DesignPH – 05: Adding Detail - Thermal Bridges, TFA

Webinar. July 21, 2020

NYPH NEW YORK PASSIVE HOUSE

bldgtyp

designPH

Ed May I Partner, Building-Type, LLC

(architect, passive house consultant, teacher)

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NYPH 2020 Technical Workshops

May 19th

June 2nd

June 16th

June 30th

July 21st

TBD…

DesignPH | SketchUp | PHPP | Ventilation

DesignPH 2.0 A Powerful Tool	NYPH Members	General Admission	PHI CEUs
MODULE 01 | BASIC | FOR EVERYONE			
01_Workflow: Modeling, Required Tools	Free	$ 15	1.0 EC
02_Solar: Location, Orientation, Axes, Shadow	Free	$ 15	1.0 EC
MODULE 02 | ADVANCED | FOR PASSIVE HOUSE DESIGNERS			
03_Face Assignments: Exposure Type, U-Values, Creating Assemblies	Free	$ 15	TBD
04_Face Assignments: Below Grade, Shading Context, Non-Thermal Faces	Free	$ 15	TBD
05_Assignments: Thermal Bridge, TFA Surface	Free	$ 15	TBD
06_Window: Modeling, Components, Mullions and Reveals	Free	$ 15	TBD
07_Window: Editing and Adjusting, Curtain Walls, Shading	Free	$ 15	TBD
MODULE 03 | PROFESSIONAL | FOR ENERGY MODELERS			
08_Analysis: Run Simulations, Results Tracker	TBD	$ 15	TBD
09_Shading: Analyzing Window Radiation, Trees and Irregular Shading	TBD	$ 15	TBD
10_PHPP: Exporting .PPP File, Importing .PPP File, Finish off the model in PHPP	TBD	$ 15	TBD

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Agenda [1 hour]

- DesignPH Review
- Thermal Bridges in DesignPH
- Psi-Values?
- Interior Spaces, TFA
- Room-level Data Management

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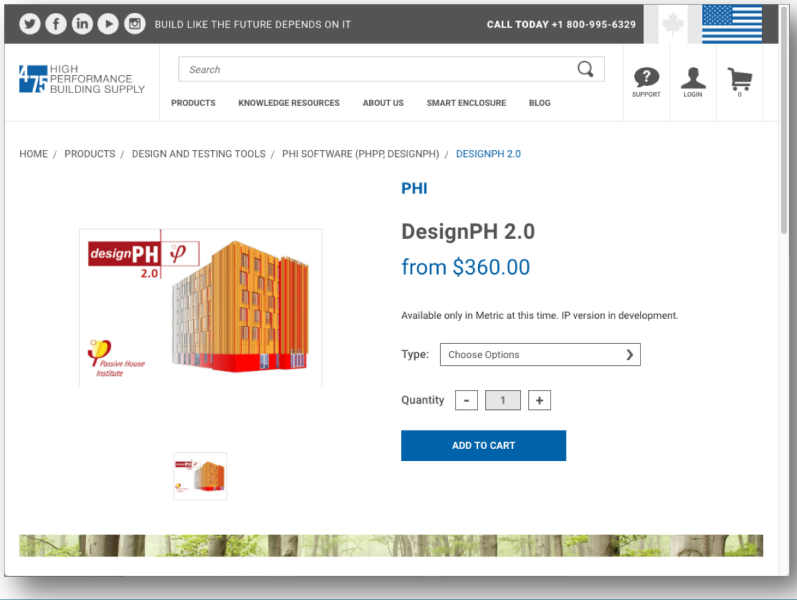
DesignPH Review

Requirements

What you'll need:

- A copy of the DesignPH 2.0 plugin
- Sketchup 3-D modeling software
- A copy of the PHPP v.8 or 9 (and Excel)

https://foursevenfive.com/designph-2-0/



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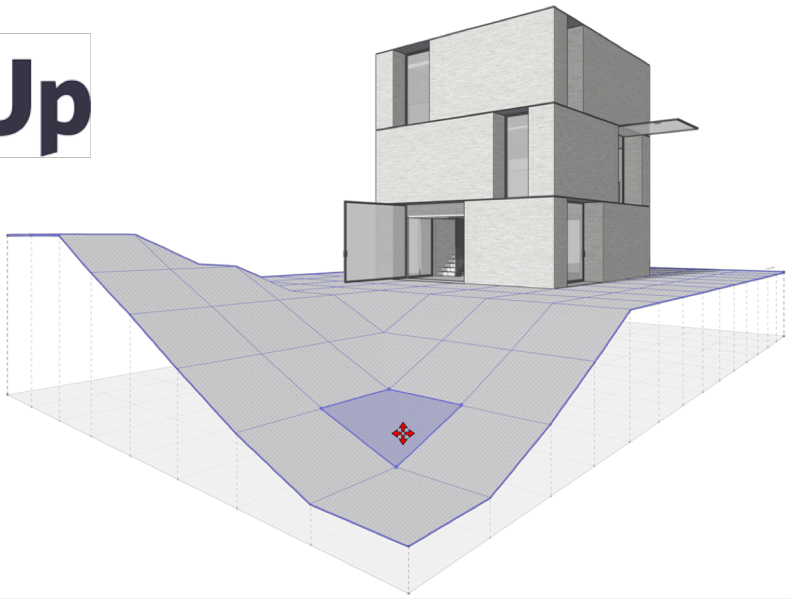
Sketchup



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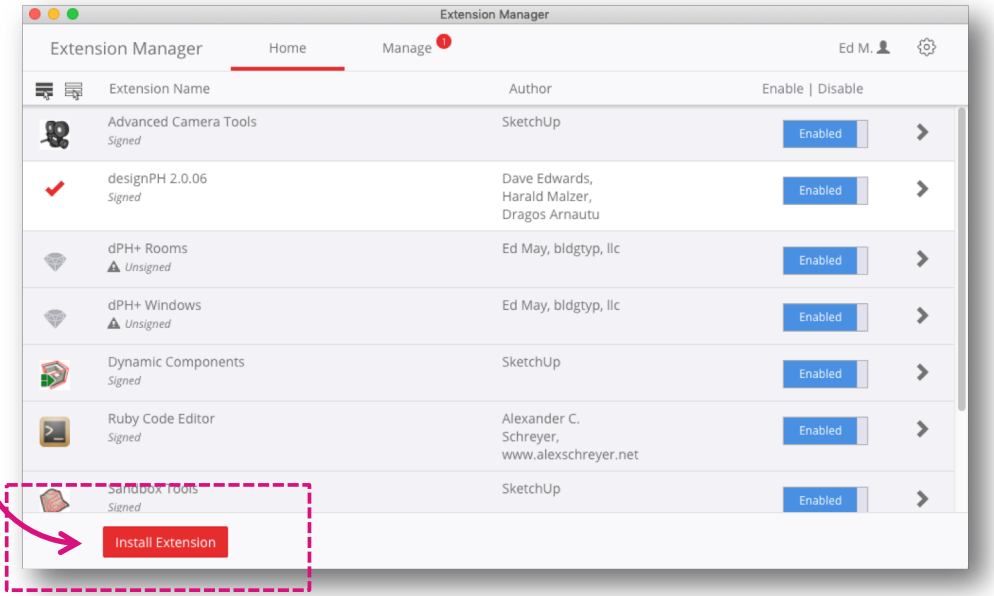
Sketchup Extensions Manager



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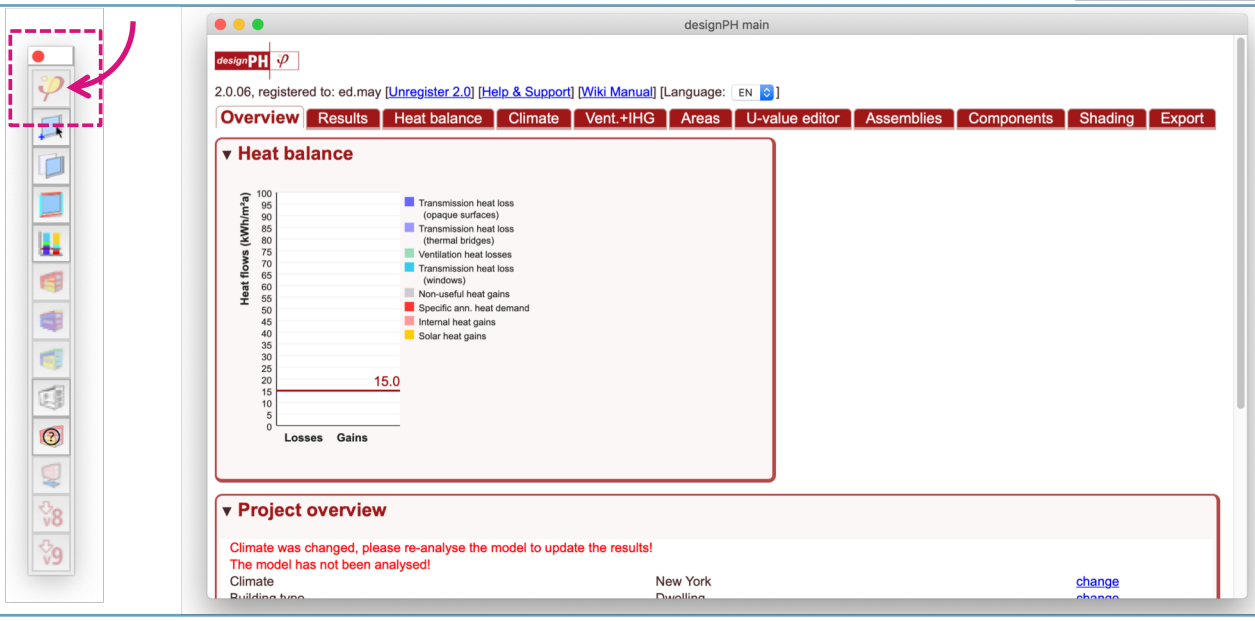
Start DesignPH Plugin [Each time you run Sketchup]



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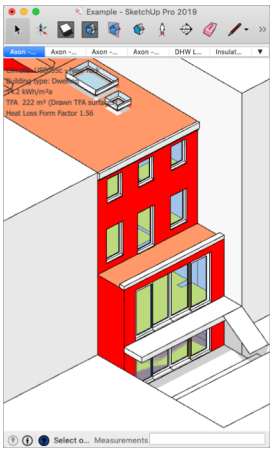
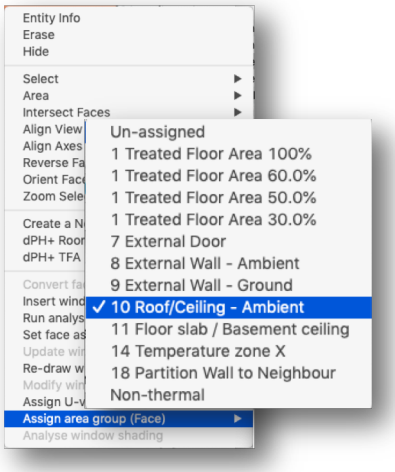
DesignPH Workflow

1) Model Geometry



2) Tag Model Geometry w/ Data



3) Analyze

4) Export

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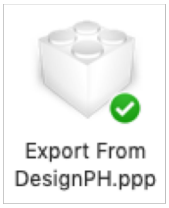
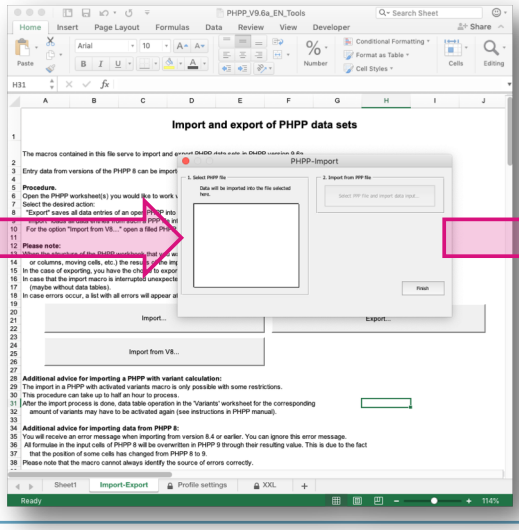
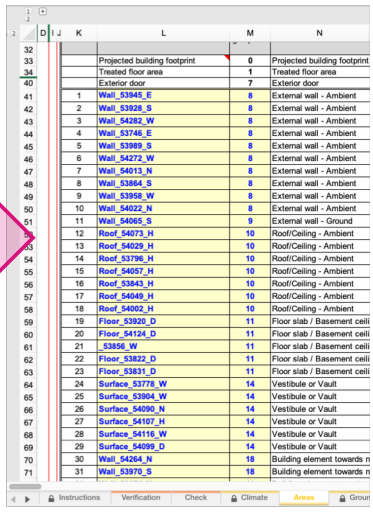
DesignPH Workflow



5) Import



6) Complete the PHPP



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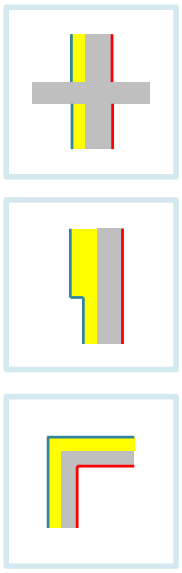
Thermal Bridges In DesignPH 2.0

How do you calculate the heat loss of a surface?

$$\text{Heat Loss}_{surface} = \text{Area}_{surface} \times \text{U-Value}_{surface} \times \Delta T$$

Describes the 'Typical' assembly

‘Thermal Bridge’ ?



Any place in the building envelope where the otherwise uniform thermal resistance is significantly changed due to:

full or partial penetration of the insulating layers by materials with a different thermal conductivity **and/or** a change in thickness of the insulating layers

and/or a difference between internal and external areas, such as occurs at wall/floor/ceiling junctions.

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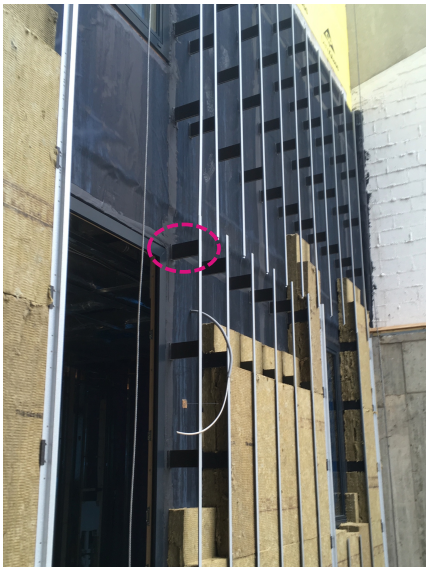
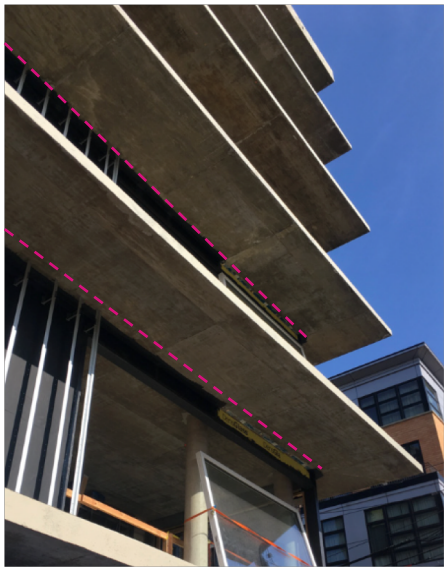
‘Thermal Bridge’ ?



Repeating Thermal Bridges
Included as part of the U-Value

Non-Repeating Thermal Bridges
Included separately from the U-Value



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NYC DOB Method

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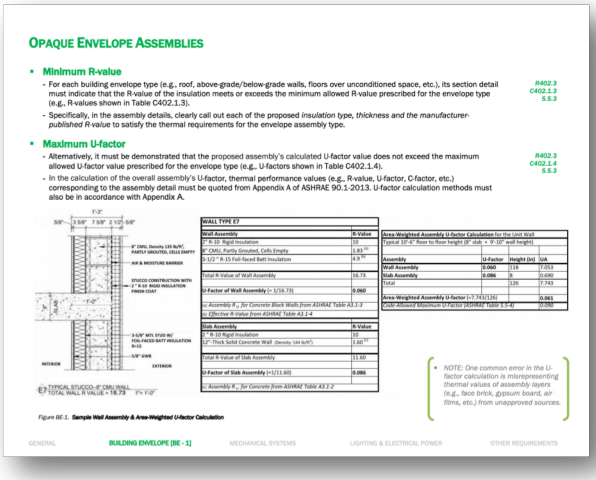
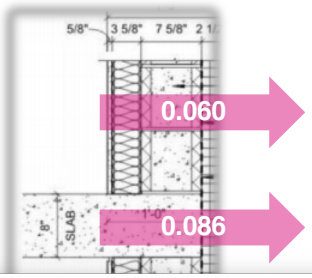
NYC DOB: How-to Guide: Supporting Documentation



OPAQUE ENVELOPE ASSEMBLIES

- **Minimum R-value**
  - For each building envelope type (e.g., roof, above-grade/below-grade walls, floors over unconditioned space, etc.), its section detail must indicate that the R-value of the insulation meets or exceeds the minimum allowed R-value prescribed for the envelope type (e.g., R-values shown in Table C402.1.3).
  - Specifically, in the assembly details, clearly call out each of the proposed *insulation type, thickness and the manufacturer-published R-value* to satisfy the thermal requirements for the envelope assembly type.
- **Maximum U-factor**
  - Alternatively, it must be demonstrated that the proposed assembly's calculated U-factor value does not exceed the maximum allowed U-factor value prescribed for the envelope type (e.g., U-factors shown in Table C402.1.4).
  - In the calculation of the overall assembly's U-factor, thermal performance values (e.g., R-value, U-factor, C-factor, etc.) corresponding to the assembly detail must be quoted from Appendix A of ASHRAE 90.1-2013. U-factor calculation methods must also be in accordance with Appendix A.



Area-Weighted Assembly U-factor Calculation for the Unit Wall			
Typical 10'-6" floor to floor height (8" slab + 9'-10" wall height)			
Assembly	U-Factor	Height (in)	UA
Wall Assembly	0.060	118	7.053
Slab Assembly	0.086	8	0.690
Total		126	7.743
Area-Weighted Assembly U-factor (=7.743/126)			0.061
Code-Allowed Maximum U-Factor (ASHRAE Table 5.5-4)			*0.090*

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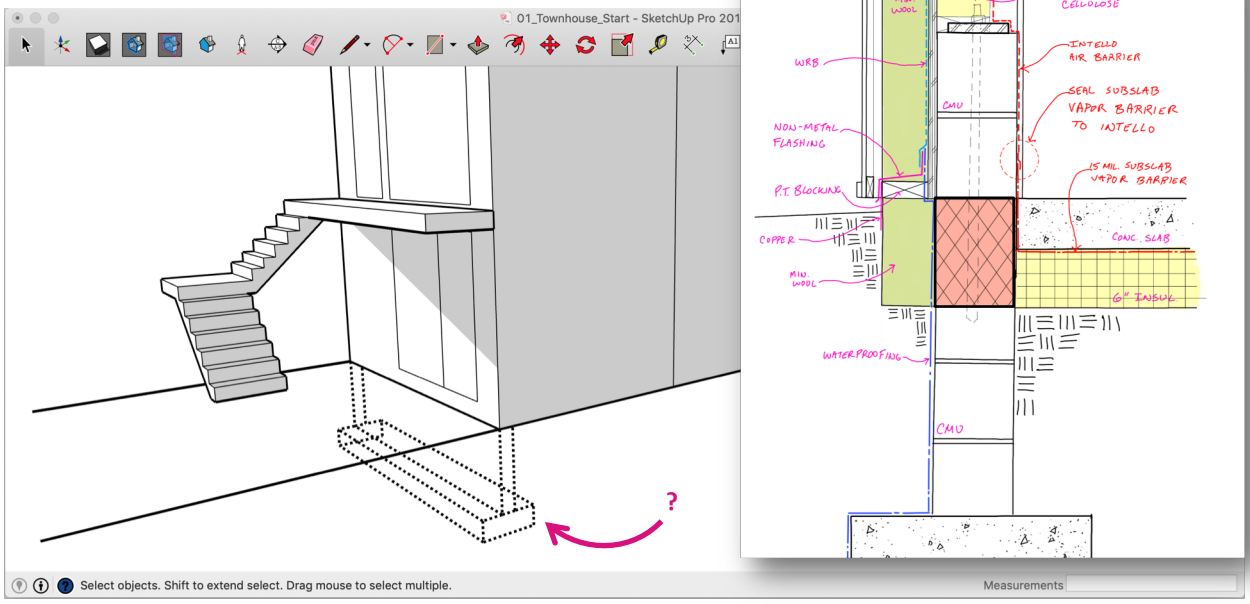
PHPP Method



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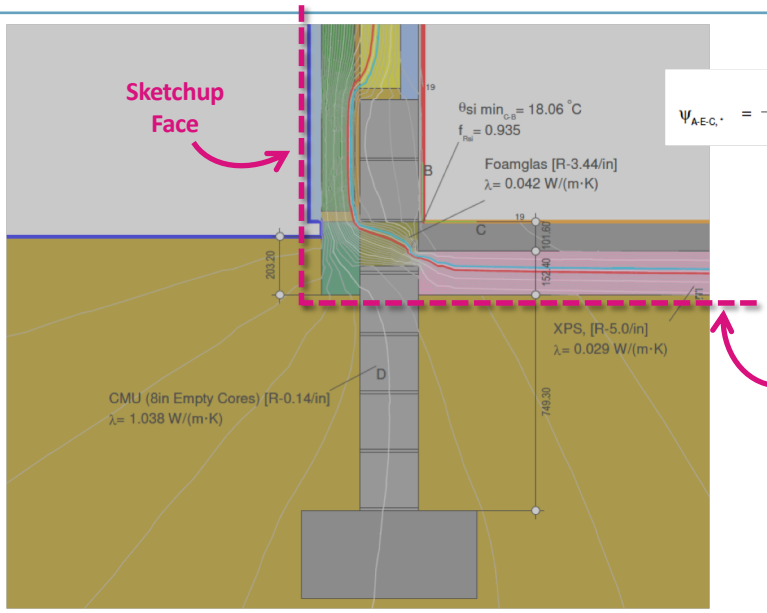
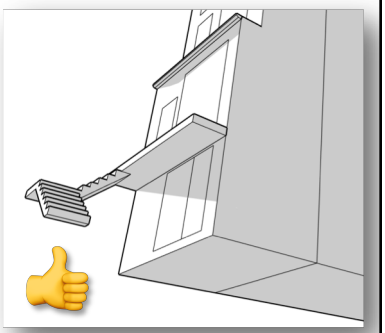
That's What Psi-Values are For!



PSI

$$\psi_{A\text{-}E\text{-}C,\cdot} = \frac{37.760}{30.000} - \frac{27.019}{30.000} - 0.170 \cdot 1.717 = 0.066\ \text{W/(m·K)}$$



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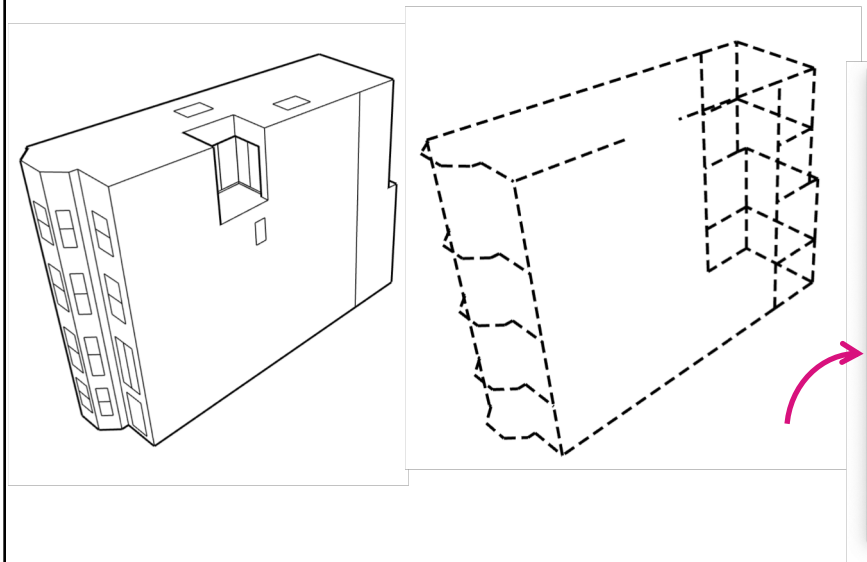
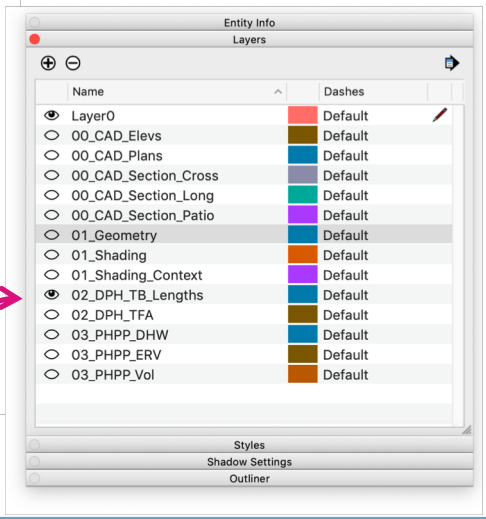
Draw all the TB Lengths as 'Edges' on their own layer





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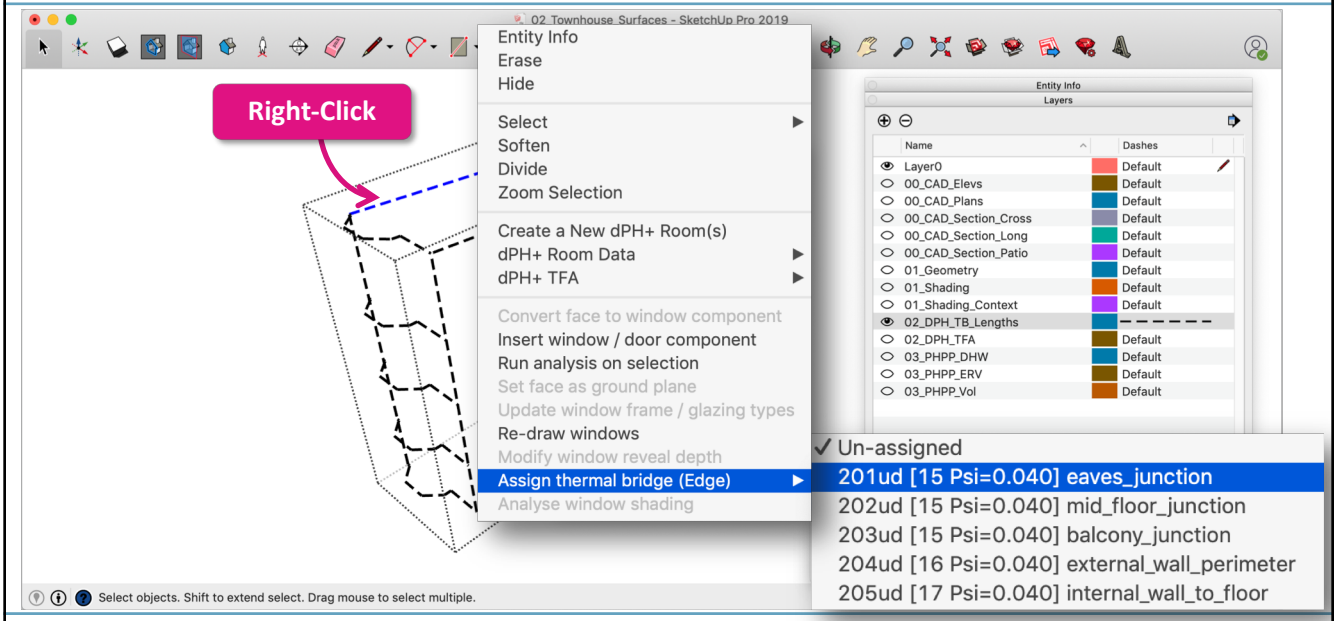
Assign Thermal Bridge 'Type' to each edge



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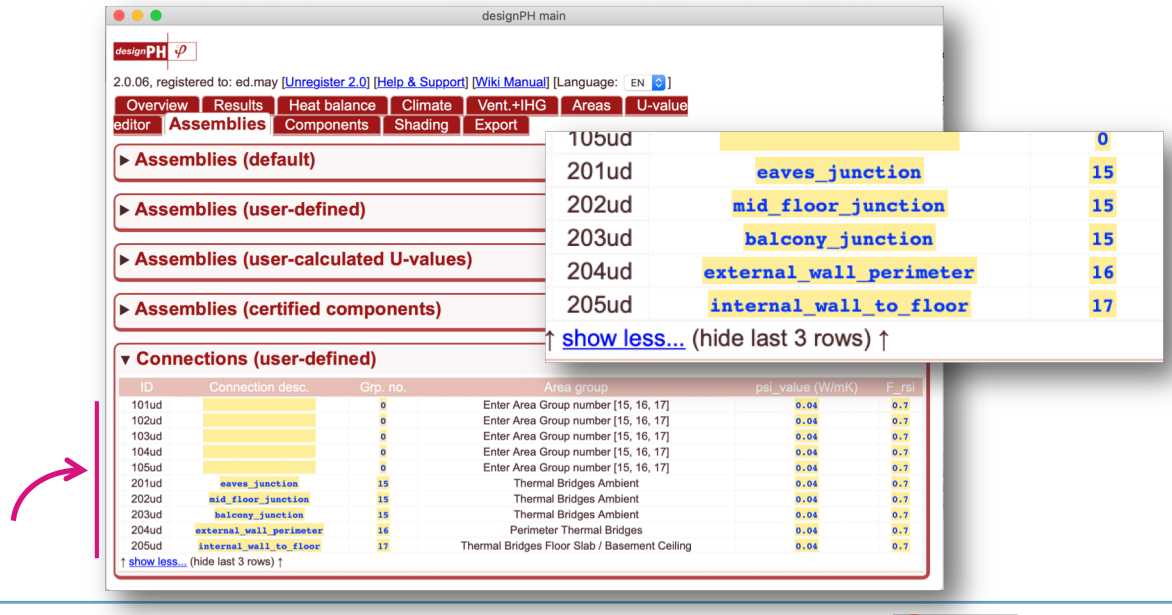
User-Determined Psi-Value 'Types'



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TB in PHPP (Areas Worksheet)

Thermal bridge inputs

No.	Thermal bridge - denomination	Group No.	Assigned to group	Quanti ty	x (	Length [m]	-	Subtraction length [m]	)=	Length l [m]	User determined psi value [W/(mK)]	User determined $f_{Rsi=0,25}$ (optional)
1					x (		-		) =			
2	DTL_PERIM_FLOOR_01	16	Perimeter thermal bridges	1	x (	6.01	-		) =	6.01	-0.077	
3	DTL_SEC_FLOOR_04	15	Thermal bridges Ambient	1	x (	6.01	-		) =	6.01	0.000	
4	DTL_SEC_FLOOR_04	15	Thermal bridges Ambient	1	x (	6.01	-		) =	6.01	0.000	
5	DTL_SEC_ROOF_03	15	Thermal bridges Ambient	1	x (	6.01	-		) =	6.01	-0.083	
6	DTL_SEC_FLOOR_04	15	Thermal bridges Ambient	1	x (	6.01	-		) =	6.01	0.000	
7	DTL_SEC_ROOF_04	15	Thermal bridges Ambient	1	x (	2.52	-		) =	2.52	-0.066	
8	DTL_PLAN_03_WALL_REAR	15	Thermal bridges Ambient	1	x (	12.98	-		) =	12.98	0.070	
9	DTL_SEC_FLOOR_02-B	15	Thermal bridges Ambient	1	x (	0.69	-		) =	0.69	-0.067	
10	DTL_PLAN_05_WALL_REAR	15	Thermal bridges Ambient	1	x (	3.75	-		) =	3.75	0.065	
11	DTL_SEC_ROOF_04	15	Thermal bridges Ambient	1	x (	2.52	-		) =	2.52	-0.066	
12	DTL_SEC_ROOF_05	15	Thermal bridges Ambient	1	x (	5.00	-		) =	5.00	-0.046	
13	DTL_PERIM_FLOOR_03	16	Perimeter thermal bridges	1	x (	3.21	-		) =	3.21	0.066	
14	DTL_PERIM_FLOOR_03	16	Perimeter thermal bridges	1	x (	3.21	-		) =	3.21	0.066	
15	DTL_SEC_FLOOR_03-B	15	Thermal bridges Ambient	1	x (	3.21	-		) =	3.21	0.016	
16	DTL_SEC_FLOOR_03-B	15	Thermal bridges Ambient	1	x (	3.21	-		) =	3.21	0.016	
17	DTL_SEC_FLOOR_02-C	15	Thermal bridges Ambient	1	x (	2.52	-		) =	2.52	0.018	
18	DTL_SEC_FLOOR_02-C	15	Thermal bridges Ambient	1	x (	2.52	-		) =	2.52	0.018	
19	DTL_SEC_FLOOR_01-B	15	Thermal bridges Ambient	1	x (	2.52	-		) =	2.52	0.015	
20	DTL_SEC_FLOOR_01-B	15	Thermal bridges Ambient	1	x (	2.52	-		) =	2.52	0.015	
21	DTL_PLAN_06_WALL_REAR	15	Thermal bridges Ambient	1	x (	12.98	-		) =	12.98	0.043	
22	DTL_SEC_ROOF_01	15	Thermal bridges Ambient	1	x (	6.24	-		) =	6.24	-0.103	

TB in PHPP (Heating Load Worksheet)

Building assembly	mperature zone	Area m²		U-Value W/(m²K)		Factor always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		PT 1 W		PT 2 W
External wall - Ambient	A	357.4	*	0.223	*	1.00	*	29.9	or	24.4	=	2386	or	1947
External wall - Ground	B		*		*	1.00	*	7.8	or	7.8	=		or	
Roof/Ceiling - Ambient	A	87.6	*	0.110	*	1.00	*	29.9	or	24.4	=	288	or	235
Floor slab / Basement ceiling	B	89.3	*	0.223	*	1.00	*	7.8	or	7.8	=	156	or	156
Suspended Floor	A		*		*	1.00	*	29.9	or	24.4	=		or	
	A		*		*	1.00	*	29.9	or	24.4	=		or	
	X		*		*	0.75	*	29.9	or	24.4	=		or	
Windows	A	72.5	*	0.859	*	1.00	*	29.9	or	24.4	=	1861	or	1519
Exterior door	A		*		*	1.00	*	29.9	or	24.4	=		or	
Exterior TB (length/m)	A	185.9	*	0.006	*	1.00	*	29.9	or	24.4	=	31	or	25
Perimeter TB (length/m)	P	31.5	*	-0.025	*	1.00	*	7.8	or	7.8	=	-6	or	-6
Ground TB (length/m)	B		*		*	1.00	*	7.8	or	7.8	=		or	
Building element towards neighbour	I	193.6	*	0.352	*	1.00	*	3.0	or	3.0	=	204	or	204
Transmission heat load P_T										Total	=	4920	or	4080

Psi-Values?

Where do Psi-Values come from?

1. Building Codes
2. Engineering Reference Documents
3. Pre-Certified Construction Systems
4. 2 or 3-D Heat Flow Simulations

Building Code (NYC ECC2020)

C402.6.3 Linear thermal bridges. Construction documents shall include the following documentation in tabular format for linear thermal bridges listed in Table C402.6:

1. Linear thermal bridge type.
2. Aggregate length of each type of linear thermal bridge.
3. Relevant detail in the construction documents showing a cross-section through the thermal bridge.
4. Ψ-value for each thermal bridge from Table C402.6.

Exception: Where linear thermal bridges have been tested or modeled using methods approved by the department, alternate values may be used.

TABLE C402.6
AVERAGE THERMAL TRANSMITTANCE FOR UNMITIGATED LINEAR THERMAL BRIDGES

TYPE OF THERMAL BRIDGE	Ψ-value[a] [Btu/hr • ft • F]
Balcony	0.50
Floor Slab	0.44
Fenestration Perimeter Transition[b]	0.32
Parapet	0.42
Shelf Angle	0.41

a. Psi-values are derived from the *BC Hydro Building Envelope Thermal Bridging Guide Version 1.2 - September 2018*, and are based on poor performing details.
b. Fenestration Perimeter Transition is the thermal bridge between any fenestration frame and the typical wall, roof or floor assembly it abuts or is mounted within.

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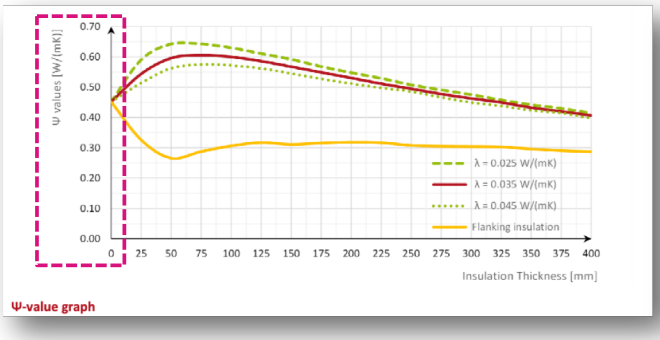
PHI Catalog

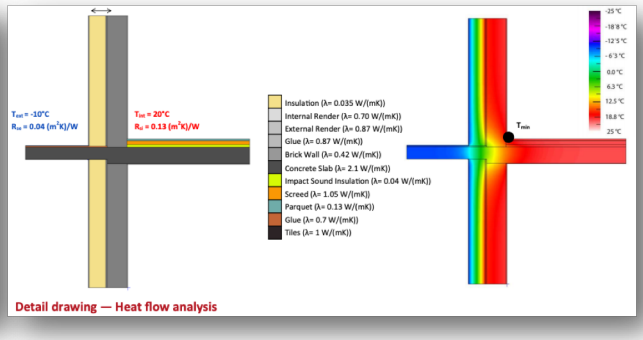
Thermal Bridges Catalogue
Passive House Institute

Passive House Institute

https://passipedia.org/basics/building_physics_-_basics/thermal_bridges/thermal_bridges_catalogue



Ψ-value graph



Detail drawing — Heat flow analysis

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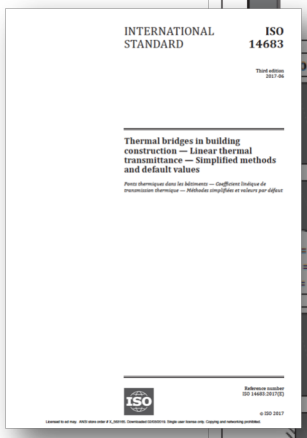
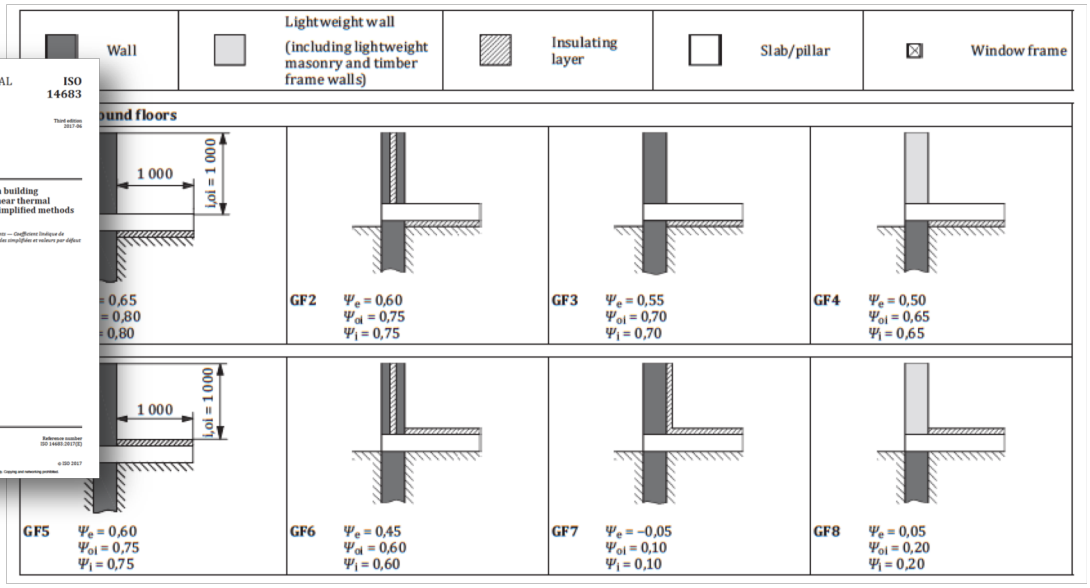
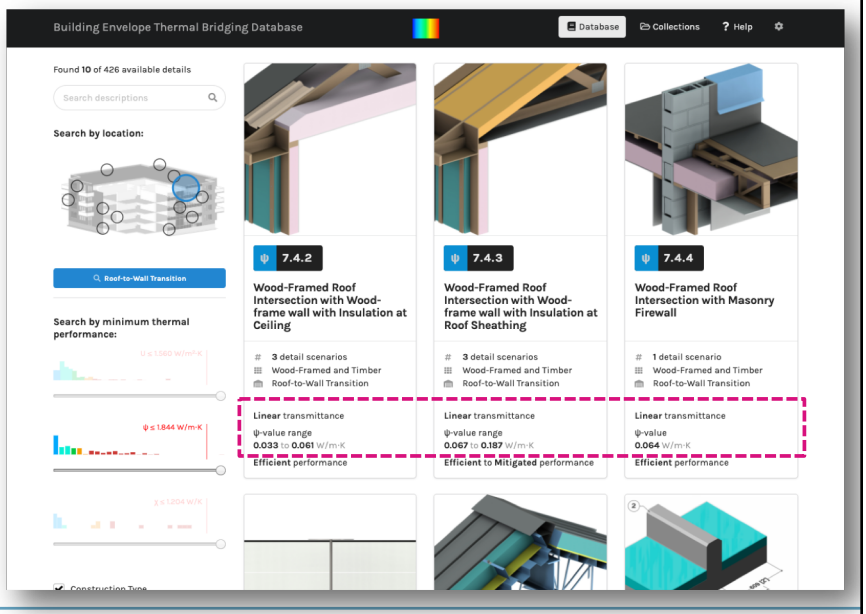
ISO 14683



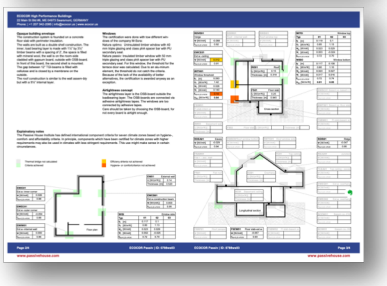


BC Hydro Online Guide

https://betb.ca/



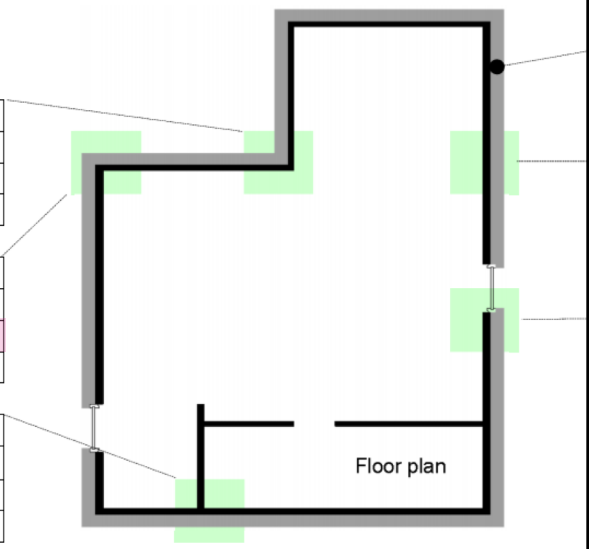
PHI Pre-Certified Construction Systems



EWIC01	
Ext.w.-inner corner	
Ψ [W//mK]	0.026
$f_{Rsi=0,25\ m^2K/W}$	0.98

EWEC01	
Ext.w.-outer corner	
Ψ [W//mK]	-0.054
$f_{Rsi=0,25\ m^2K/W}$	0.88

EWIW01	
Ext.w.-internal wall	
Ψ [W//mK]	0.000
$f_{Rsi=0,25\ m^2K/W}$	0.96



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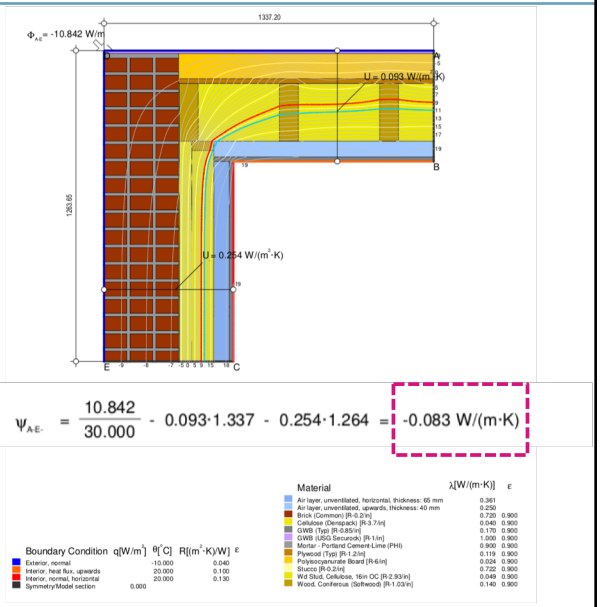
Calculate Your Own



$$\Psi_{A\text{-}E} = \frac{10.842}{30.000} - 0.093 \cdot 1.337 - 0.254 \cdot 1.264 = -0.083\ W/(m \cdot K)$$

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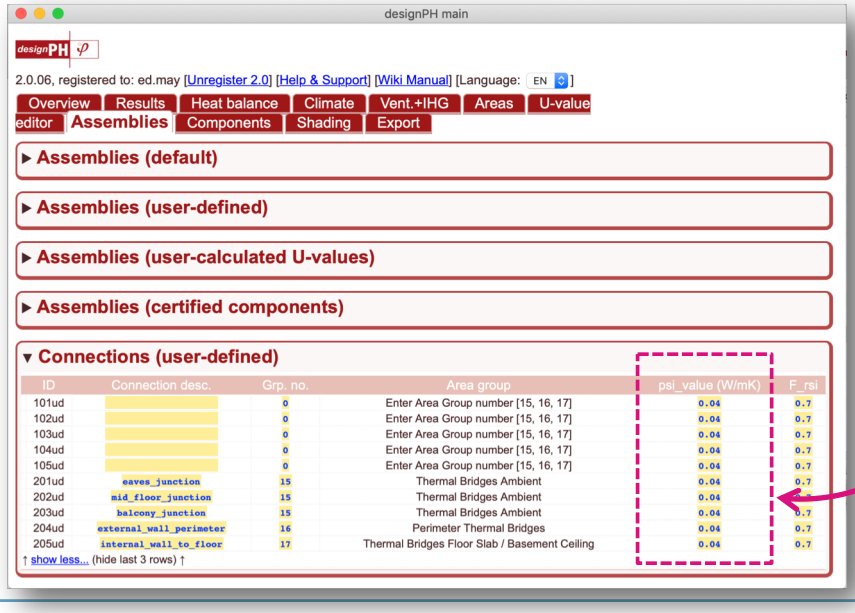
User-Determined Psi-Values



Wherever they come from, enter the Psi-Value for each here

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Interior Space: TFA

Treated Floor Area For Residential

- Only floor areas of rooms within the thermal envelope are included in the TFA.
- The floor area may be ascertained from the unfinished dimensions of the building.
- The following can be taken into account for the floor area:
- Floor-to-ceiling window reveals with a depth of more than 0.43 ft
- Plinth, skirting boards, built-in furniture, bathtubs
- Areas under staircases only if enclosed such as WC or store (depending on the height, see below) - Stair heads and landings, see sketch next slide

Taken into account at **100%**	Taken into account at **60%**	Taken into account at **0%**
• Living areas where long periods of time are spent • Washrooms, storage rooms etc. within dwellings • Access areas within dwellings	• Auxiliary Rooms outside of dwellings / apartments or in basements • Access areas outside of dwellings or in basements* ** In detached houses auxiliary rooms and access areas are taken into account with 60% if they are located on floors in which less than 50 % of the floor area consists of living areas, e.g. in the basement*	• Flights of stairs with more than 3 steps • Elevator shafts Shafts/chimneys > 4” • Pillars/room-high facework > 4” • Void (void over room with double height) • Door and floor-to-ceiling window recesses (depth up to 0.43 ft) • Rooms outside of the thermal envelope

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Treated Floor Area

7.8.1 Example: Auxiliary rooms/access areas in detached houses

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And then it gets even more complicated for multi-family, commercial, etc…… so check the PHPP manual for details.

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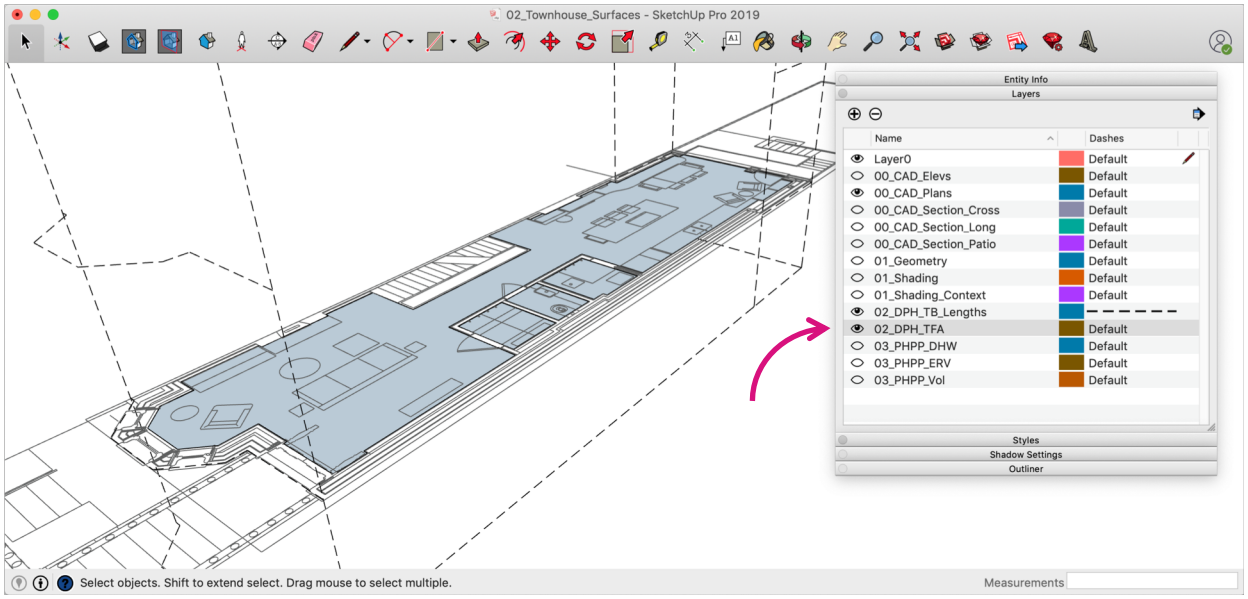
TFA Surface Assignment



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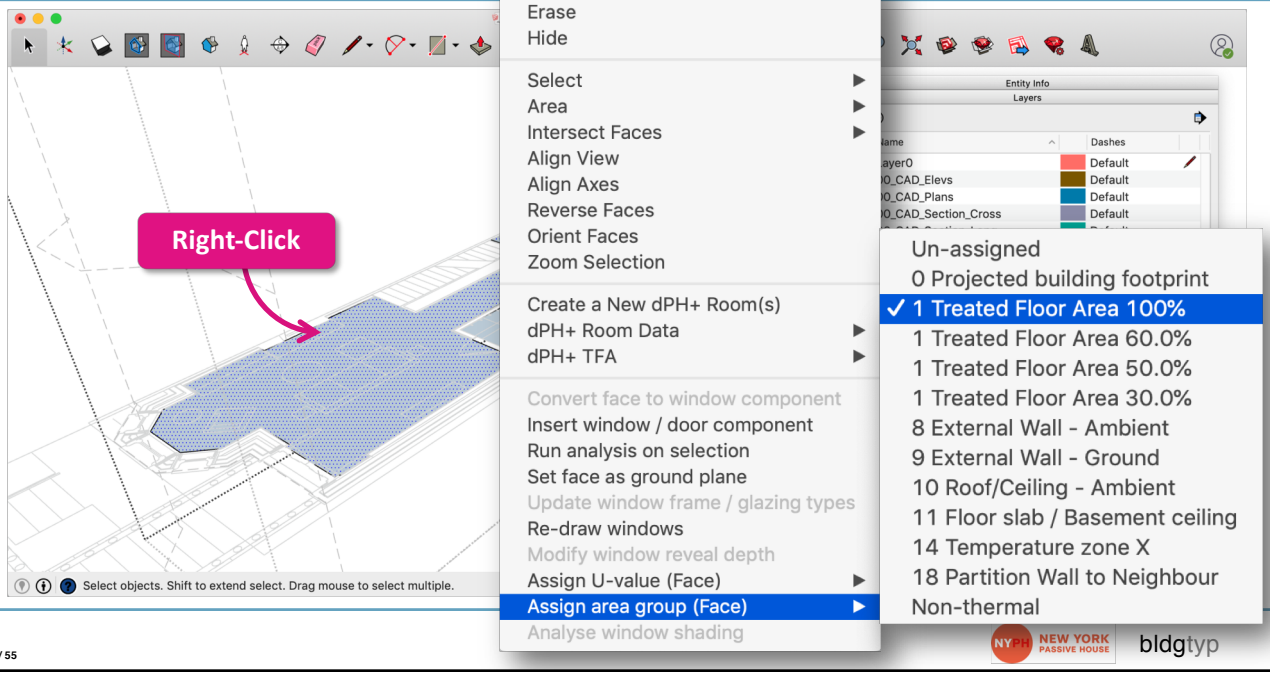
TFA Surface Assignment



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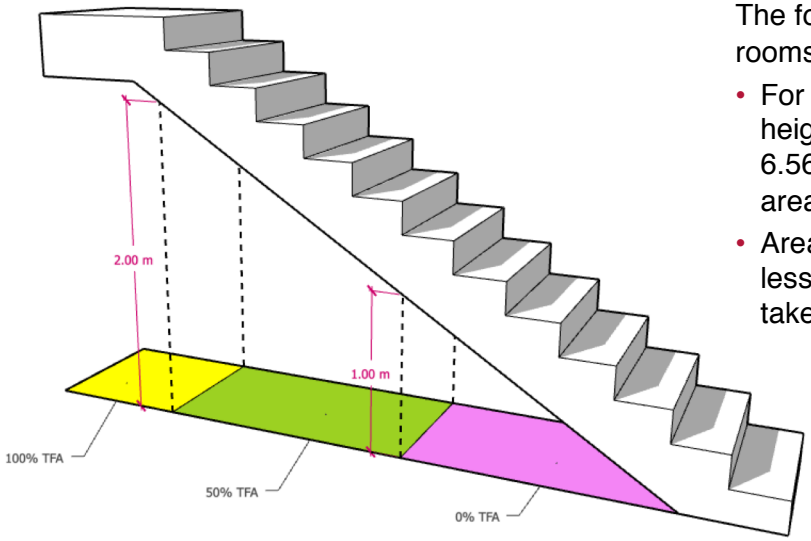
Low Ceiling Height Areas



The following applies for all rooms/partial areas:

- For areas where the clear ceiling height is between 3.28 ft [1m] and 6.56 ft [2m], the TFA of these areas is reduced by 50%
- Areas with a clear ceiling height of less than 3.28 ft [1m] are not taken into account

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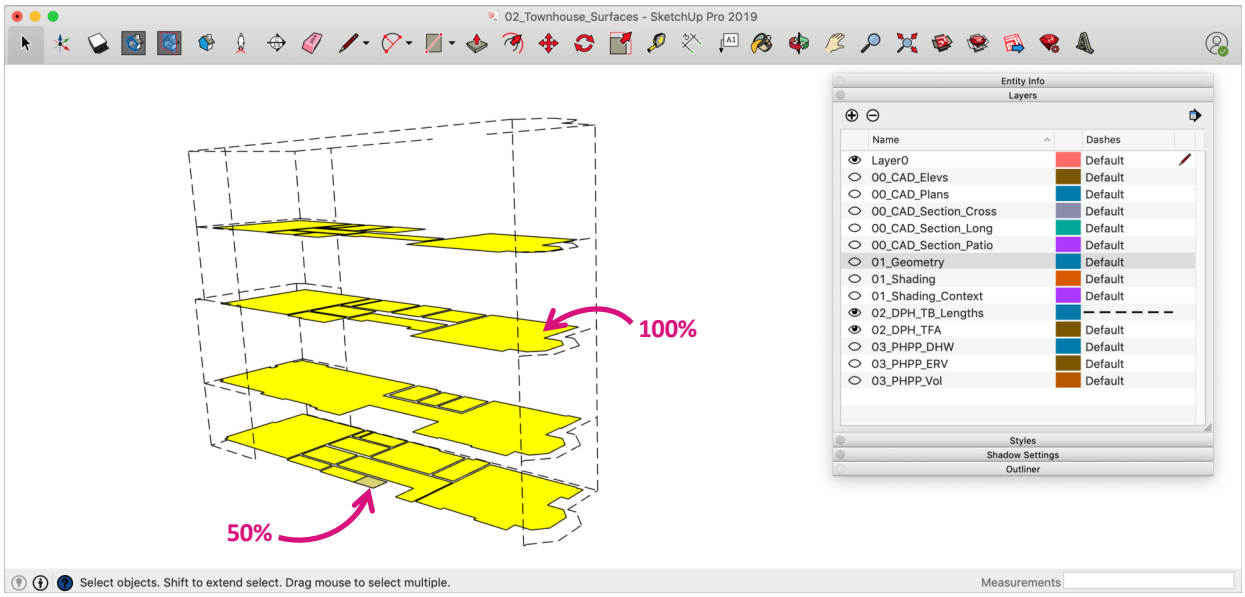
TFA Surface Assignment



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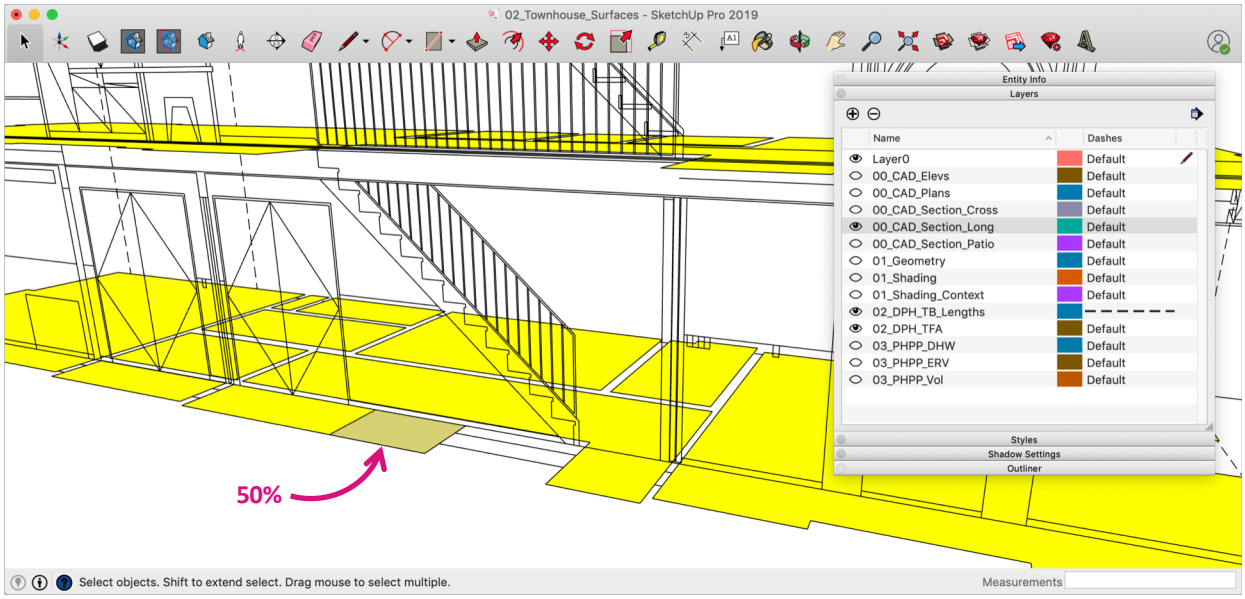
TFA Surface Assignment



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Vn50

Ventilation data

Hollis Montessori School / Climate: Boston / TFA: 9058 ft² / Heating: 1.7 kBTU/(ft²yr) / Cooling: 3.47 kBTU/(ft²yr) / PER: 7.97 kBTU/(ft²yr)

Treated floor area A_{TFA}		ft²	9058	*('Areas' worksheet)*
Room height h		ft	8.20	8.20
Volume of ventilated space (A_{TFA}*h) =	V_v	ft³	74293	*(Worksheet 'Annual heating')*

Ventilation type

Please select: 1-Balanced PH ventilation with HR

Infiltration air change rate

Wind protection coefficients e and f		
Coefficient e for wind protection class	Several side exposed	One side exposed
No protection	0.10	0.03
Moderate protection	0.07	0.02
High protection	0.04	0.01
Coefficient f	15	20

			For annual demand:	For heating load:	
Wind protection coefficient, e			0.10	0.25	
Wind protection coefficient, f			15	15	Net air volume for press. test V_{n50}
Air change rate at press. test	n_{50}	1/hr	0.30	0.30	121,871 ft³

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Vv or Vn50 ?

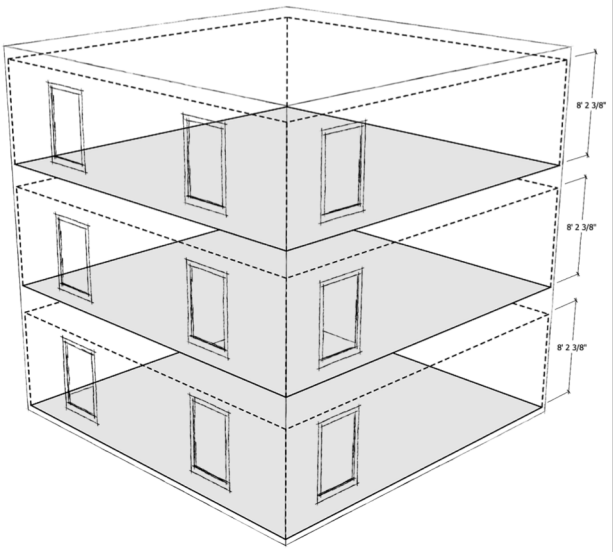
V_{n50}: Net Internal Volume

In the EN13829 standard, the internal air volume is given as follows:

The internal volume, V_{n50}, is the volume of air inside the measured building or part of building. The internal volume is calculated by multiplying the net floor area with the actual net ceiling height. The volume of furniture is not subtracted.

V_v: 'Ventilated' Volume

For residential buildings, in order to better compare the different air exchange rates in dwellings, multiply the TFA by a standard 8.2-ft to calculate the Ventilated Volume. For Non-residential buildings, use the actual ceiling height.



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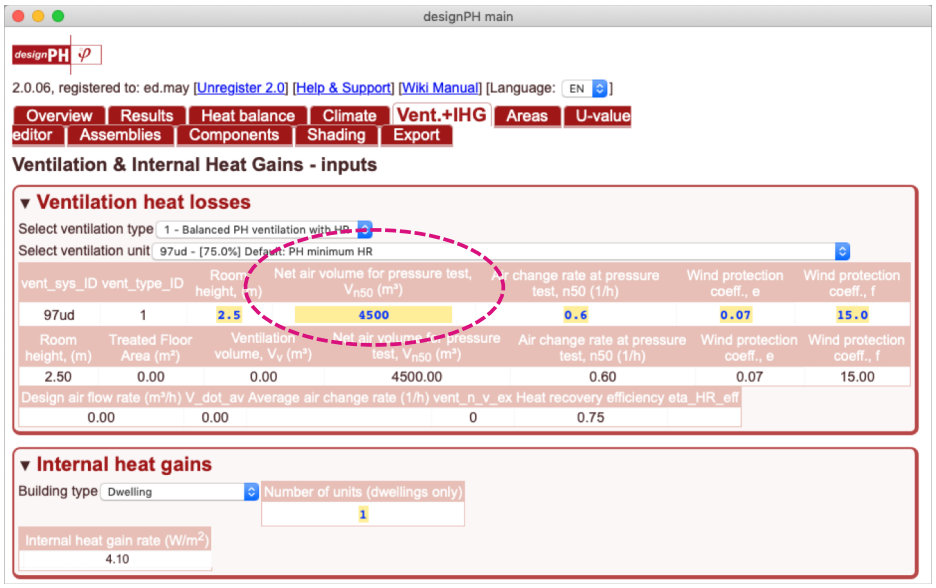
Vn50



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Spreadsheet Method

	Space:									Total Unit TFA [m²]	Total Unit Volume [m³]	Total Unit Supply Rate [cfm]	Total Unit Supply Rate [m³/h]	Total Unit Extract Rate [m³/h]	Total Unit Extract Rate [m³/h]	Total Unit ACH
6	Unit 200 [South - Lower Level]									144.2	516.9	126	214	126	214	0.41
7	Line #	Floor #	Bldg Unit #	Room #	Room Name	Floor Area [m²]	Ceiling Height [ft A.F.F.]	Ceiling Height [m A.F.F.]	TFA Utilization [%]	TFA [m²]	V_{n50} Volume [m³]	Supply Air Flow Rate [cfm]	Supply Air Flow Rate [m³/h]	Extract Air Flow Rate [cfm]	Extract Air Flow Rate [m³/h]	Room ACH
8	1	2	200	220	Living Room	33.2	21.0	6.40	100%	33.2	212.6					0.0
9	2	2	200	221	Powder Room	3.4	9.0	2.74	100%	3.4	9.2			25	42	4.6
10	3	2	200	221	Dinning Room	28.3	9.0	2.74	100%	28.3	77.6	101	172			2.2
11	4	2	200	222	Kitchen	26.5	9.0	2.74	100%	26.5	72.8			60	102	1.4
12	5	2	200	223	Vestibule	4.8	9.0	2.74	100%	4.8	13.2					0.0
13	6	2	200	224	Master Bedroom	18.7	9.0	2.74	100%	18.7	51.4	25	42			0.8
14	7	2	200	225	Master Bath	12.7	9.0	2.74	100%	12.7	34.8			26	44	1.3
15	8	2	200	226	WIC	11.0	9.0	2.74	100%	11.0	30.2			15	25	0.8
16	9	2	200	-	Entry	5.5	9.0	2.74	100%	5.5	15.1					0.0
17	10															0.0
28	Name	Manufacturer	FCU Model #			Required Total Cooling [Btu/h]	Unit Max Cooling [Btu/h]	Required Total Heating [Btu/h]	Unit Max Heating [Btu/h]	Required Total Cooling [W]	Unit Max Cooling [W]	Required Total Heating [W]	Unit Max Heating [W]	Airflow [cfm]	Airflow [m³/h]	Sound [dBa]
29	FCU-2S-1	Daikin	FXMQ12PBVJU			7,426	10,201	5,654	13,512	2,176	2,990	1,657	3,960	450	765	35-39
30	FCU-2S-2	Daikin	FXMQ15PBVJU			9,889	12,729	9,582	16,514	2,898	3,731	2,808	4,840	560	951	37-40
31	Name	Manufacturer	Condensor Model			EER [Btu/Wh]	HSPF [Btu/Wh]	Heating Capacity [Btu/h]	Cooling Capacity [Btu/h]	EER [W/W]	HSPF [W/W]	Heating Capacity [W]	Cooling Capacity [W]	Refrigerant	Capacity Range [%]	
32	CU-2S	Daikin	RXTQ48TAVJU			9	9	49,500	45,500	2.8	2.6	14,507	13,335	R-410A	14-100	

Building Data | HP Data | Print - TFA | Print - Volume | Print - Ventilation | +

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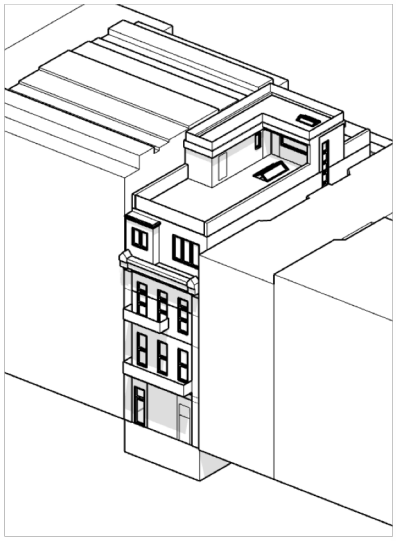
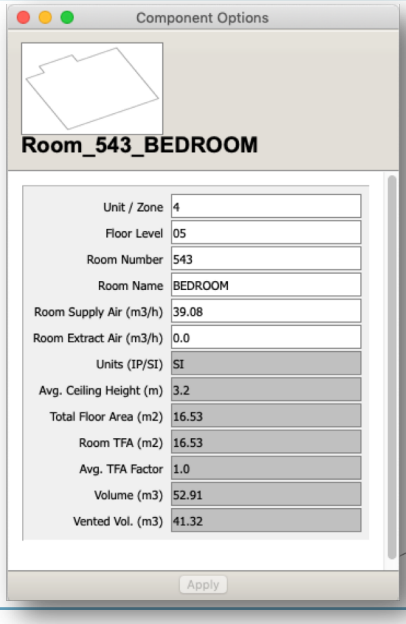
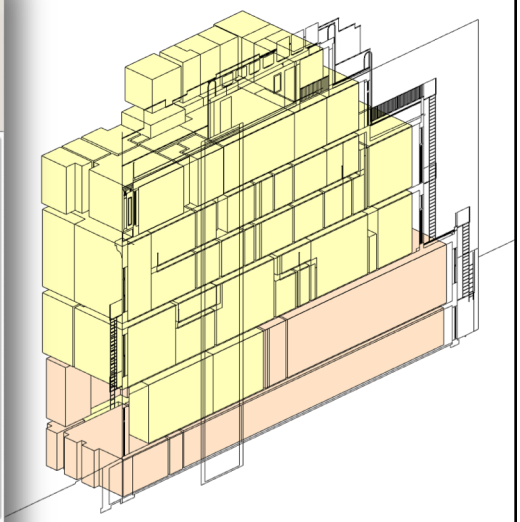
Room Data Tool [Not Part of DesignPH]







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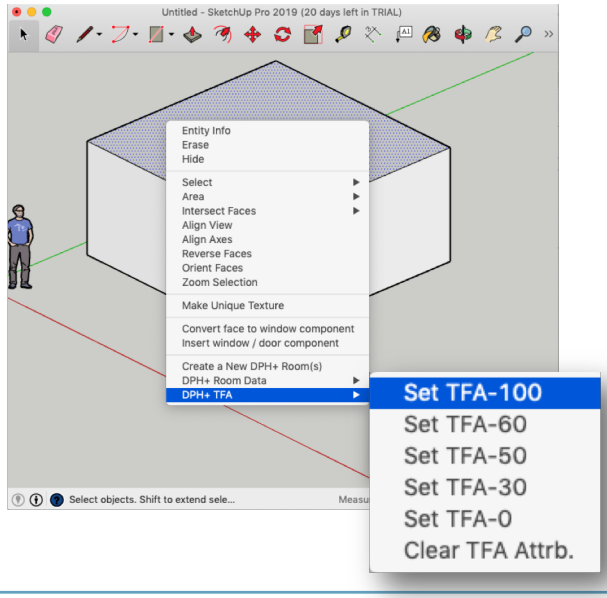
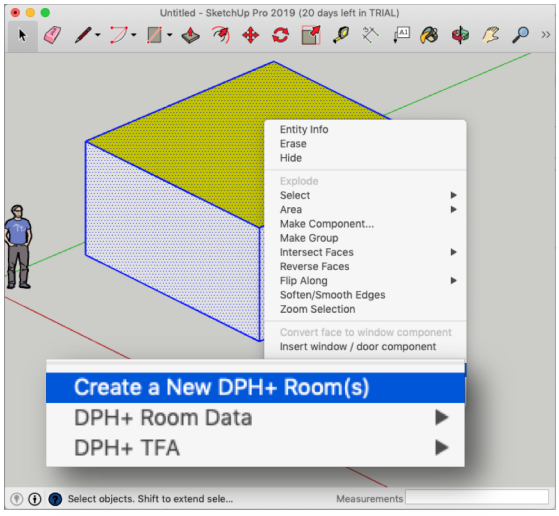
Set up the room's geometry, TFA and dictionary





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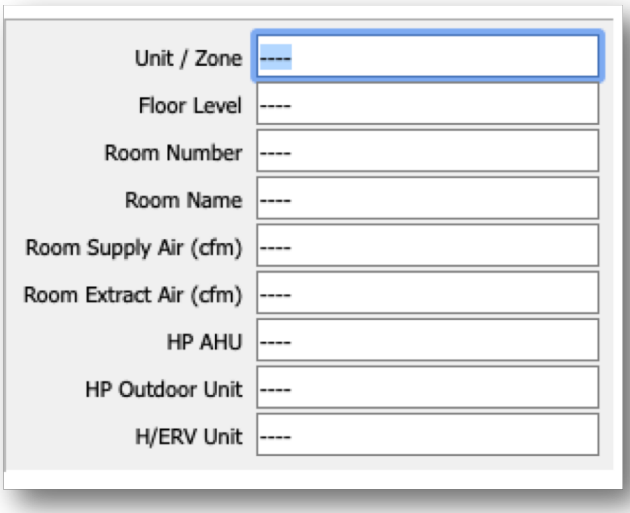
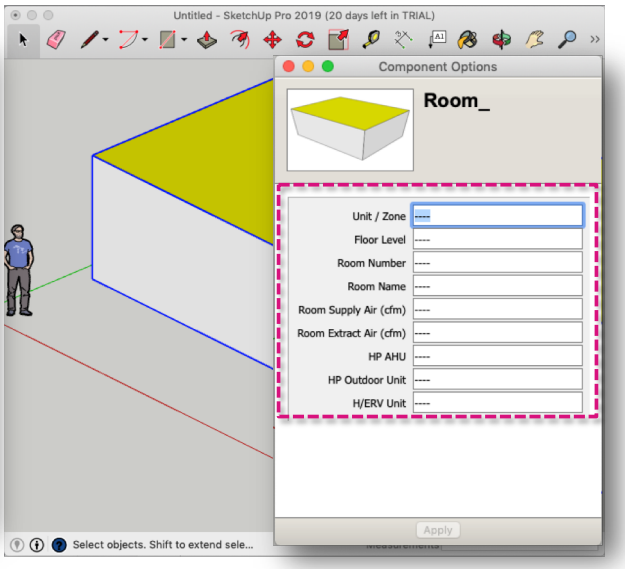
Attributes: User Determined





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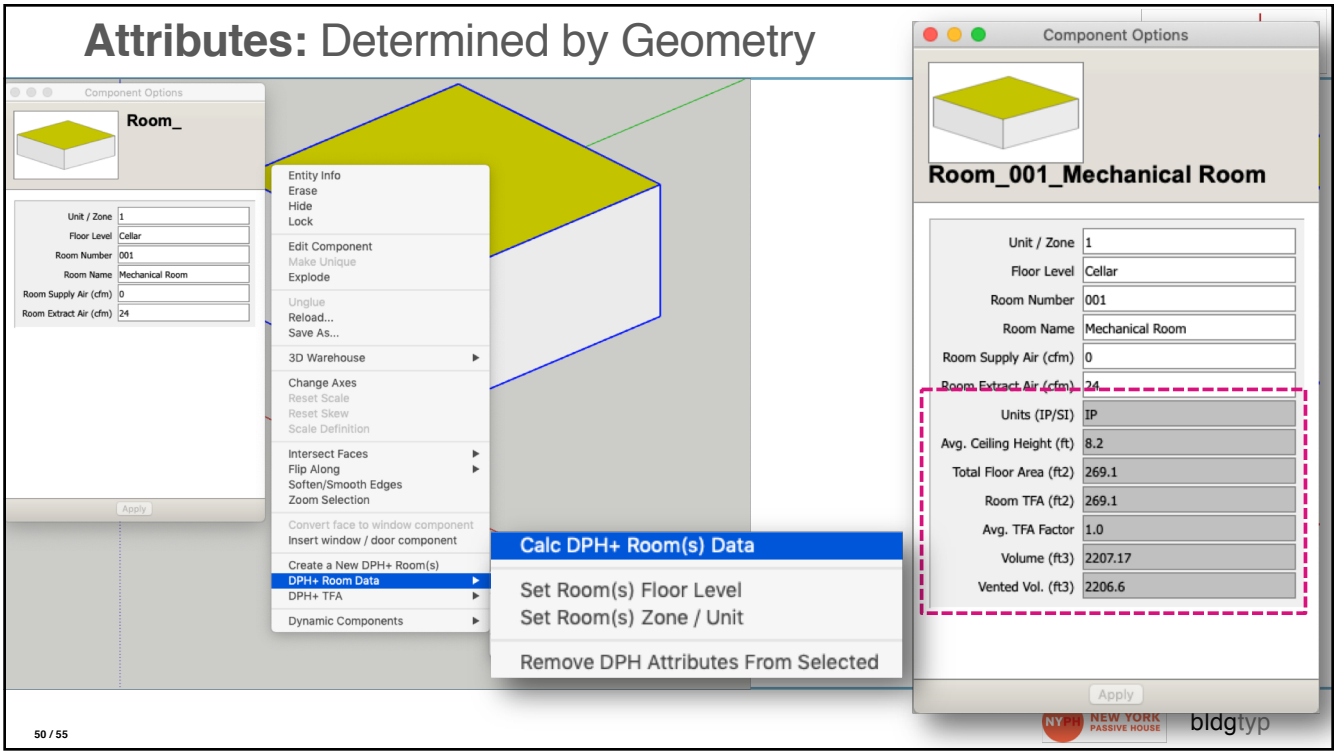
Attributes: Determined by Geometry



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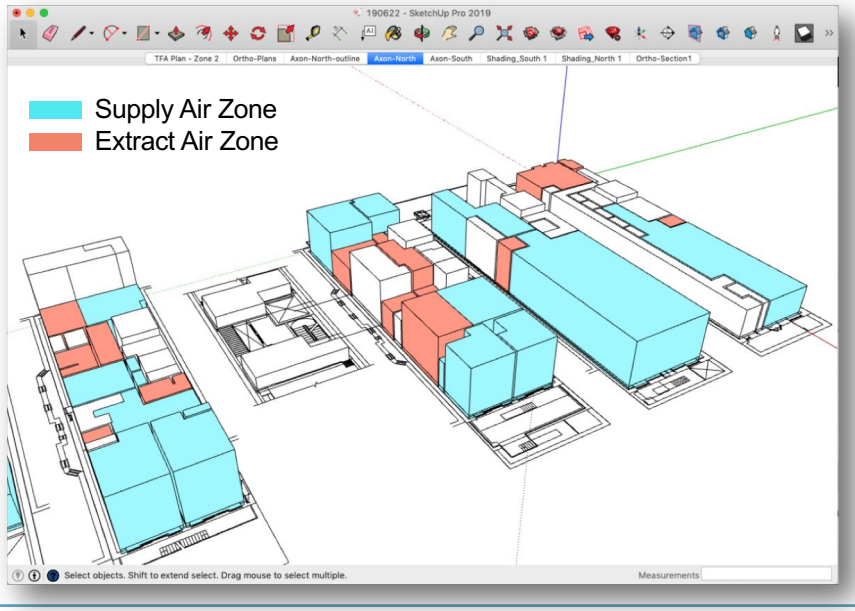
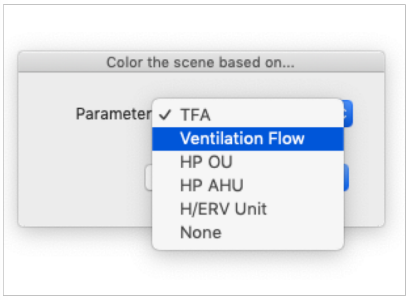
Using the Data: In Application Visuals





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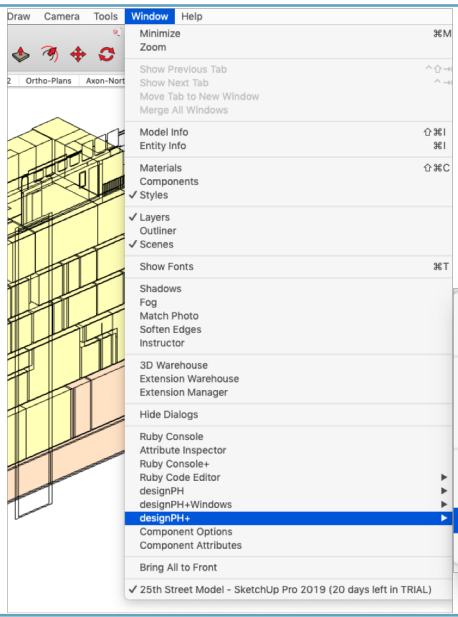
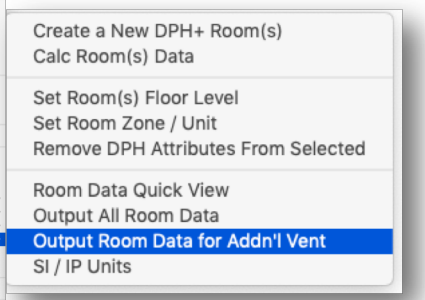
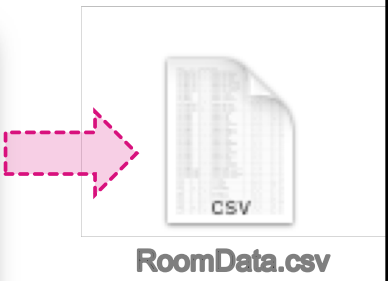
Using the Data: PHPP







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Using the Data: PHPP

RoomData.csv — Open with Microsoft Excel

SKP-PID	Zone	Floor	Room Nun	Amount	Room Name	Allocation to Vent	Area (m2)	Vv Reference Height (m)	V-Sup (m3/h)	V-Eta
351594	0-COMMERCIAL	0-CELLAR	000	1	0-COMMERCIAL_FL-0-CELLAR_ 000-STAIR	1	0.0	0.0	0.0	0.0
351596	0-COMMERCIAL	0-CELLAR	000	1	0-COMMERCIAL_FL-0-CELLAR_ 000-FIRE PASSAGE	1	16.4	2.5	0.0	0.0
351590	0-COMMERCIAL	0-CELLAR	000	1	0-COMMERCIAL_FL-0-CELLAR_ 000-STORAGE	1	4.08	2.5	0.0	0.0

Amount a	Room name	Allocation to ventilation unit (No.)	Area A m²	Clear height h m	Room vol. A x h m³	Volume flow per room V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h	Air chr per ro 1/h
0	0-COMMERCIAL_FL-0-CELLAR_ 000-STAIR	1	0.0	0.00		0	0	0	
0	0-COMMERCIAL_FL-0-CELLAR_ 000-FIRE PASSAGE	1	16.4	2.50		0	0	0	
0	0-COMMERCIAL_FL-0-CELLAR_ 000-STORAGE	1	4.1	2.50		0	0	0	
0	0-COMMERCIAL_FL-0-CELLAR_ 000-FIRE STAIR	1	0.0	0.00		0	0	0	
0	0-COMMERCIAL_FL-0-CELLAR_ C03-MECH ROOM / STOR	1	14.6	2.50		0	127	0	
0	0-COMMERCIAL_FL-0-CELLAR_ C04-ELEV. MACHINE ROOM	1	0.0	0.00		0	255	0	
0	0-COMMERCIAL_FL-0-CELLAR_ C07-WC	1	2.8	2.50		0	127	0	
0	0-COMMERCIAL_FL-0-CELLAR_ C08-COMMUNITY FACILITY	1	67.8	2.50		85	0	0	
0	0-COMMERCIAL_FL-0-CELLAR_ C10-MECH CLOSET	1	2.6	2.50		0	0	0	
0	0-COMMERCIAL_FL-01_ 100-VESTIBULE	1	0.0	0.00		0	0	0	
0	0-COMMERCIAL_FL-01_ 101-CELLAR ACCESS	1	0.0	0.00		0	0	0	
0	0-COMMERCIAL_FL-01_ 106-WC	1	0.0	0.00		0	127	0	
0	0-COMMERCIAL_FL-01_ 107-COMMUNITY FACILITY	1	91.6	2.50		136	0	0	
0	1-RES-COMMON_FL-0-CELLAR_ 000-ELEV	2	0.0	0.00		0	0	0	

omponents | Windows | Shading | Ventilation | Additional Vent | Annual heating | Heating | Heating Load | SummVent | Cooling | Cooling units | Cooling load

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Using the Data: Sketchup Layout

TFA Plans- CELLAR

Room: <DynamicComponent(3roomnum)>-<DynamicComponent(4roomname)>
TFA: <DynamicComponent(tfa)> m2
Vn50: <DynamicComponent(vn50)> m3
Clg Height: <DynamicComponent(avgheight)> m
V-Sup: <DynamicComponent(5supplyair)> m3/h
V-Extr: <DynamicComponent(6extractair)> m3/h
Room: C03-MECH ROOM / STOR...

3.797 m 1.067 m

Room: C03-MECH ROOM / STOR
TFA: 14.57 m2
Vn50: 61.07 m3
Clg Height: 2.51 m
V-Sup: 0 m3/h
V-Extr: 127.43 m3/h

Room: C06A-TRASH RM
TFA: 1.45 m2
Vn50: 3.64 m3
Clg Height: 2.51 m
V-Sup: 0 m3/h
V-Extr: 0 m3/h

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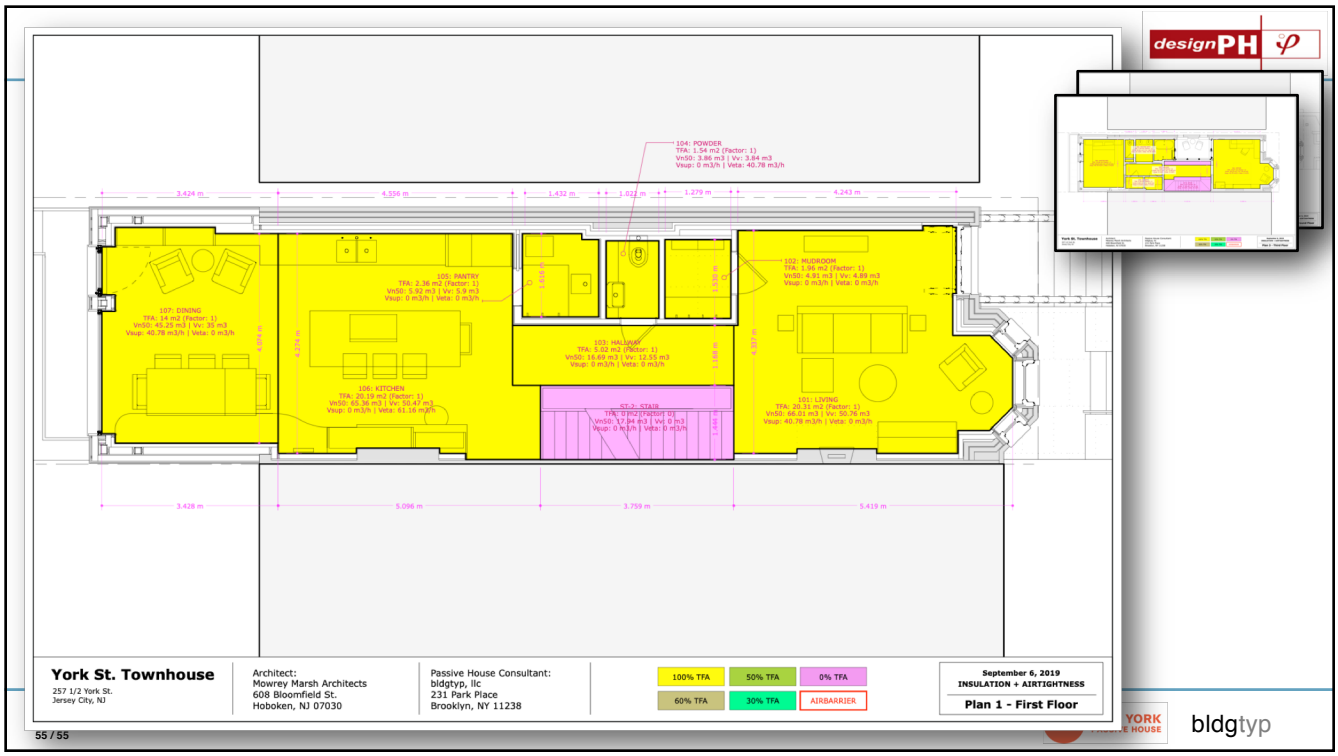
designPH
York St. Townhouse
257 1/2 York St.
Jersey City, NJ
Architect:
Mowrey Marsh Architects
608 Bloomfield St.
Hoboken, NJ 07030
Passive House Consultant:
bldgtyp, llc
231 Park Place
Brooklyn, NY 11238
100% TFA
50% TFA
0% TFA
60% TFA
30% TFA
AIRBARRIER
September 6, 2019
INSULATION + AIRTIGHTNESS
Plan 1 - First Floor
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designPH
http://www.bldgtyp.com/resources.html
SKETCHUP PLUGINS
PHPP Visualizer (Sketchup Plugin)
PHPP Room Data Manager (Sketchup Plugin)
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