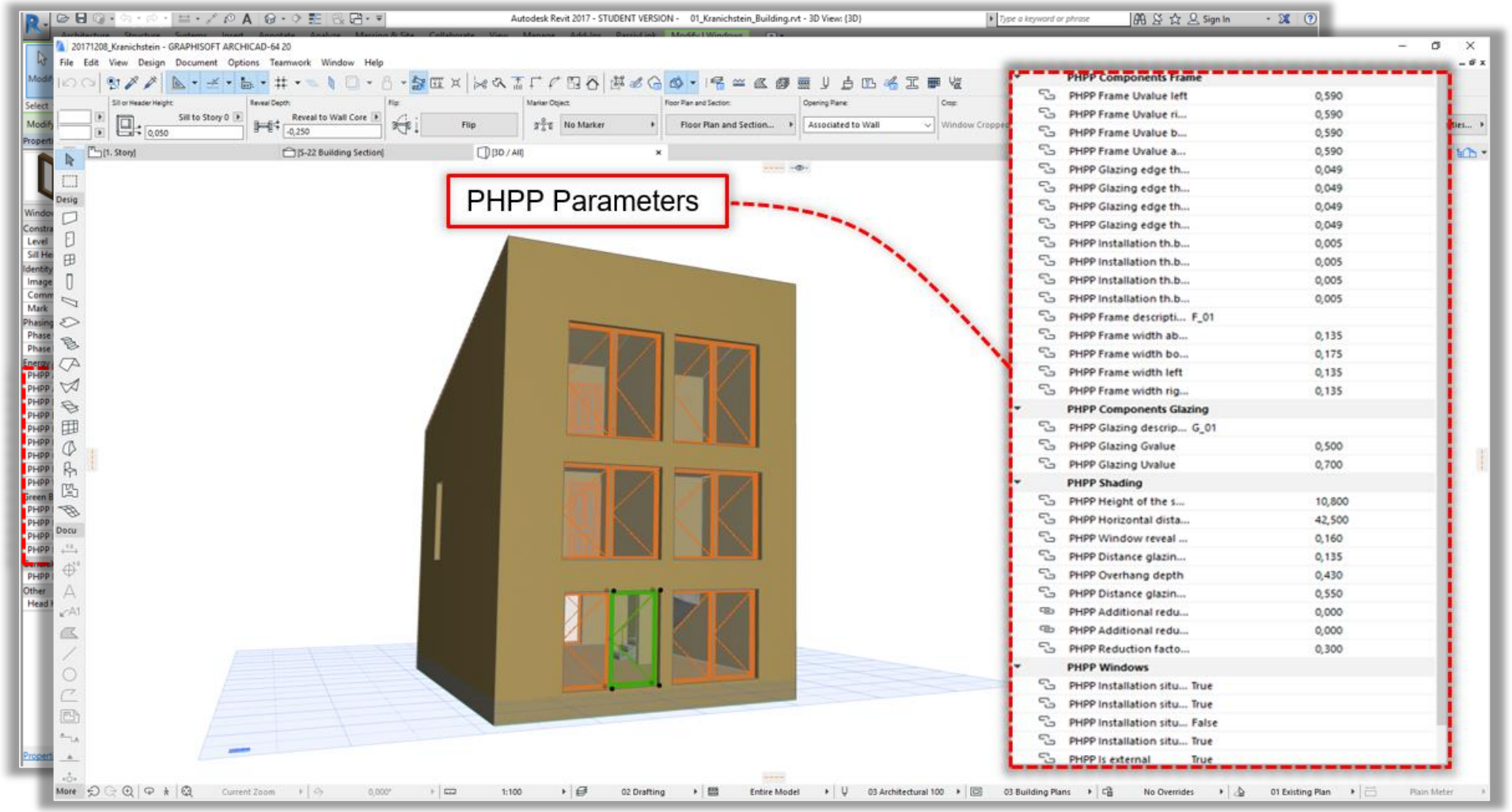
How does it work?

User Templates



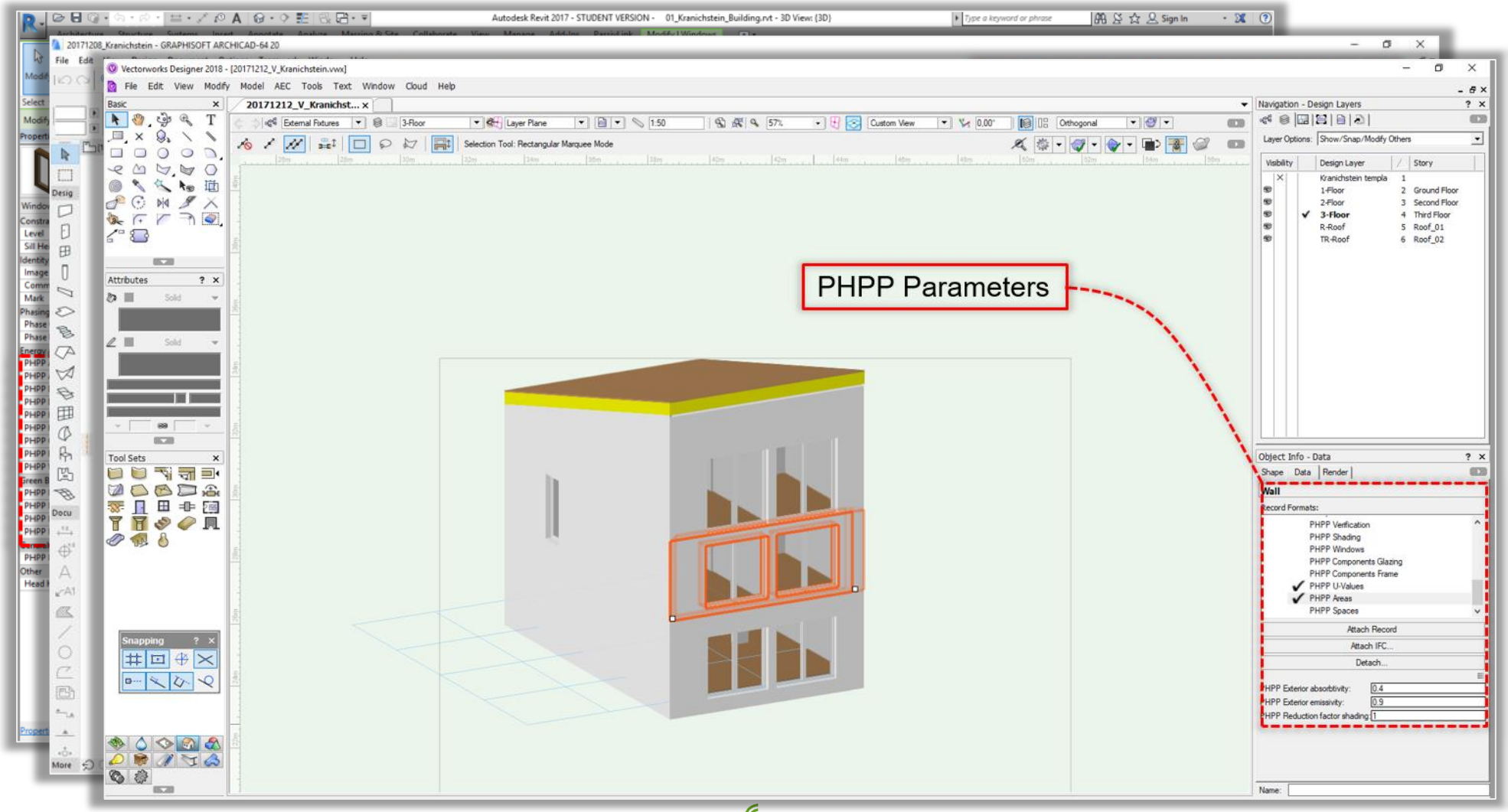
How does it work?

User Templates



How does it work?

User Templates



Passive House Institute

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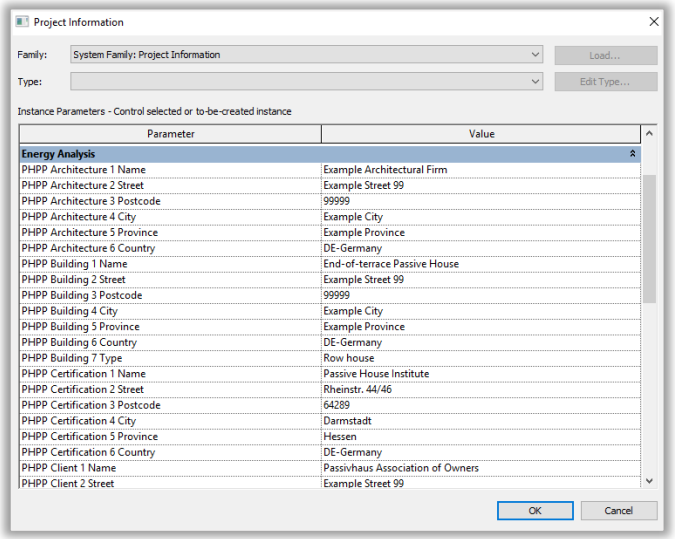
Tools for the 21st Century Construction Worksite

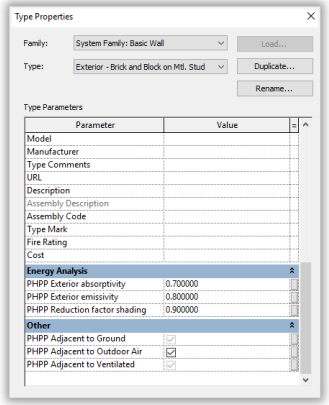
How does it work?

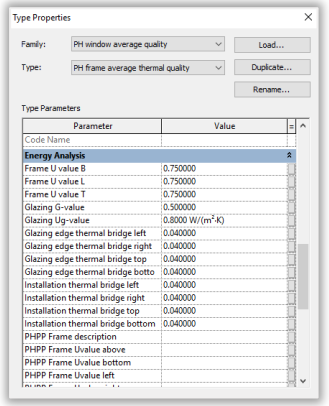
Modeling entering PHPP parameters

Parameters typology:

- Geometry parameters
- Standard parameters
- Custom parameters





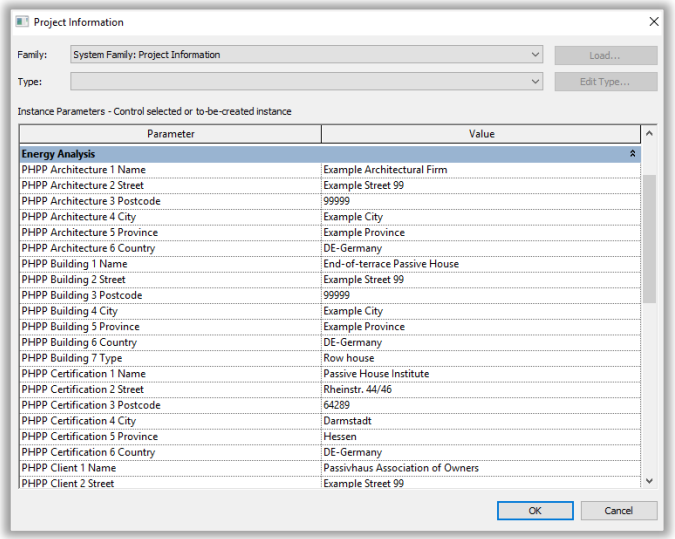


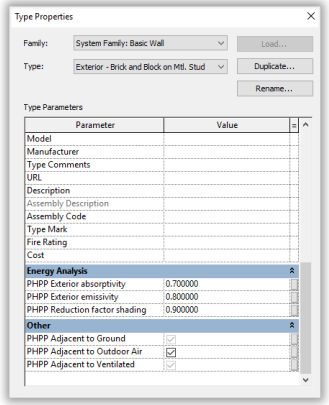
How does it work?

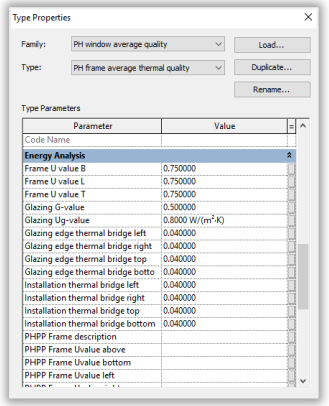
Modeling entering PHPP parameters

Parameters typology:

- Geometry parameters
- Standard parameters
- Custom parameters





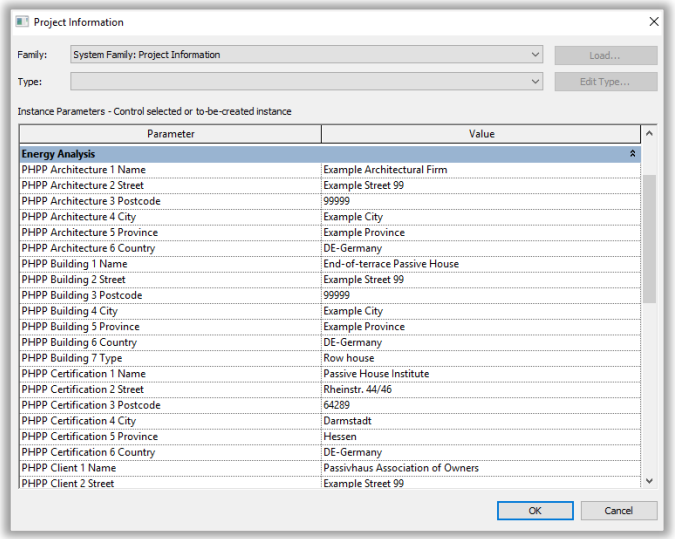


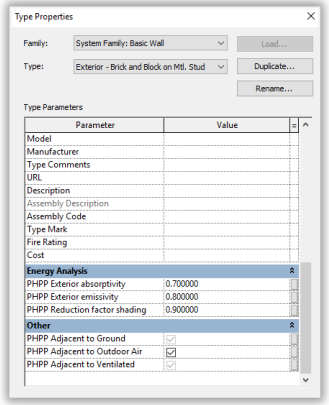
How does it work?

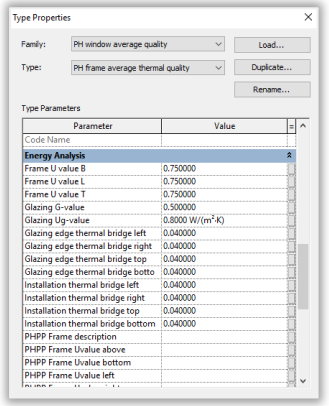
Modeling entering PHPP parameters

Parameters typology:

- Geometry parameters
- Standard parameters
- Custom parameters







How does it work?

IFC aspect

```
#186= IFCWALLSTANDARDCASE('1bBpKXqT58j9ZBKrZWWWvE',#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.),$);
#374= IFCPROPERTYSINGLEVALUE('Exterioremissivity',$,IFCREAL(0.9),$);
#375= PROPERTYSET('3nNpwFmGXCKvXcA39MFnNF',#42, 'PHPP_Area', $,(#372,#373,#374));
#…
#383= IFCRELDEFINESBYPROPERTIES('2DU8zPrHPCFwOdbN0zW9sH',#42,$,$,(#186),#375);
```

```
#1342= IFCWALLSTANDARDCASE('1AO2V$k_n0SPqXarzTD8JA',#42,'Basic Wall:underground
walls:211697',$,'Basic Wall:underground walls',#1306,#1338,'211697',.EXTERNAL.);
#…
#1345= IFCQUANTITYLENGTH('Height',$,$,3.,$);
#1346= IFCQUANTITYLENGTH('Length',$,$,6.74999999999999,$);
#1347= IFCQUANTITYLENGTH('Width',$,$,0.5,$);
#1348= IFCQUANTITYAREA('GrossFootprintArea',$,$,3.25,$);
#1349= IFCQUANTITYAREA('GrossSideArea',$,$,20.25,$);
#1350= IFCQUANTITYVOLUME('GrossVolume',$,$,9.75,$);
#1351=IFCELEMENTQUANTITY('28F0eIeEX6oOcWcPJAqcda',#42,'BaseQuantities',$,$,(#1345,#1346
,#1347,#1348,#1349,#1350));
#…
#1353= IFCRELDEFINESBYPROPERTIES('39Rd7aAX57ShFyBN_jKVK6',#42,$,$,(#1342),#1351);
```

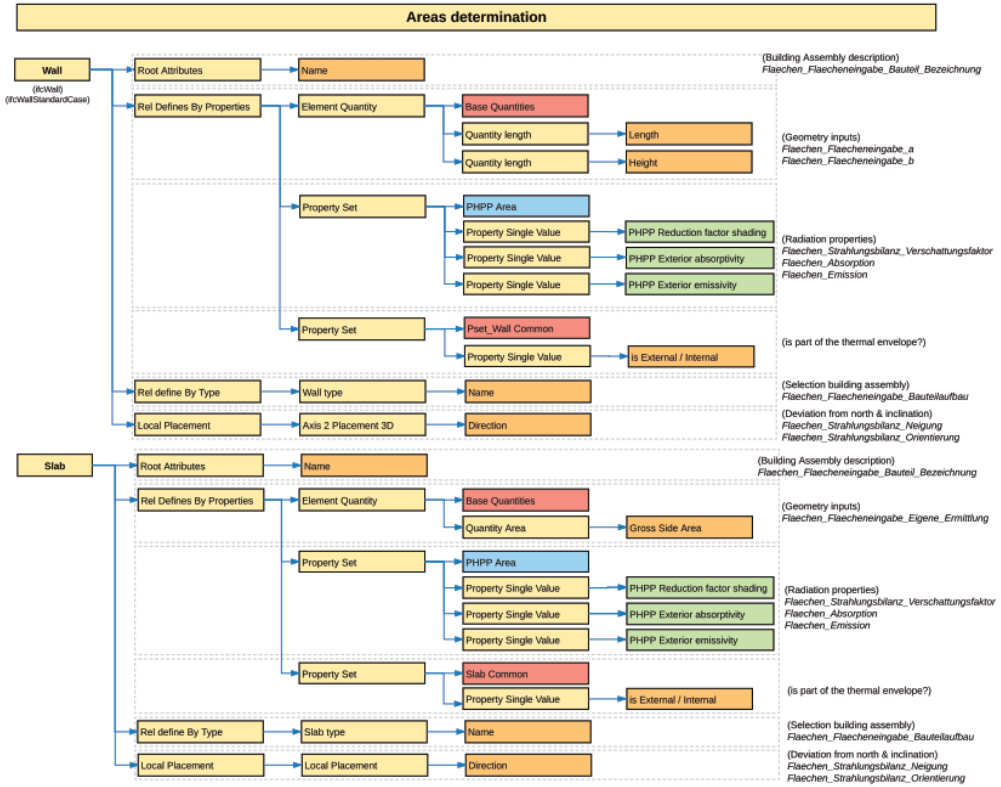
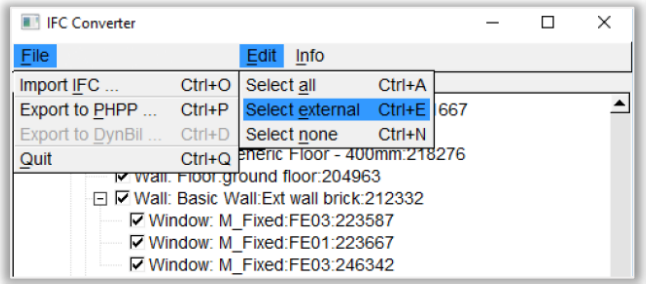


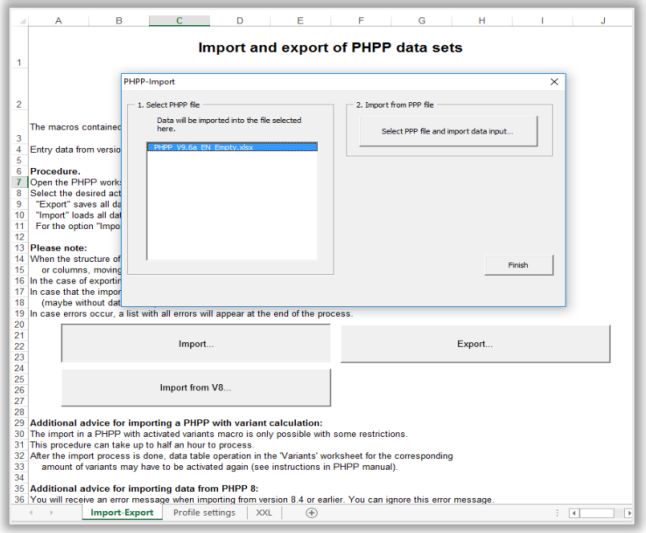
Fig.04: IFC Layout and Chart used for data communication

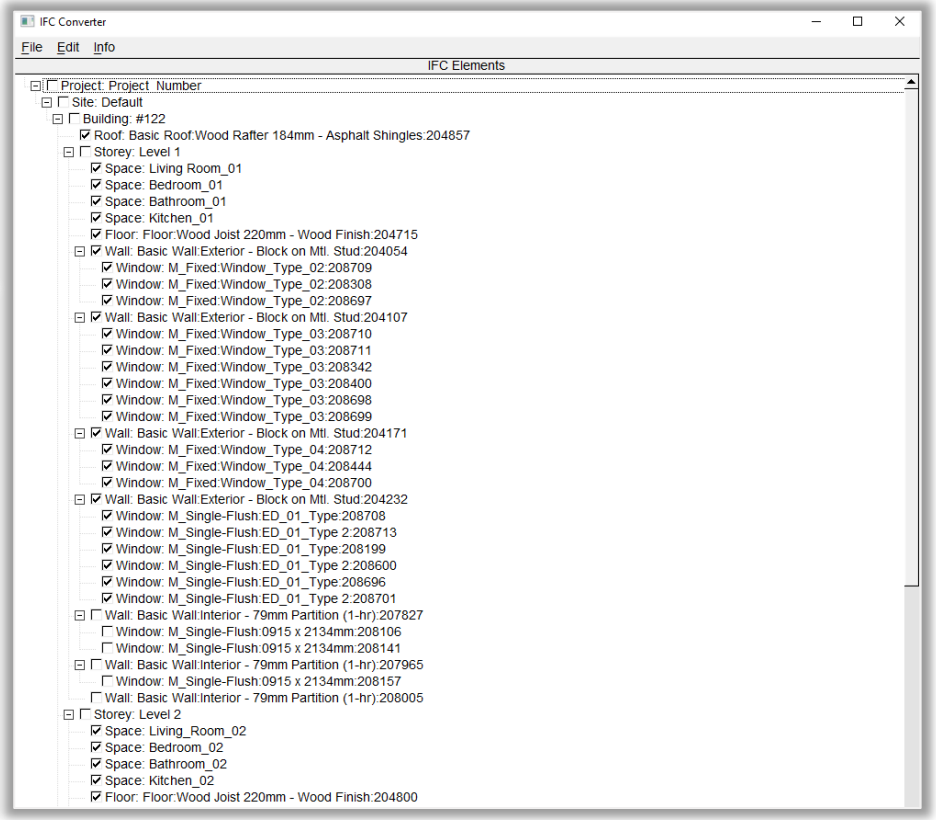
How does it work?

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?

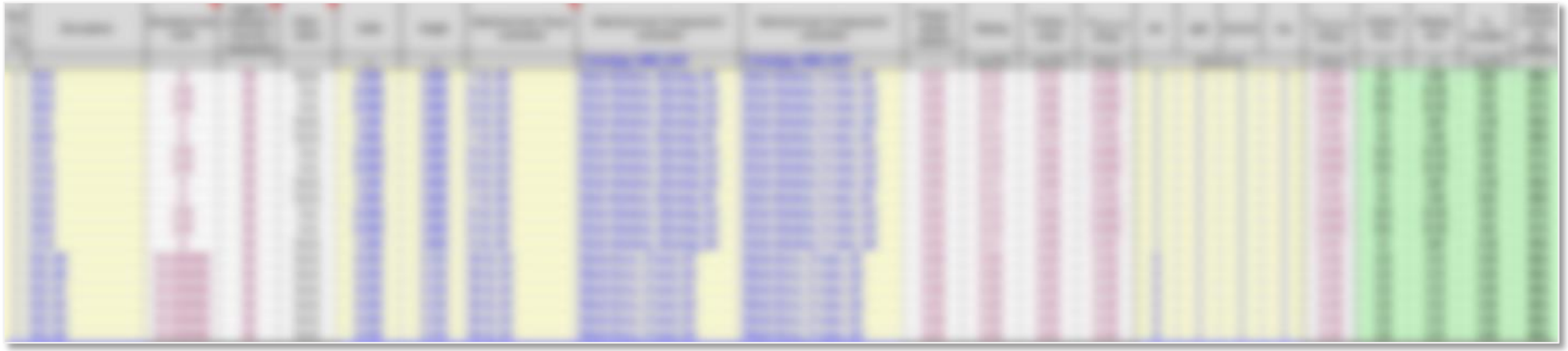
PHPP results

Passive House Verification

Photo or Drawing

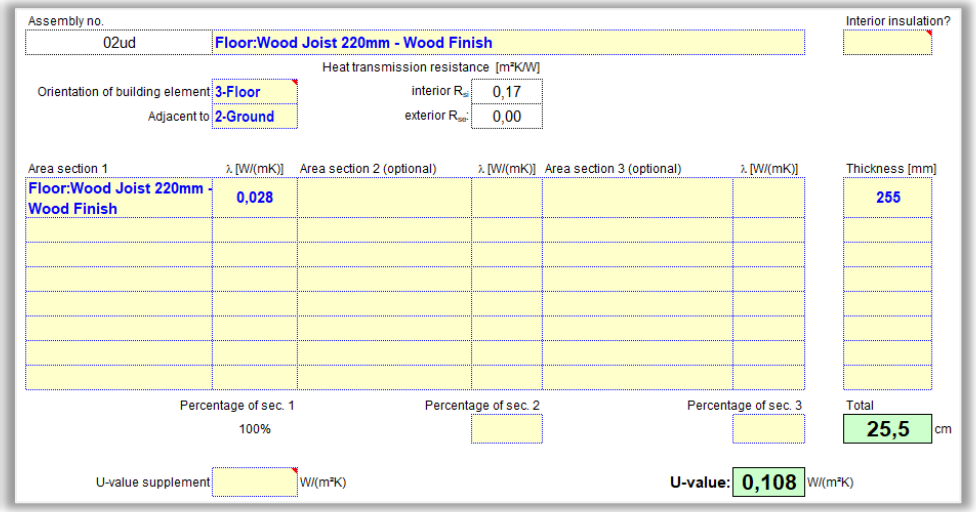
Building:	End-of-terrace Passive House		
Street:	Example Street 99		
Postcode/City:	99999	Example City	
Province/Country:	Example Province	DE-Germany	
Building type:	Row house		
Climate data set:	DE0002a-Husum		
Climate zone:	3: Cool-temperate	Altitude of location:	50 m
Home owner / Client:	Passivhaus Association of Owners		
Street:	Example Street 99		
Postcode/City:	99999	Example City	
Province/Country:	Example Province	DE-Germany	
Architecture:	Example Architectural Firm		
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	
Energy consultancy:	Example Energy Consultant		
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	

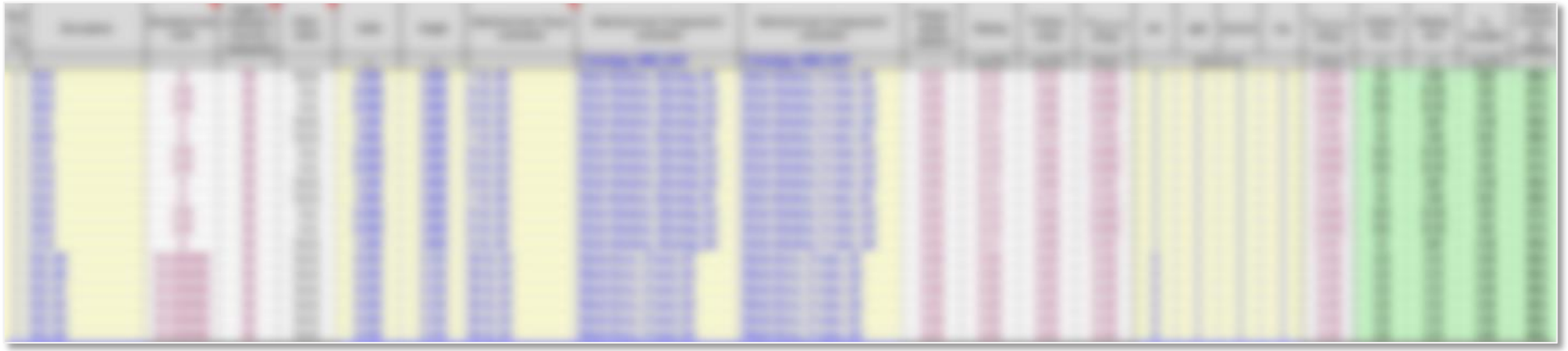
Year of construction:	2016	Interior temperature winter [°C]:	20,0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2,6
No. of occupants:	2,2	Specific capacity [Wh/K per m² TFA]:	60
		Interior temp. summer [°C]:	25,0
		IHG cooling case [W/m²]:	2,6
		Mechanical cooling:	



How does it work?

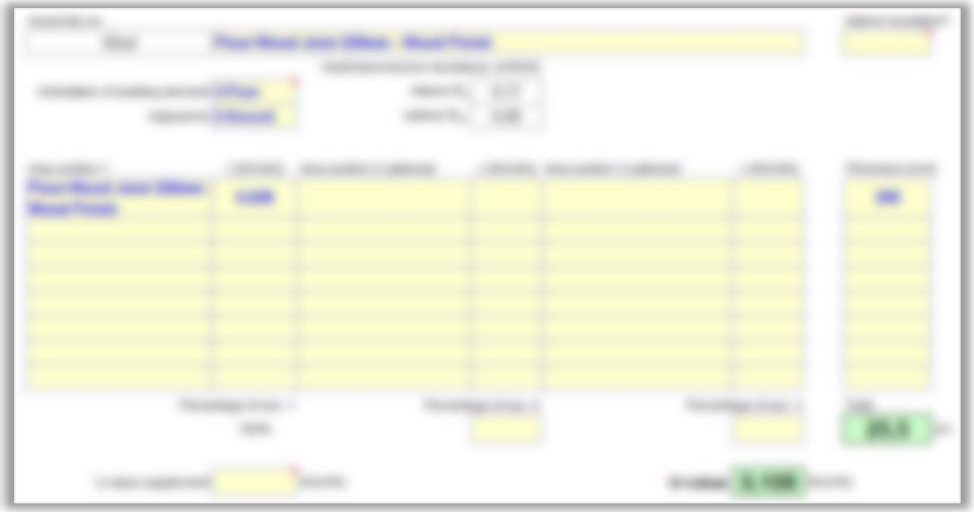
PHPP results





How does it work?

PHPP results



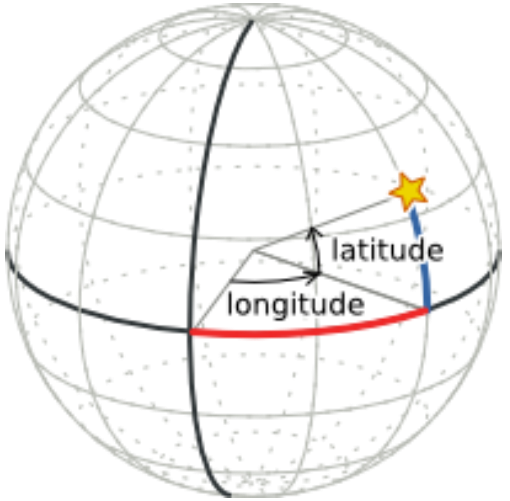
Quantity	Description	Deviation from north	Angle of inclination from the horizontal	Orientation	Width	Height	Selection from 'Areas' worksheet	Selection from 'Components' worksheet	Selection from 'Components' worksheet	Perpendicular radiation	Glazing	Frames (avg.)	$\Psi_{Glazing edge}$ (Avg.)	left	right	bottom	top	$\Psi_{Installation}$ (Avg.)	Window Area	Glazing area	U_w installed	Glazed fraction per window
					m	m		1-Sorting: LIKE LIST	1-Sorting: LIKE LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%
1	28,0	0	90	North	1,500	1,000	7-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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-W_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



Conclusions

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Passive House Institute

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- Materials
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- Surfaces
- TFA
- Volume
- Windows/Doors geometry
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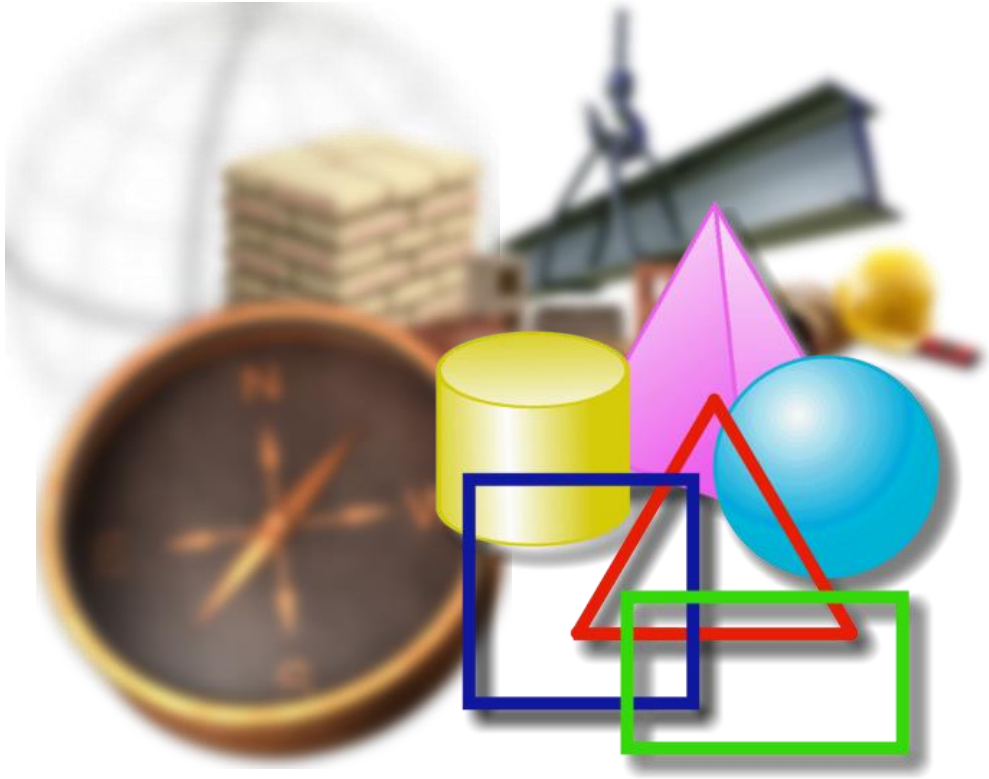

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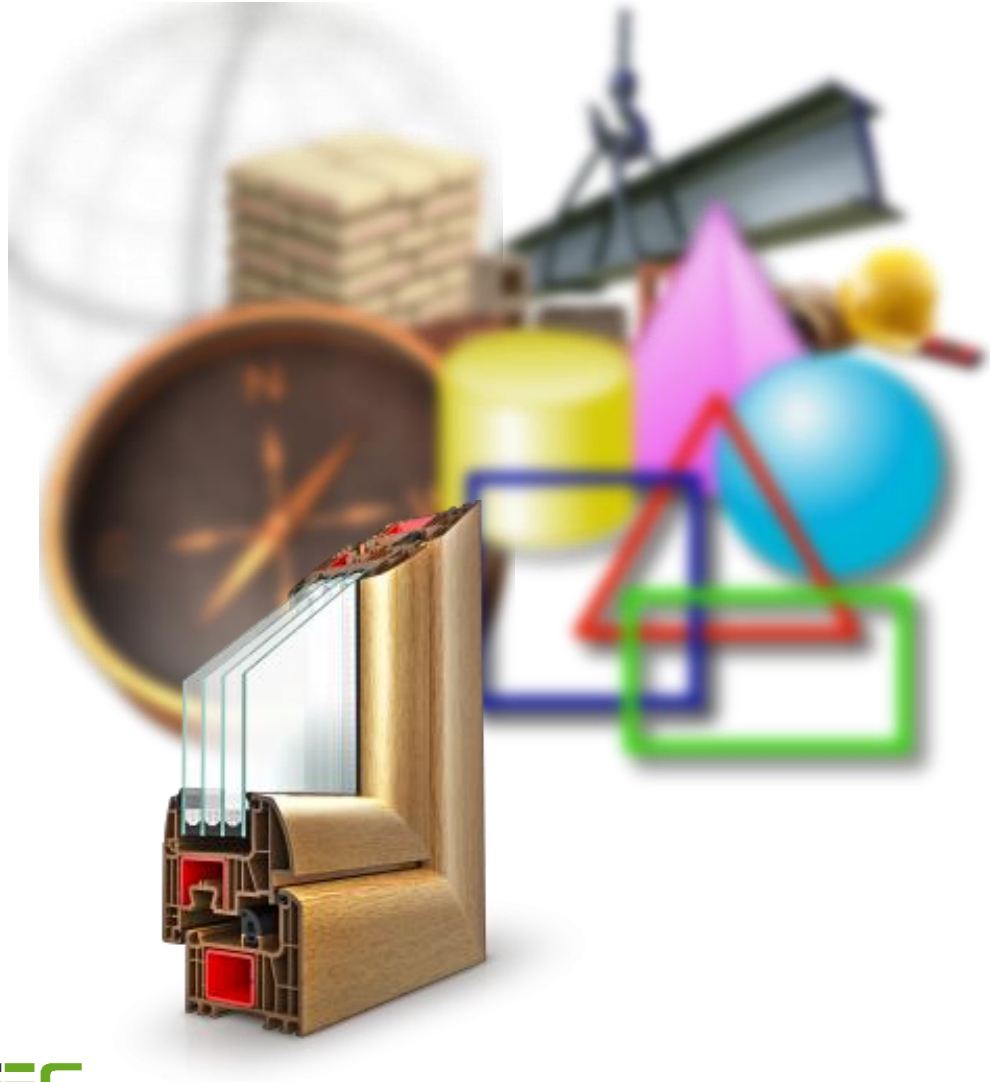

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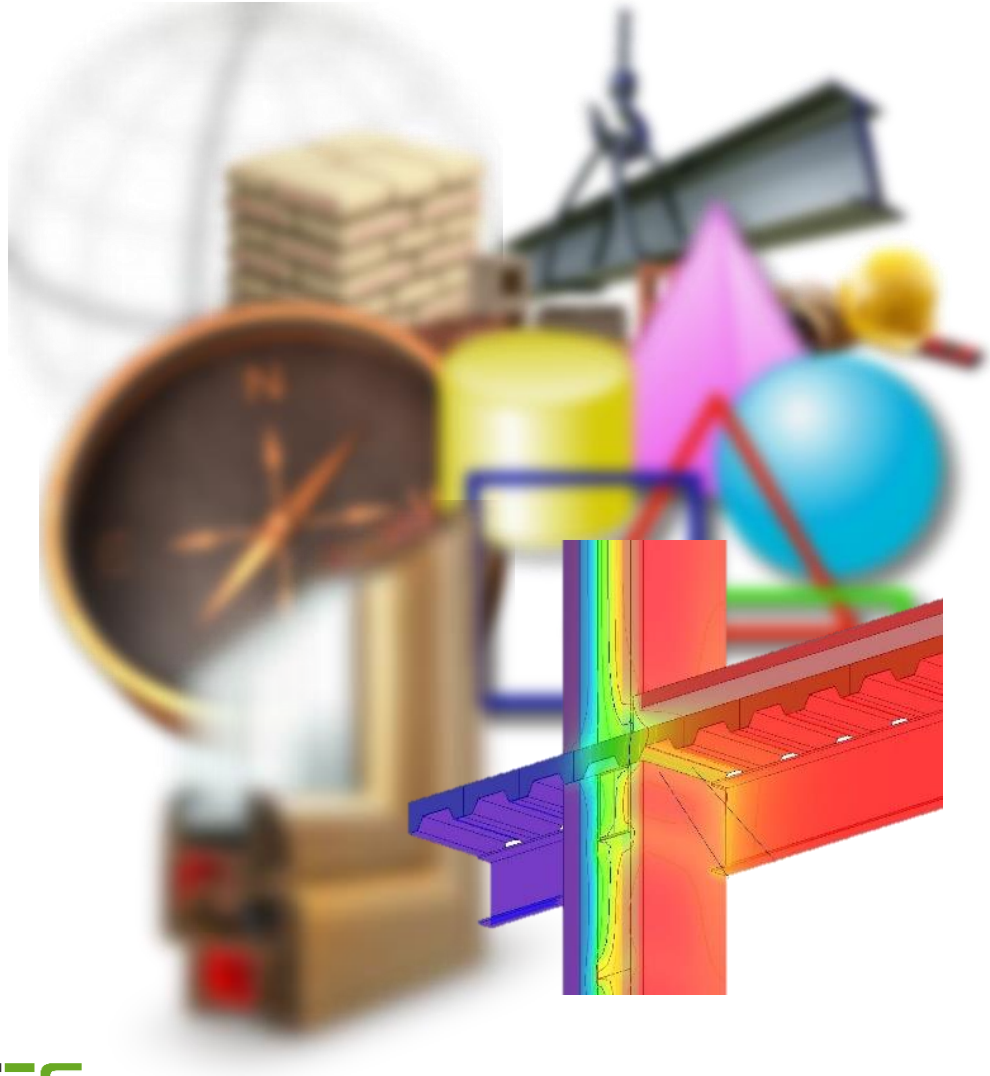
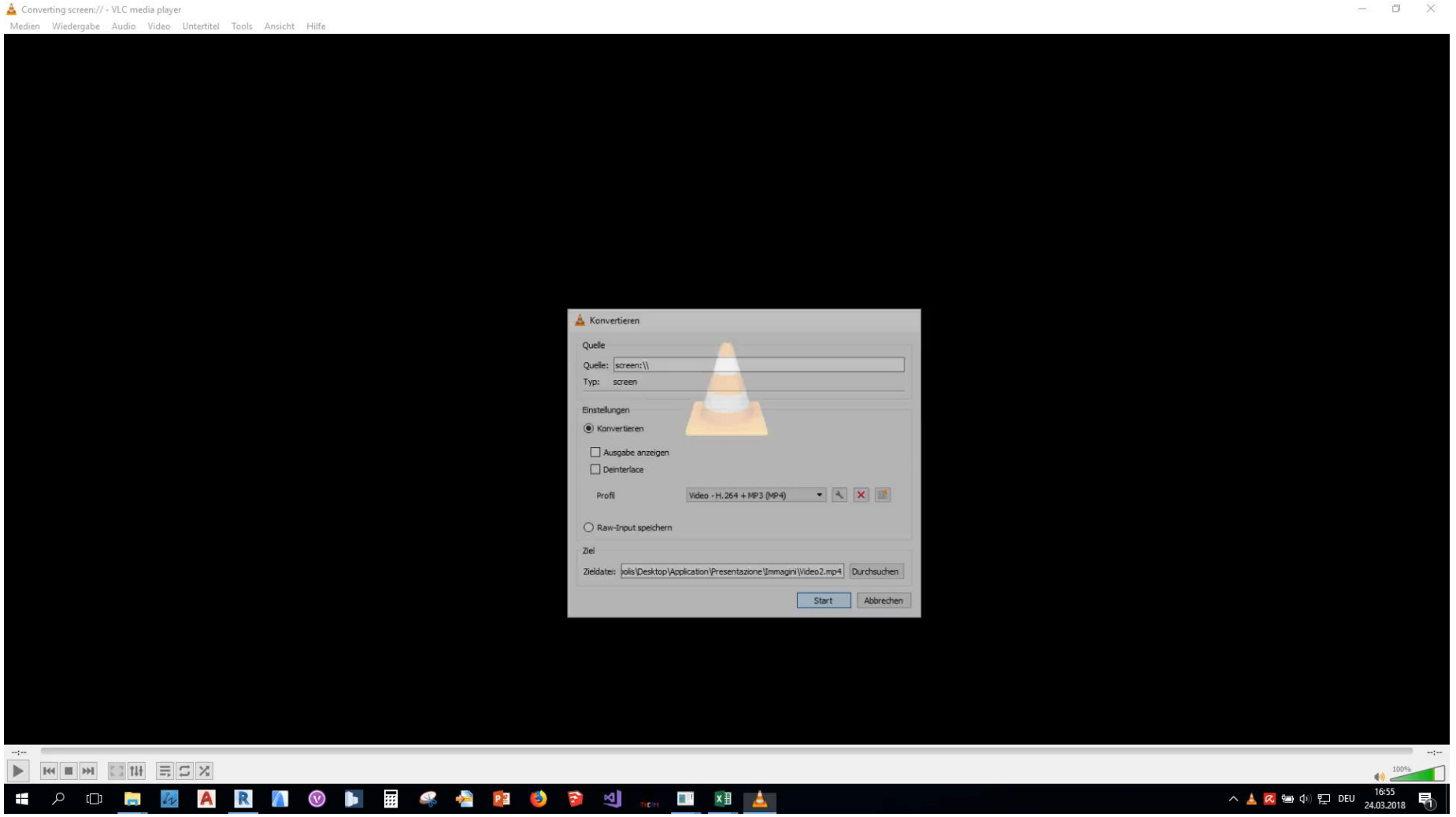
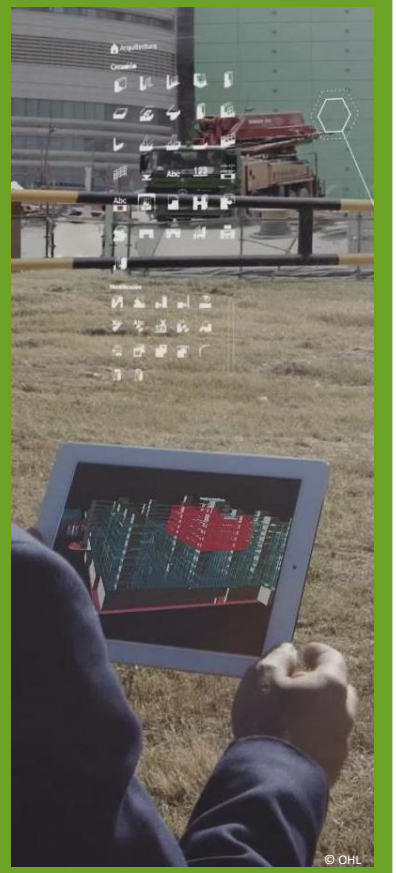


Conclusions

Let´s have a look!





BUILT2SPEC

Tools for the 21st Century Construction Worksite

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