DesignPH – U-Values & Surface Parameters

Webinar. June 16, 2020

NYPH NEW YORK PASSIVE HOUSE   bldgtyp

Ed May | Partner, Building-Type, LLC

(architect, passive house consultant, teacher)

NYPH NEW YORK PASSIVE HOUSE   bldgtyp

NYPH 2020 Technical Workshops

May 19th

June 2nd

June 16th

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

Agenda [1 hour]

- DesignPH Review
- U-Values and Heat Loss
- Creating Surface U-Values
- Assemblies in DesignPH 2.0
- Surface Parameter Assignment in DesignPH 2.0
- DesignPH 2.0 Visualization Methods

DesignPH Review

Requirements

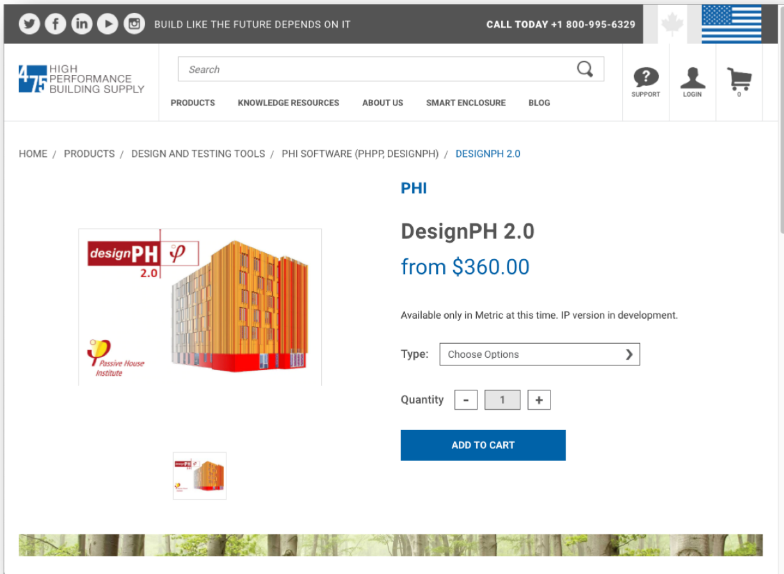
What you'll need:

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

6 / 55

NY PH NEW YORK PASSIVE HOUSE bldgtyp

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



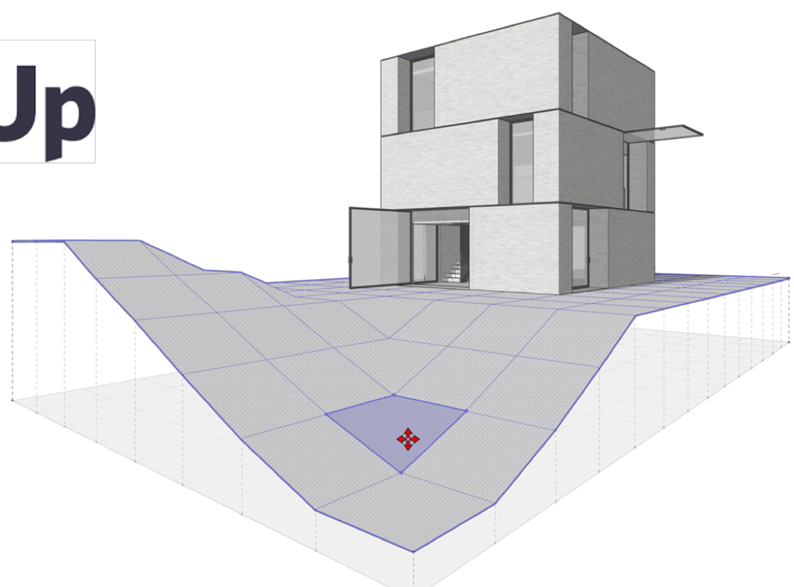
7 / 55

NEW YORK PASSIVE HOUSE

bldgtyp

Sketchup

SketchUp

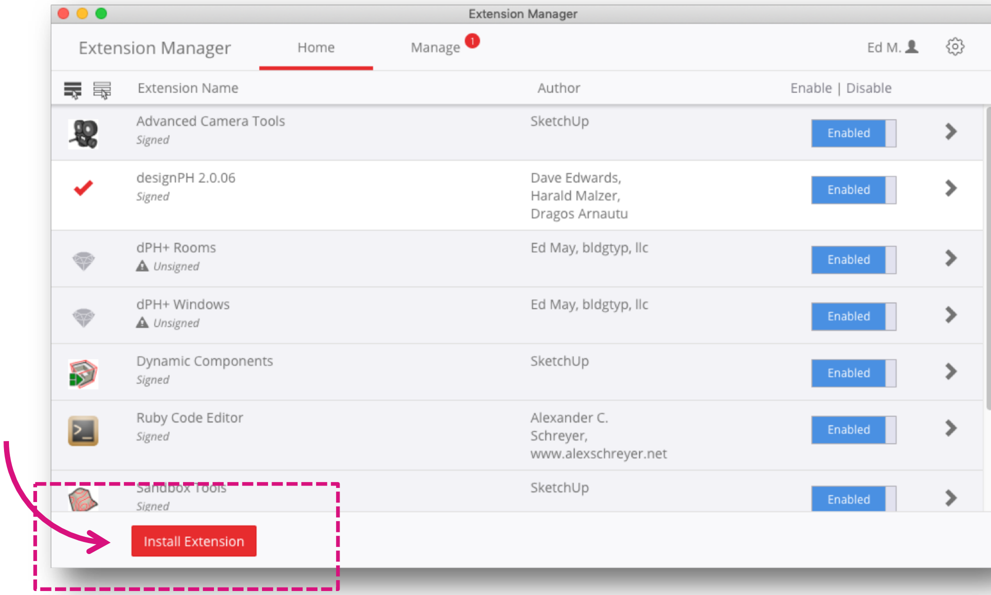


8 / 55

NEW YORK PASSIVE HOUSE

bldgtyp

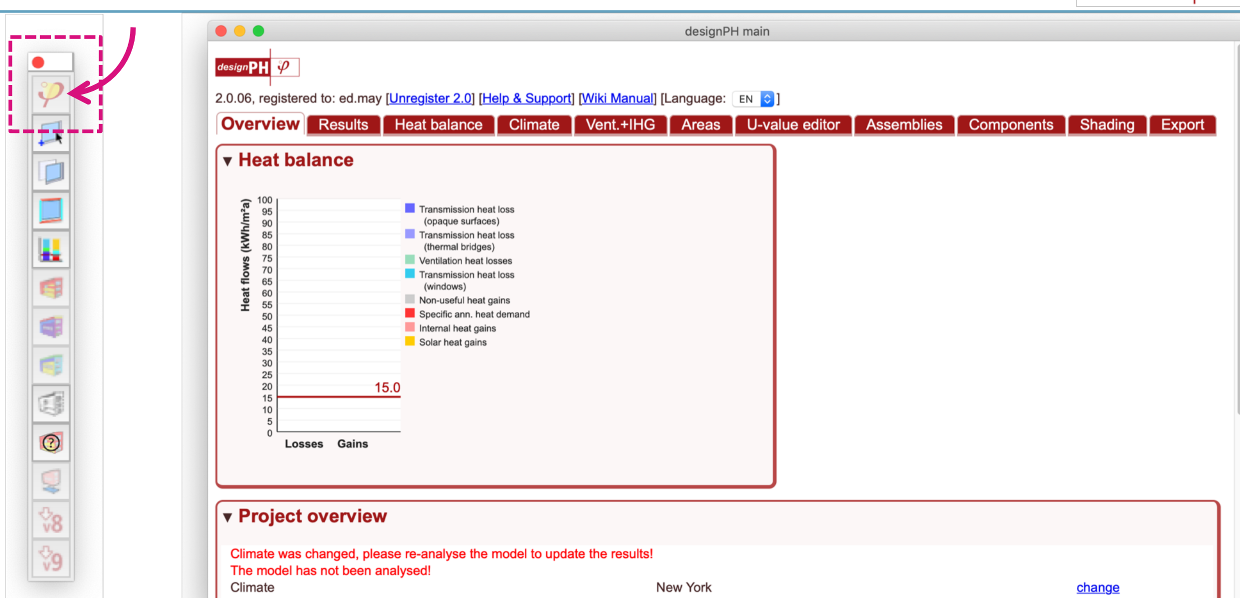
Sketchup Extensions Manager



9 / 55

NEW YORK PASSIVE HOUSE bldgtyp

Start DesignPH Plugin [Each time you run Sketchup]

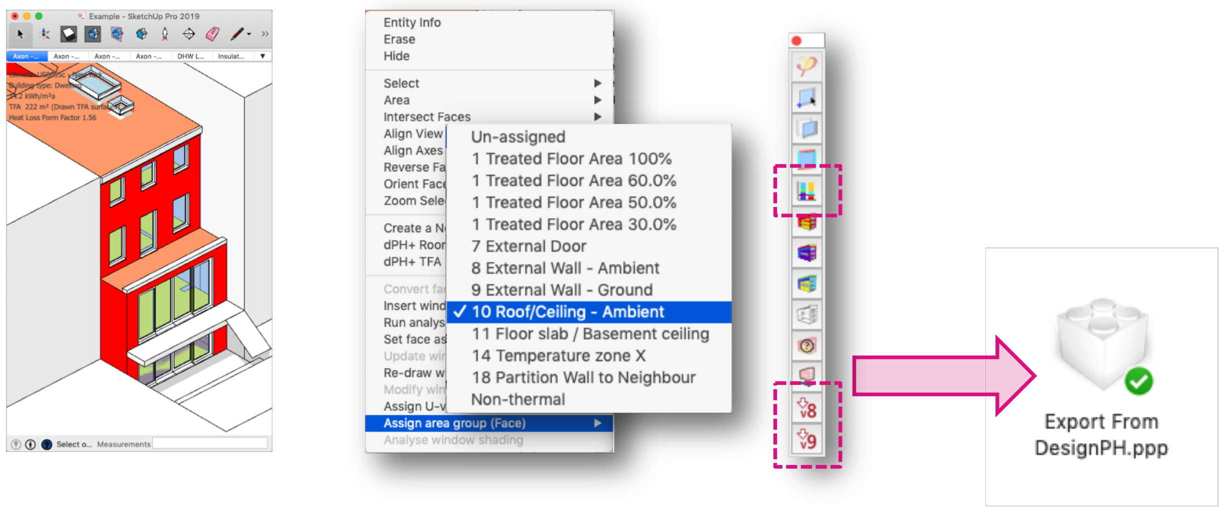


10 / 55

NEW YORK PASSIVE HOUSE bldgtyp

DesignPH Workflow

1) Model Geometry 2) Tag Model Geometry w/ Data 3) Analyze 4) Export

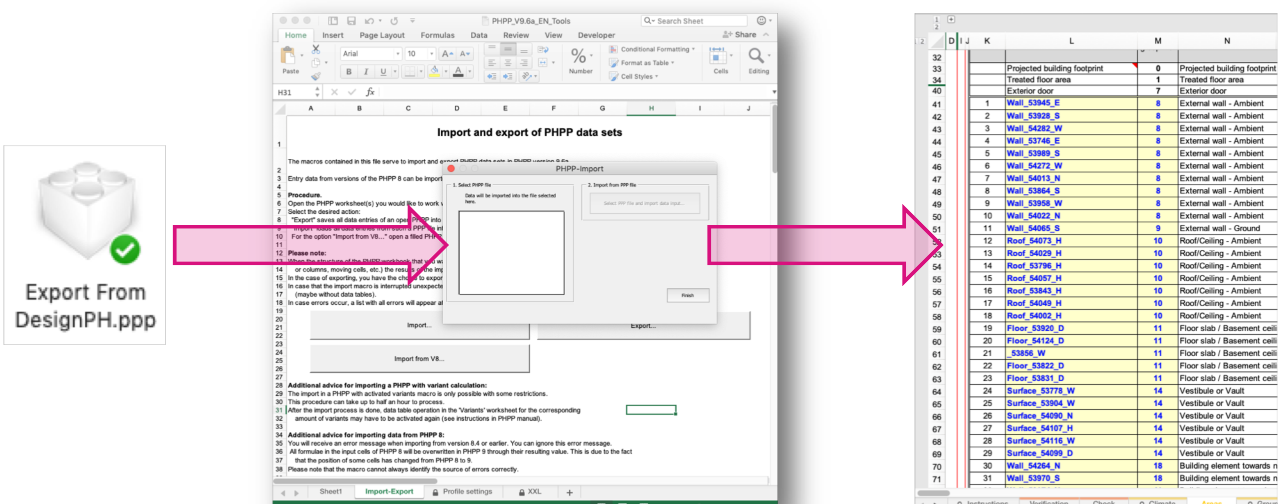


11 / 55

NEW YORK PASSIVE HOUSE bldgtyp

DesignPH Workflow

5) Import 6) Complete the PHPP



12 / 55

NEW YORK PASSIVE HOUSE bldgtyp

U-Values and Heat Loss

How do you calculate the heat loss of a surface?

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

(But / hr) (ft^2) (But / ft^2-hr-F) (F)

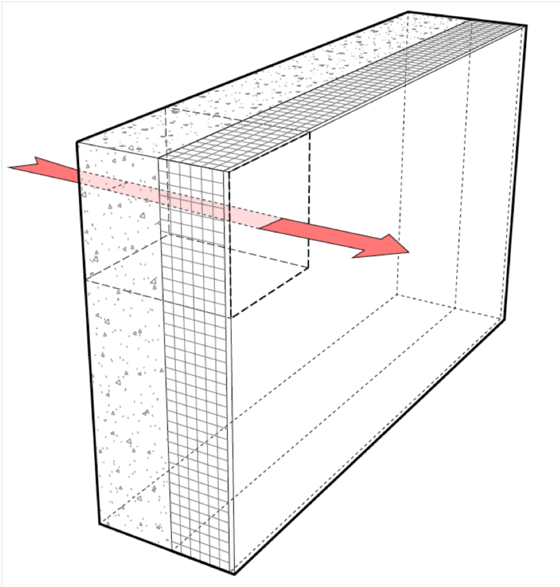
In order to calculate the transmission heat loss for each surface of a building, we need to:

1. Determine the surface area (ft^2)
2. Determine the surface's U-Value
3. Determine the difference in temperature between inside and outside

14 / 55

bldgtyp

U-Values ?



U-Values are a measurement of

Btu/hr-ft^2-F

How many Btus flow….

…. Through one square foot of surface

…. Over one hour

…. For each degree (F) of difference

15 / 55

NEW YORK PASSIVE HOUSE bldgtyp

U-Values vs. R-Values

U-Values are a measure of heat flow through an assembly

(Btu / hr-ft^2-F)

R-Values are a measure of an assembly’s resistance to heat flow

(hr-ft^2-F / Btu)

U-Value = 1 / R-Value

R-Value = 1 / U-Value

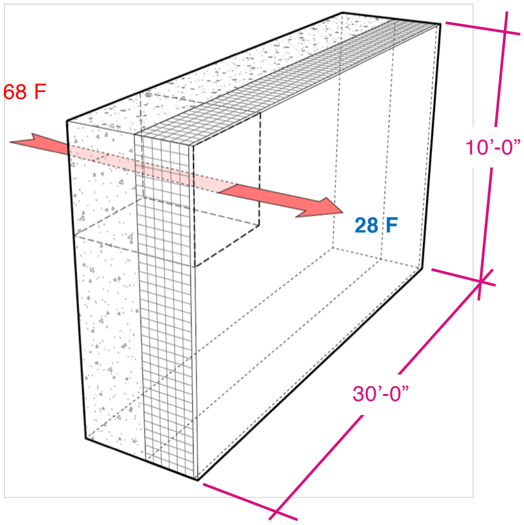
For instance: R-40:: 1/40 = U-Value of 0.025

U-0.025:: 1/0.025 = R-Value of 40

16 / 55

NEW YORK PASSIVE HOUSE bldgtyp

Example 1: 4” of XPS Insulation (R-20)



$Q_{T\text{-}surface} = Area_{surface} \times U\text{-}Value_{surface} \times \Delta T$

$\mathbf{Area_{surface}} =$ 10’ × 30’ = 300 ft²

$\mathbf{U\text{-}Value_{surface}} =$ 0.050 Btu/hr-ft²-F

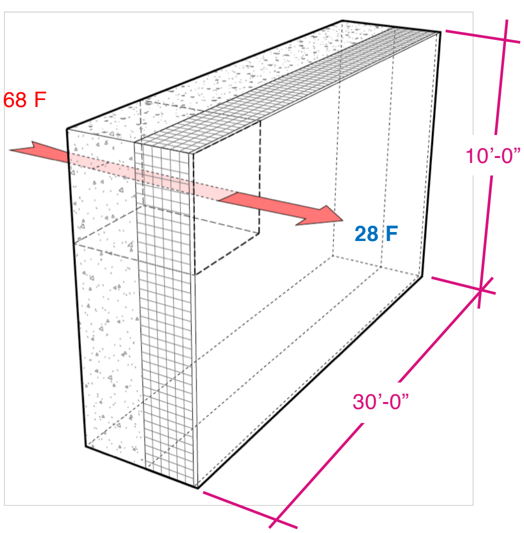
$\mathbf{\Delta T} =$ 68 F – 28 F = 40 F

$Q_{T\text{-}surface}$ = 300 ft² × 0.050 Btu/hr-ft²-F × 40 F

$Q_{T\text{-}surface}$ = 600 Btu/hr

NEW YORK PASSIVE HOUSE bldgtyp

Example 2: 8” of XPS Insulation (R-40)



$Q_{T\text{-}surface} = Area_{surface} \times U\text{-}Value_{surface} \times \Delta T$

$\mathbf{Area_{surface}} =$ 10’ × 30’ = 300 ft²

$\mathbf{U\text{-}Value_{surface}} =$ 0.025 Btu/hr-ft²-F

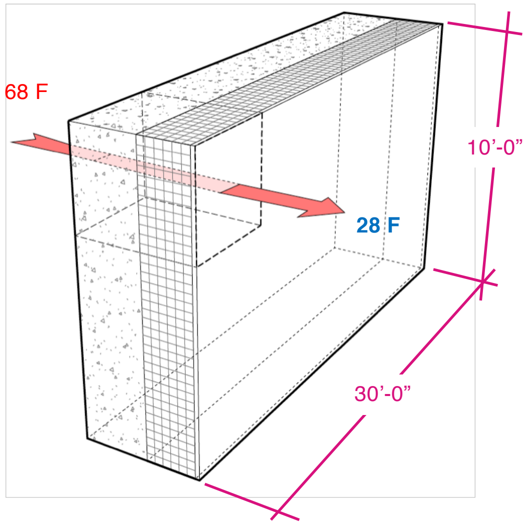
$\mathbf{\Delta T} =$ 68 F – 28 F = 40 F

$Q_{T\text{-}surface}$ = 300 ft² × 0.025 Btu/hr-ft²-F × 40 F

$Q_{T\text{-}surface}$ = 300 Btu/hr

NEW YORK PASSIVE HOUSE bldgtyp

Example 3: 16” of XPS Insulation (R-80)



$Q_{T\text{-surface}}$ = $\text{Area}_{\text{surface}}$ × $\text{U-Value}_{\text{surface}}$ × ΔT

$\text{Area}_{\text{surface}}$ = 10’ × 30’ = 300 ft^2

$\text{U-Value}_{\text{surface}}$ = 0.0125 Btu/hr-ft^2-F

ΔT = 68 F – 28 F = 40 F

$Q_{T\text{-surface}}$ = 300 ft^2 × 0.0125 Btu/hr-ft^2-F × 40 F

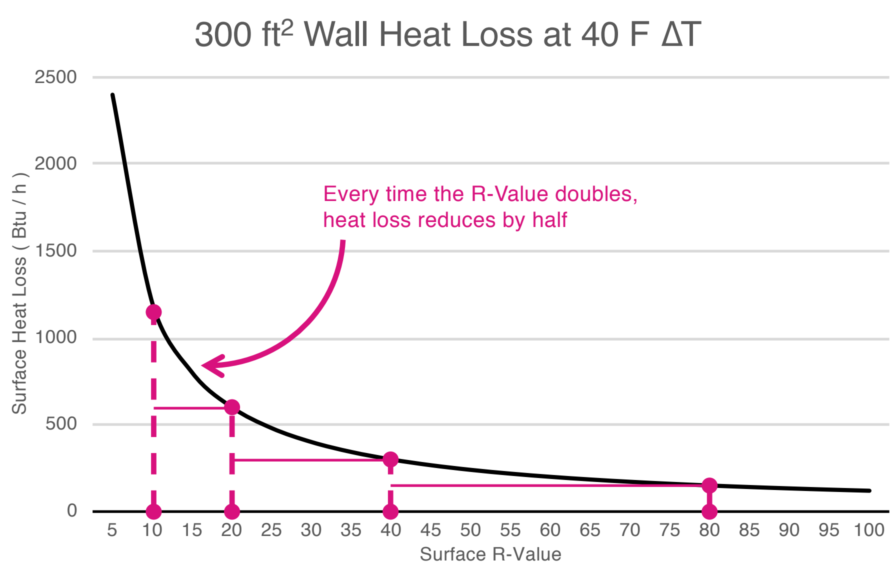
$Q_{T\text{-surface}}$ = 150 Btu/hr

designPH

NYPH NEW YORK PASSIVE HOUSE bldgtyp

19 / 55

designPH



NYPH NEW YORK PASSIVE HOUSE bldgtyp

20 / 55

NY State 2020 ECC: U-Value Requirements

[NY] TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, b]

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4		6	
	All other	Group R	All other	Group R	All other	Group R
Roofs						
Insulation entirely above roof deck	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032
Metal buildings	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031
Attic and other	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021
Walls, above grade						
Mass[g]	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071
Metal building	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052
Metal framed	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064
Wood framed and other[c]	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051
Walls, below grade						
Below-grade wall[c]	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119
Floors						
Mass[d]	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064
Joist/framing	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors						
Unheated slabs	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52
Heated slabs[f]	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55
Opaque doors						
Swinging door	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

Different climate zones and different assembly types have maximum U-Values that all projects must meet.

NEW YORK PASSIVE HOUSE bldgtyp

NY State 2020 ECC: U-Value Requirements

[NY] TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, b]

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4		6	
	All other	Group R	All other	Group R	All other	Group R
Roofs						
Insulation entirely above roof deck	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032
Metal buildings	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031
Attic and other	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021
Walls, above grade						
Mass[g]	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071
Metal building	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052
Metal framed	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064
Wood framed and other[c]	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051
Walls, below grade						
Below-grade wall[c]	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119
Floors						
Mass[d]	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064
Joist/framing	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors						
Unheated slabs	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52
Heated slabs[f]	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55
Opaque doors						
Swinging door	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

a.
*"Where assembly U-factors, C-factors, and F-factors are established in **ASHRAE 90.1 Appendix A**, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table…"*

We'll come back to this in a few minutes.

NEW YORK PASSIVE HOUSE bldgtyp

NY City 2020 ECC: U-Value Requirements

For NYC, most max. U-Values are a bit lower (harder to meet) than the State's ECC

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, b]

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4		6	
	All other	Group R	All other	Group R	All other	Group R
Roofs						
Insulation entirely above roof deck	U-0.030	U-0.030	U-0.032	U-0.032	U-0.032	U-0.032
Metal buildings	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031
Attic and other	U-0.020	U-0.020	U-0.027	U-0.021	U-0.021	U-0.021
Walls, above grade						
Mass[f]	U-0.099	U-0.086	U-0.090	U-0.080	U-0.080	U-0.071
Metal building	U-0.048	U-0.048	U-0.052	U-0.052	U-0.052	U-0.052
Metal framed	U-0.061	U-0.061	U-0.064	U-0.064	U-0.064	U-0.064
Wood framed and other[c]	U-0.061	U-0.061	U-0.064	U-0.064	U-0.051	U-0.051
Walls, below grade						
Below-grade wall[c]	C-0.119	C-0.092	C-0.119	C-0.119	C-0.119	C-0.119
Floors						
Mass[d]	U-0.057	U-0.051	U-0.074	U-0.064	U-0.064	U-0.064
Joist/framing	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors						
Unheated slabs	F-0.52	F-0.52	F-0.54	F-0.54	F-0.54	F-0.52
Heated slabs[e]	F-0.63 0.64	F-0.63 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55
Opaque doors						
Swinging door	U-0.50	U-0.50	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

23 / 55

bldgtyp

Creating U-Values

Where do U-Values come from?

1. Building Codes
2. Engineering Reference Documents
3. Numerical Models
4. 2 or 3-D Heat Flow Simulations

NY State 2020 Energy Conservation Code

Throughout the code, we can find tables of U-Values (or R-Values) for various types of assemblies

TABLE C402.1.4.1
EFFECTIVE R-VALUES FOR STEEL STUD WALL ASSEMBLIES

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY *R*-VALUE (insulation)	CORRECTION FACTOR (F_C)	EFFECTIVE *R*-VALUE(ER) (Cavity *R*-Value × F_C)
3½	16	13	0.46	5.98
		15	0.43	6.45
3½	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
6	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50

ASHRAE 90.1 Appendix A

designPH

Appendix A includes more detailed tables of values which can be used for various assembly types

Normative Appendix A

Table A3.1-1 Assembly *U-Factors* for Above-*Grade* Concrete *Walls* and Masonry *Walls* (*Continued*)

Framing Type and Depth	Rated *R-Value* of Insulation Alone	Assembly *U-Factors* for 8 in. Normal Weight 145 lb/ft^3 Solid Concrete *Walls*	Assembly *U-Factors* for 8 in. Medium Weight 115 lb/ft^3 Concrete Block *Walls*: Solid Grouted	Assembly *U-Factors* for 8 in. Medium Weight 115 lb/ft^3 Concrete Block *Walls*: Partially Grouted (Cores Uninsulated Except Where Specified)
No Framing	R-0	U-0.740	U-0.580	U-0.480
	Ungrouted Cores Filled with Loose-Fill Insulation	NA	NA	U-0.350
1 in. Metal Clips at 24 in. on Center Horizontally and 16 in. Vertically				
1.0 in.	R-3.8	U-0.210	U-0.195	U-0.182
	R-5.0	U-0.184	U-0.172	U-0.162
	R-5.6	U-0.174	U-0.163	U-0.154
1.5 in.	R-5.7	U-0.160	U-0.151	U-0.143

27 / 55

NEW YORK PASSIVE HOUSE

bldgtyp

Numerical Calculation (Sometimes)

designPH

Sometimes 90.1 Appendix A allows us to use a simplified numerical calculation to figure out our own U-Values

A9.2 Required Procedures

Two- or three-dimensional finite difference and finite volume computer models shall be an acceptable alternative method to calculating the thermal performance values for all assemblies and constructions listed below. The following procedures shall also be permitted to determine all alternative *U-factors*, *F-factors*, and *C-factors*:

a. Roofs
   1. *Roofs with insulation entirely above deck*: Testing or series calculation method.
   2. *Metal building roofs*: Testing, or for single-layer and double-layer *systems*, calculation method in Section A9.4.6.
   3. Attic *roofs*, wood joists: Testing or parallel path calculation method.
   4. Attic *roofs*, *steel joists*: Testing or parallel path calculation method using the insulation/framing layer adjustment factors in Table A9.2-1 or modified zone calculation method.
   5. Attic *roofs*, concrete joists: Testing or parallel path calculation method if concrete is solid and uniform, or isothermal planes calculation method if concrete has hollow sections.
   6. Other attic *roofs* and other *roofs*: Testing or two-dimensional calculation

28 / 55

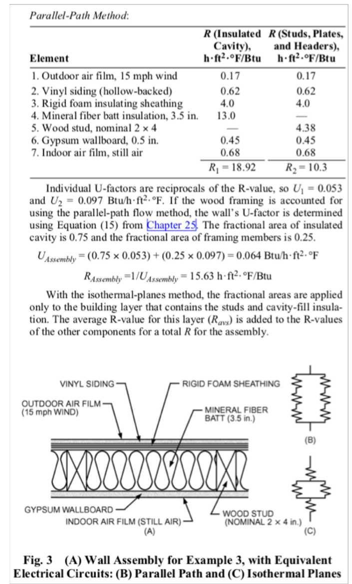
NEW YORK PASSIVE HOUSE

bldgtyp

ASHRAE HOF Chapter 25 and 27

CHAPTER 25

HEAT, AIR, AND MOISTURE CONTROL IN BUILDING ASSEMBLIES—FUNDAMENTALS



Parallel-Path Method:

Element	*R* (Insulated Cavity), h·ft²·°F/Btu	*R* (Studs, Plates, and Headers), h·ft²·°F/Btu
1. Outdoor air film, 15 mph wind	0.17	0.17
2. Vinyl siding (hollow-backed)	0.62	0.62
3. Rigid foam insulating sheathing	4.0	4.0
4. Mineral fiber batt insulation, 3.5 in.	13.0	—
5. Wood stud, nominal 2 × 4	—	4.38
6. Gypsum wallboard, 0.5 in.	0.45	0.45
7. Indoor air film, still air	0.68	0.68
	$R_1 = 18.92$	$R_2 = 10.3$

Individual U-factors are reciprocals of the R-value, so $U_1 = 0.053$ and $U_2 = 0.097$ Btu/h·ft²·°F. If the wood framing is accounted for using the parallel-path flow method, the wall's U-factor is determined using Equation (15) from Chapter 25. The fractional area of insulated cavity is 0.75 and the fractional area of framing members is 0.25.

$$U_{Assembly} = (0.75 \times 0.053) + (0.25 \times 0.097) = 0.064 \text{ Btu/h·ft}^2\text{·°F}$$

$$R_{Assembly} = 1/U_{Assembly} = 15.63 \text{ h·ft}^2\text{·°F/Btu}$$

With the isothermal-planes method, the fractional areas are applied only to the building layer that contains the studs and cavity-fill insulation. The average R-value for this layer (R_{avs}) is added to the R-values of the other components for a total *R* for the assembly.

Fig. 3 (A) Wall Assembly for Example 3, with Equivalent Electrical Circuits: (B) Parallel Path and (C) Isothermal Planes

NEW YORK PASSIVE HOUSE bldgtyp

ASHRAE 1D Assembly U-Factor

HOF Chapter 27: 1.1

Layer	R/inch		Thickness		Layer Resistance
R_{se}					0.17
Vinyl Siding	1.24	×	1/2"	=	0.62
Bldg Paper	1.00	×	1/16"	=	0.06
OSB	1.24	×	1/2"	=	0.62
XPS foam	5.00	×	6"	=	30
Gyp Board	0.90	×	1/2"	=	0.45
R_{si}					0.74
			R-Value	=	32.60
			U-Value	=	0.031

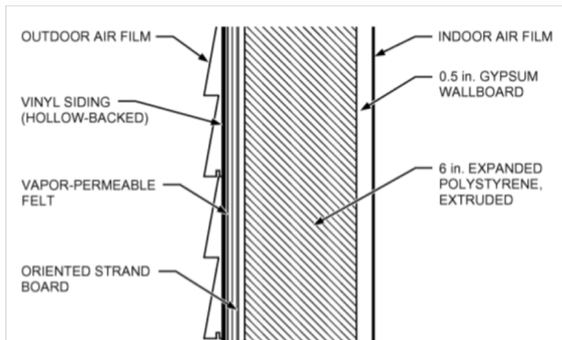
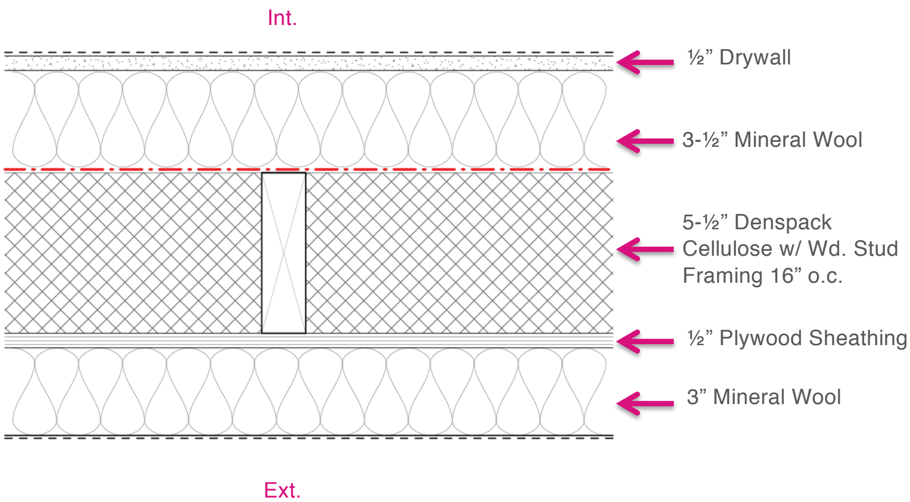


Fig. 1 Structural Insulated Panel Assembly (Example 1)

NEW YORK PASSIVE HOUSE bldgtyp

ASHRAE 2D Assembly U-Factor Methods



R-Values

Wood Studs: R-1.1/inch

Plywood Sheathing: R-1.3/inch

Denspack Cellulose: R-3.2/inch

Mineral Wool: R-4/inch

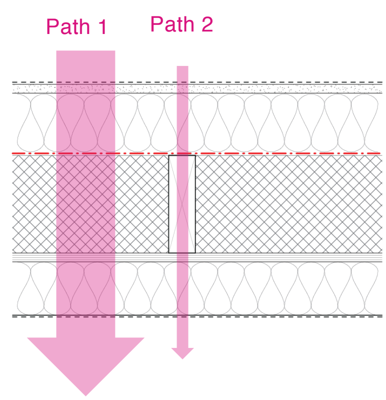
Drywall: R-0.2/inch

31 / 55

ASHRAE 2D Assembly U-Factor – Parallel Path

Parallel Path Method

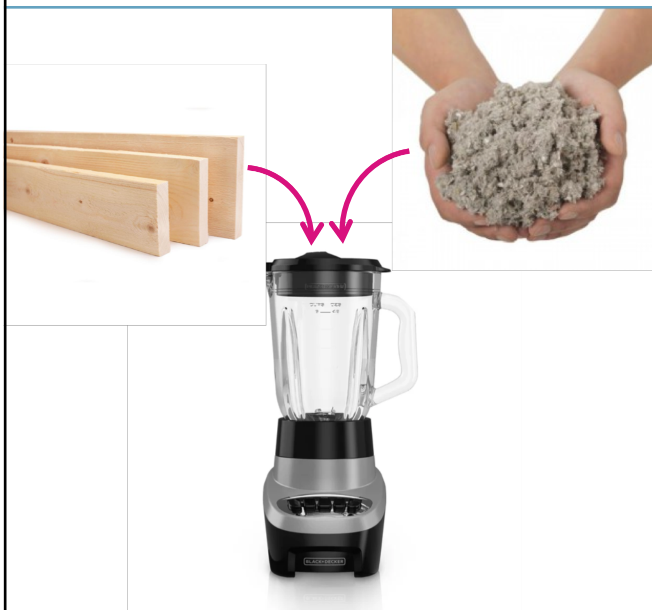
	R-per-Inch (hr·ft²·°F/Btu)		Thickness (inches)		Total Resistance (hr·ft²·°F/Btu) PATH 1	PATH 2
R_{si} (Int. Wall)					0.74	0.74
Drywall	0.2	×	0.5	=	0.1	0.1
Mineral Wool	4.0	×	3.5	=	14	14
Cellulose	3.2	×	5.5	=	17.6	-
Wood Stud	1.1	×	5.5	=	-	6.05
Ext. Sheathing	1.3	×	0.5	=	0.65	0.65
Mineral Wool	4.0	×	3	=	12	12
R_{se} (Ext. Wall)				=	0.23	0.23
				R_{PATH} =	45.2	33.7
				U_{PATH} =	0.0221 ×	0.0296 ×
				Area % =	90.6% =	9.4% =
				$U_{weighted}$	0.02 +	0.0028
				U_{total}	0.0228 (Btu/hr·ft2·°F)	
				R_{total}	43.9(hr·ft2·°F/Btu)	

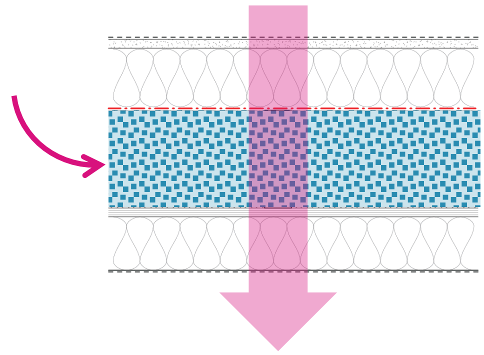


32 / 55

NEW YORK PASSIVE HOUSE bldgtyp

ASHRAE 2D Assembly U-Factor – Isothermal Plane





33 / 55

NEW YORK PASSIVE HOUSE bldgtyp

ASHRAE 2D Assembly U-Factor – Isothermal Plane

Isothermal Plane Method

	R-per-Inch (hr·ft²·°F/Btu)		Thickness (inches)		R-Value	U-Value	Area%	$U_{weighted}$	U_{total}	R-Value
R_{si} (Int. Wall)					0.74					0.74
Drywall	0.2	×	0.5	=	0.1					0.1
Mineral Wool	4.0	×	3.5	=	14					14
Cellulose	3.2	×	5.5	=	17.6	0.057 ×	90.6% =	0.0515 +	0.0670	14.92
Wood Stud	1.1	×	5.5	=	6.05	0.165 ×	9.4% =	0.0155		
Ext. Sheathing	1.3	×	0.5	=	0.65					0.65
Mineral Wool	4.0	×	3	=	12					12
R_{se} (Ext. Wall)					0.23					0.23
									R-Value	**42.5**
									U-Value	**0.0235**

34 / 55

NEW YORK PASSIVE HOUSE bldgtyp

So…

Parallel Plane Method gives us a U-Value of 0.0228 Btu/hr-ft^2-F

Isothermal Plane Method gives us a U-Value of 0.0235 Btu/hr-ft^2-F

Which is right?

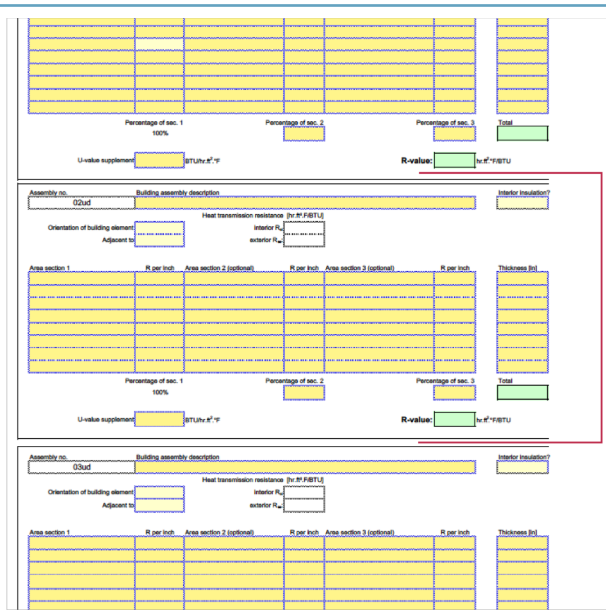
Neither. So we take the average of the two methods. This is exactly what the PHPP is doing in the background

0.0228 + 0.0235 / 2 = 0.02315 Btu/hr-ft^2-F

35 / 55

NEW YORK PASSIVE HOUSE bldgtyp

PHPP / DesignPH Includes Numerical Calculators



Each calculator is used to create an R-Value 'type'. By default, the PHPP / DesignPH includes room for up to 82 unique 'types' in a single project file's catalog.

36 / 55

NEW YORK PASSIVE HOUSE bldgtyp

PHPP Numerical Calculator

designPH

Assembly no.	Building assembly description	Interior insulation?
01ud		

Heat transmission resistance [hr.ft².F/BTU]

Orientation of building element | interior R_{si}

Adjacent to | exterior R_{se}:

Area section 1	R per inch	Area section 2 (optional)	R per inch	Area section 3 (optional)	R per inch	Thickness [in]

Percentage of sec. 1 | Percentage of sec. 2 | Percentage of sec. 3 | Total

100% | | | in

U-value supplement BTU/hr.ft².°F

R-value: hr.ft².°F/BTU

37 / 55

NY PH NEW YORK PASSIVE HOUSE bldgtyp

designPH

Assembly no.	Building assembly description	Interior insulation?
01ud	**Floor Slab**	

1

Heat transmission resistance [hr.ft².F/BTU]

2

Orientation of building element 3-Floor | interior R_{si}: 0.97

Adjacent to 2-Ground | exterior R_{se}: 0.00

Area section 1	R per inch	Area section 2 (optional)	R per inch	Area section 3 (optional)	R per inch	Thickness [in]

Percentage of sec. 1 ... of sec. 3 | Total

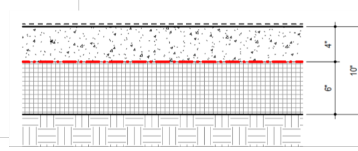
100%

U-value supplement BTU/hr.ft².°F ... 1.2 hr.ft².°F/BTU

Orientation of building element **3-Floor**

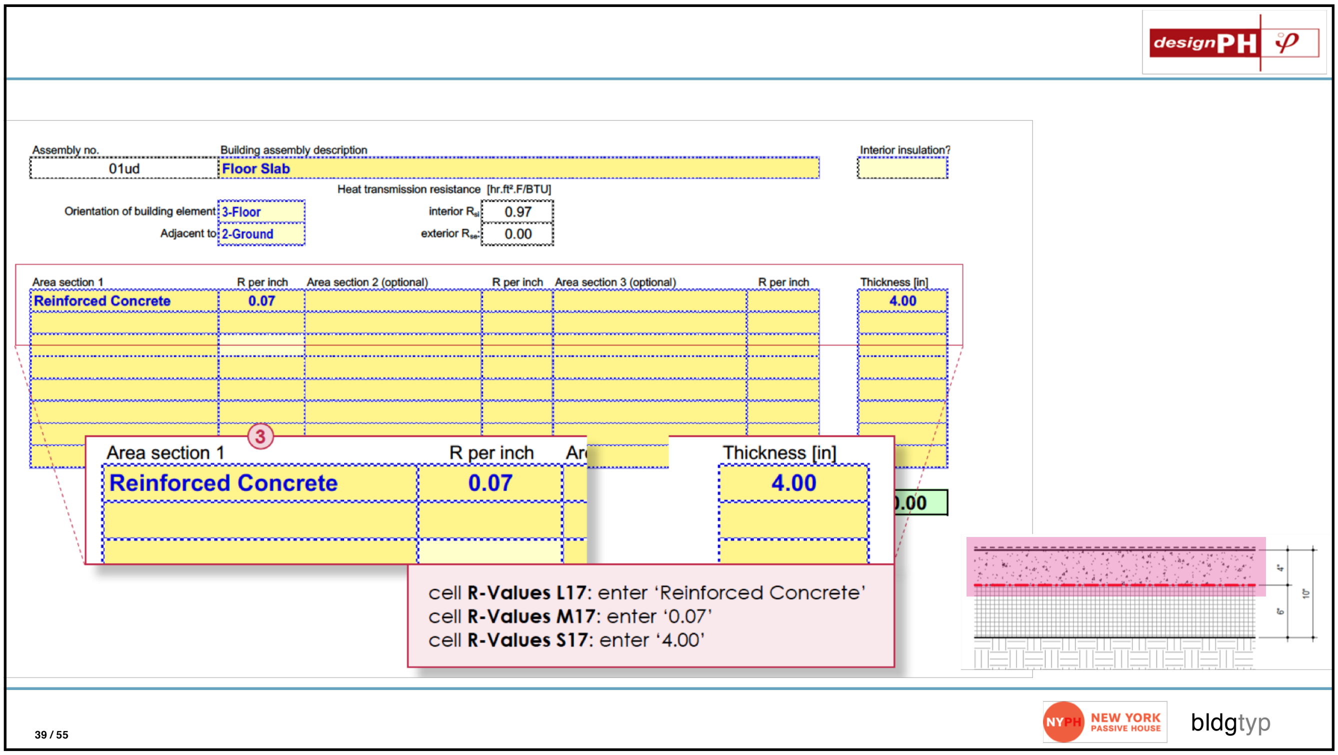
Adjacent to **2-Ground**

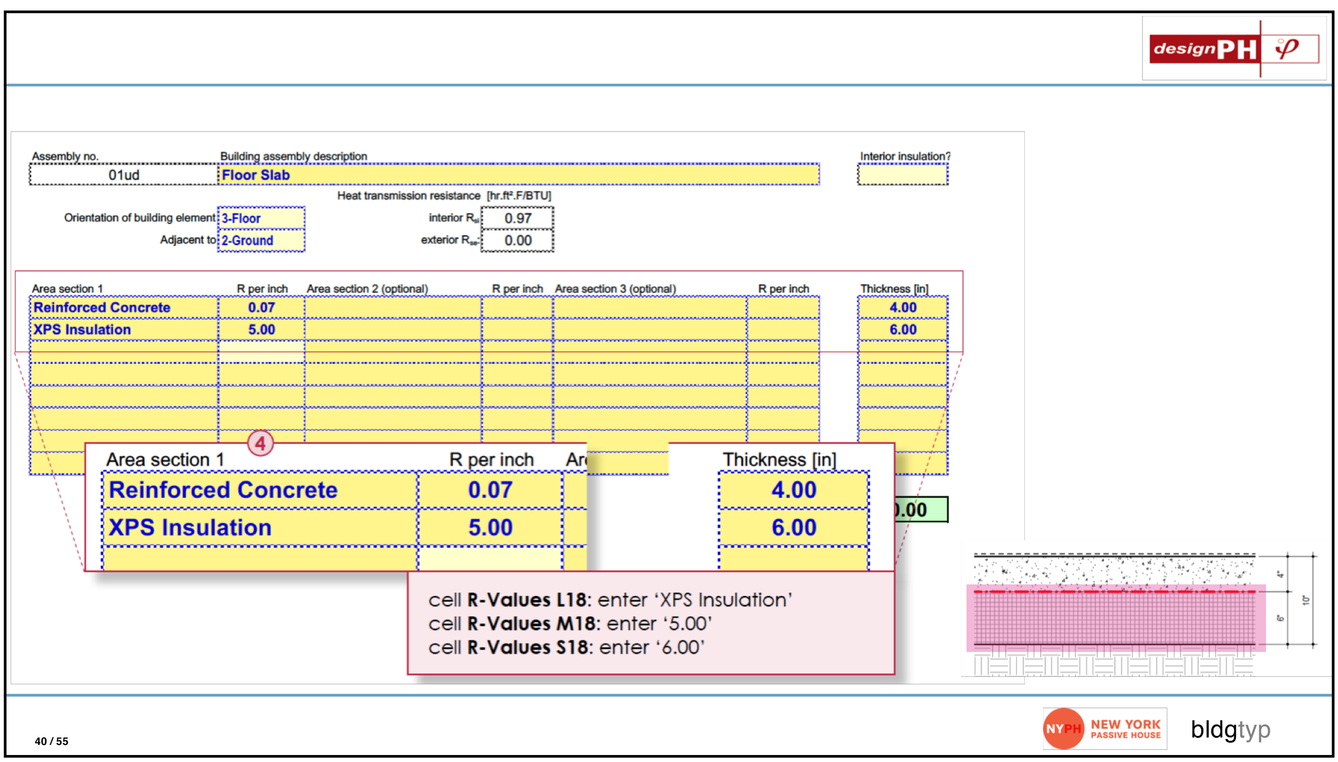
cell **R-Values M11**: enter 'Floor Slab'
cell **R-Values M13**: select '3-Floor'
cell **R-Values M14**: select '2-Ground'



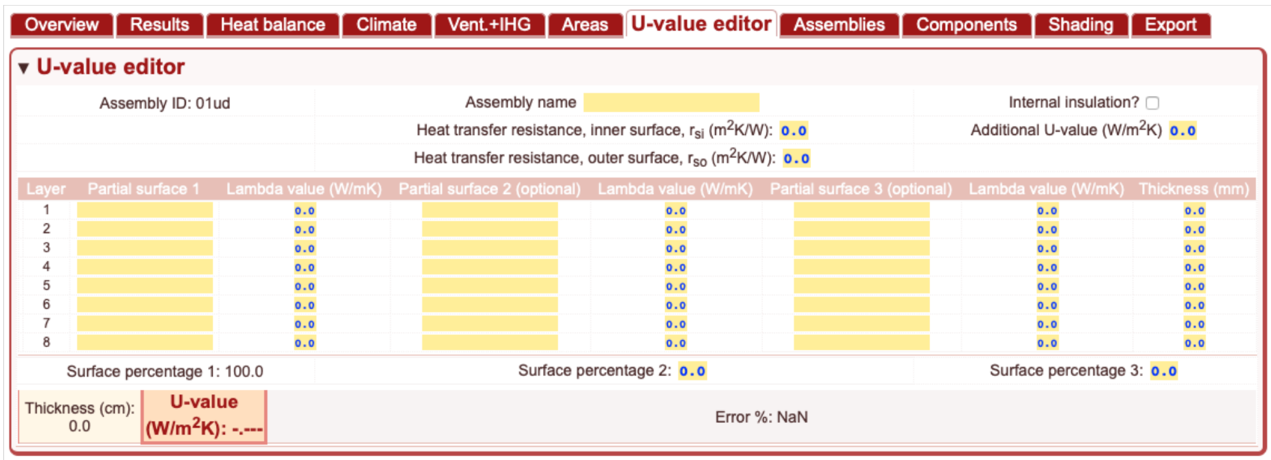
38 / 55

NY PH NEW YORK PASSIVE HOUSE bldgtyp


designPH
Assembly no.
01ud
Building assembly description
Floor Slab
Interior insulation?
Heat transmission resistance [hr.ft².F/BTU]
Orientation of building element 3-Floor
Adjacent to 2-Ground
interior Rsi 0.97
exterior Rse 0.00
Area section 1
R per inch
Area section 2 (optional)
R per inch
Area section 3 (optional)
R per inch
Thickness [in]
Reinforced Concrete
0.07
4.00
3
Area section 1
R per inch
Thickness [in]
Reinforced Concrete
0.07
4.00
cell R-Values L17: enter 'Reinforced Concrete'
cell R-Values M17: enter '0.07'
cell R-Values S17: enter '4.00'
39 / 55
NYPH NEW YORK PASSIVE HOUSE
bldgtyp


designPH
Assembly no.
01ud
Building assembly description
Floor Slab
Interior insulation?
Heat transmission resistance [hr.ft².F/BTU]
Orientation of building element 3-Floor
Adjacent to 2-Ground
interior Rsi 0.97
exterior Rse 0.00
Area section 1
R per inch
Area section 2 (optional)
R per inch
Area section 3 (optional)
R per inch
Thickness [in]
Reinforced Concrete
0.07
4.00
XPS Insulation
5.00
6.00
4
Area section 1
R per inch
Thickness [in]
Reinforced Concrete
0.07
4.00
XPS Insulation
5.00
6.00
cell R-Values L18: enter 'XPS Insulation'
cell R-Values M18: enter '5.00'
cell R-Values S18: enter '6.00'
40 / 55
NYPH NEW YORK PASSIVE HOUSE
bldgtyp

DesignPH Numerical Calculator



41 / 55

bldgtyp

TYPE	IP UNITS	CONVERSION	METRIC UNITS
Conductivity (k)	Btu / hr-ft-F	x 1.731 =	W/mk
U-Value	Btu / hr-ft^2-F	x 5.678 =	W/m^2-K
Resistivity (R/inch)	hr-ft^2-F / Btu-in	x 6.933 =	mk/W
R-Value	hr-ft^2-F / Btu	x 0.176 =	m^2-k / W

The metric system is the tool of the devil! My car gets forty rods to the hogshead and that's the way I likes it.
- Abraham 'Grandpa' Simpson

Note: 1 hogshead = 79 US gallons

42 / 55

bldgtyp

▼ U-value editor

Assembly ID: 01ud

Assembly name: My Example Floor

Internal insulation? ☐

Heat transfer resistance, inner surface, r_{si} (m^2K/W): 0.0

Additional U-value (W/m^2K): 0.0

Heat transfer resistance, outer surface, r_{so} (m^2K/W): 0.0

Layer	Partial surface 1	Lambda value (W/mK)	Partial surface 2 (optional)	Lambda value (W/mK)	Partial surface 3 (optional)	Lambda value (W/mK)	Thickness (mm)
1	Concrete Slab	2.06		0.0		0.0	101.6
2	XPS Insulation	0.029		0.0		0.0	152.4
3		0.0		0.0		0.0	0.0
4		0.0		0.0		0.0	0.0
5		0.0		0.0		0.0	0.0
6		0.0		0.0		0.0	0.0
7		0.0		0.0		0.0	0.0
8		0.0		0.0			

Surface percentage 1: 100.0

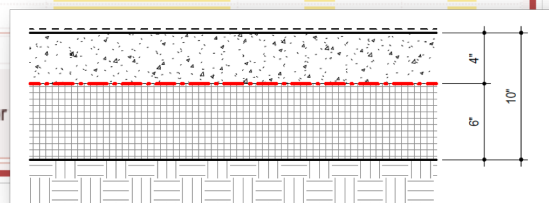
Surface percentage 2: 0.0

Thickness (cm): 25.4

U-value (W/m^2K): 0.189

5.678 ÷ 0.189 = R-30.04 hr-ft²-F/Btu

Error



Numerical Calculation Limits

Assembly no.: 01ud

Building assembly description: My Steel Stud Wall

Interior insulation?

Heat transmission resistance [hr.ft².F/BTU]

Orientation of building element: 2-Wall — interior R_{si}: 0.74

Adjacent to: 1-Outdoor air — exterior R_{se}: 0.23

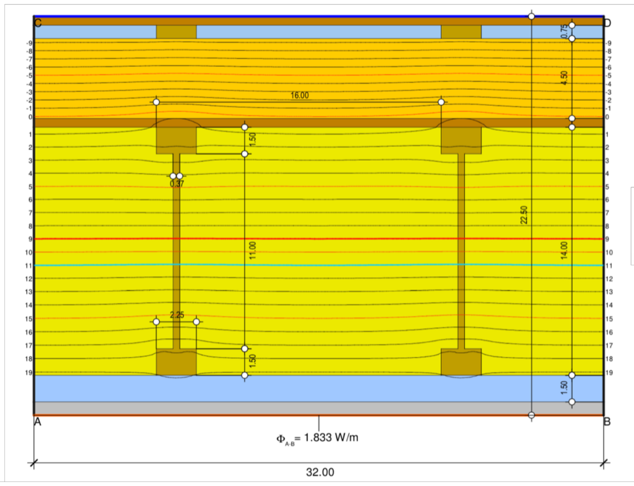
Area section 1	R per inch	Area section 2 (optional)	R per inch	Area section 3 (optional)	R per inch	Thickness [in]
Wood Sjeathing	1.00					0.50
Insulation	3.40	Steel Stud	0.0004			5.50
Gypsum Board	0.80					0.50
Percentage of sec. 1	98%	Percentage of sec. 2	2.0%	Percentage of sec. 3		Total 6.50 in

U-value supplement: BTU/hr.ft².°F

R-value: 2.2 hr.ft².°F/BTU

Error R-value possibly >10%

2 or 3-D Simulation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Exterior, normal		-10.000	0.040	
Interior, heat flux, upwards		20.000	0.100	
Symmetry/Model section	0.000			

Material	λ[W/(m·K)]	ε
Air layer, unventilated, horizontal, thickness: 40 mm	0.222	
Air layer, unventilated, upwards, thickness: 40 mm	0.250	
Cellulose (Denspack) [R-3.7/in]	0.040	0.900
GWB (Typ) [R-0.85/in]	0.170	0.900
Plywood (Typ) [R-1.2/in]	0.119	0.900
PolyIso w Metal Fasteners [R-5.7/in]	0.026	0.900
Wood, Coniferous (Softwood) [R-1.03/in]	0.140	0.900

For many assembly types (steel stud walls, complex assemblies) we will not be allowed to use a numerical calculation. We can then turn to 2D simulations in order to establish our clear field assembly U-Value.

$$U_{eq\ A\text{-}B} = \frac{1.833}{30.000 \cdot 0.813} = 0.0752\ \mathrm{W/(m^2 \cdot K)} = 0.0132\ \mathrm{Btu/(h \cdot ft^2 \cdot F)}$$

45 / 55

NEW YORK PASSIVE HOUSE bldgtyp

Material Information Sources

1. ISO 6946 / ISO 10211
2. BR 443
3. Material Datasheets
4. ASHRAE HOF (Chapter 33)
5. ASHRAE 90.1 Appendix A

Normative Appendix A

Table A9.4.4-1 *R-Values* for *Building Materials*

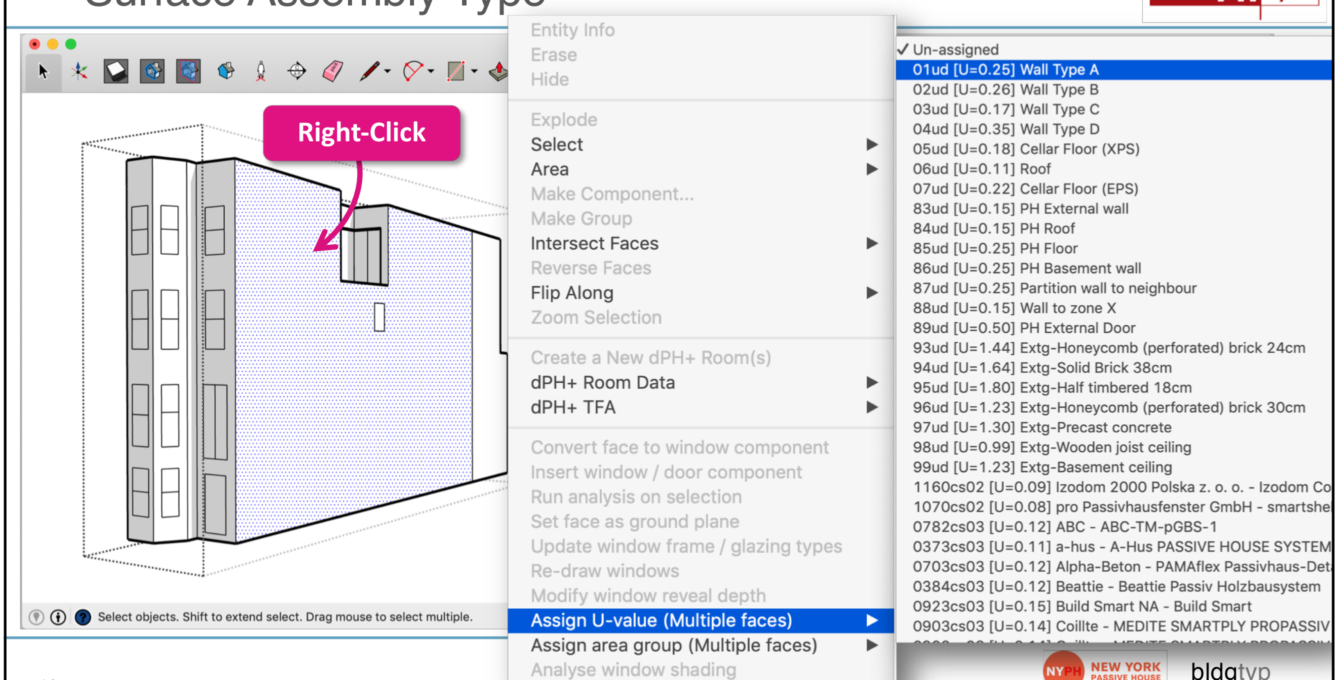
Material	Actual Size, In.	*R-Value*
Carpet and Rubber Pad		1.23
Concrete at R-0.0625/in.	2	0.13
	4	0.25
	6	0.38
	8	0.5
	10	0.63
	12	0.75
Gypsum board	0.5	0.45
	0.625	0.56
Metal Deck		0
Roofing, built-up	0.375	0.33
Soil at R-0.104/in.	12	1.25
Steel, Mild	1	0.0031807
Stucco	0.75	0.08
Wood panels, 7/16 in.	0.438	0.62
Wood subfloor	0.75	0.94
Wood, 2 × 4 at R-1.25/in.	3.5	4.38

46 / 55

NEW YORK PASSIVE HOUSE bldgtyp

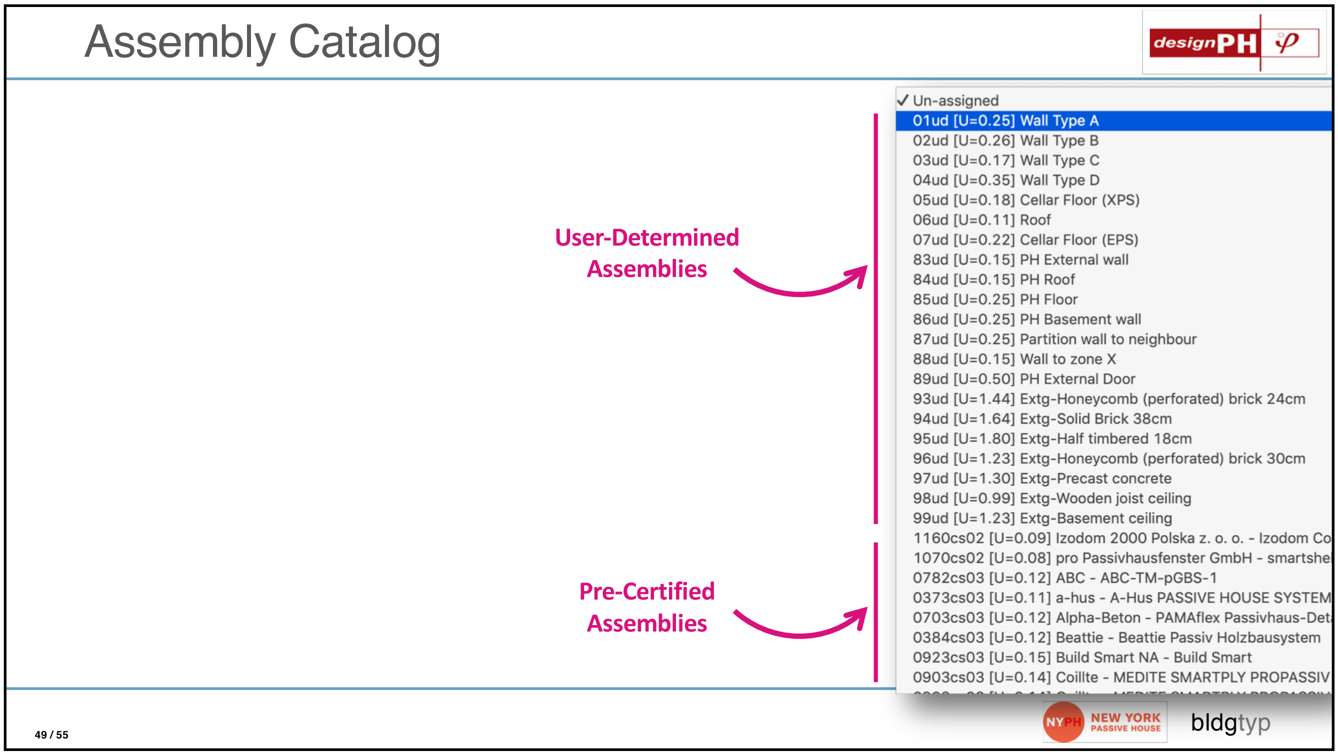
Assigning Surfaces in DesignPH 2.0

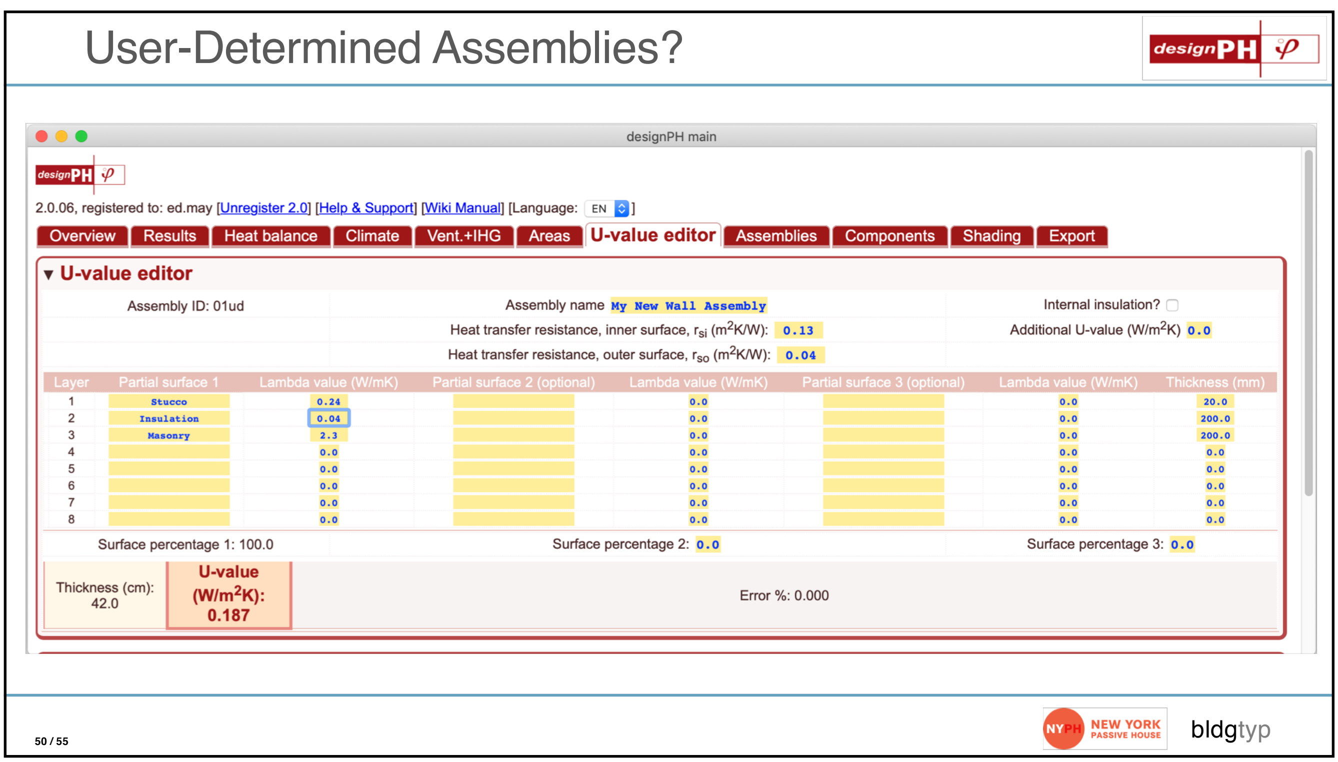
Surface Assembly Type



48 / 55

bldgtyp


Assembly Catalog
designPH
User-Determined Assemblies
Pre-Certified Assemblies
✓ Un-assigned
01ud [U=0.25] Wall Type A
02ud [U=0.26] Wall Type B
03ud [U=0.17] Wall Type C
04ud [U=0.35] Wall Type D
05ud [U=0.18] Cellar Floor (XPS)
06ud [U=0.11] Roof
07ud [U=0.22] Cellar Floor (EPS)
83ud [U=0.15] PH External wall
84ud [U=0.15] PH Roof
85ud [U=0.25] PH Floor
86ud [U=0.25] PH Basement wall
87ud [U=0.25] Partition wall to neighbour
88ud [U=0.15] Wall to zone X
89ud [U=0.50] PH External Door
93ud [U=1.44] Extg-Honeycomb (perforated) brick 24cm
94ud [U=1.64] Extg-Solid Brick 38cm
95ud [U=1.80] Extg-Half timbered 18cm
96ud [U=1.23] Extg-Honeycomb (perforated) brick 30cm
97ud [U=1.30] Extg-Precast concrete
98ud [U=0.99] Extg-Wooden joist ceiling
99ud [U=1.23] Extg-Basement ceiling
1160cs02 [U=0.09] Izodom 2000 Polska z. o. o. - Izodom Co
1070cs02 [U=0.08] pro Passivhausfenster GmbH - smartshe
0782cs03 [U=0.12] ABC - ABC-TM-pGBS-1
0373cs03 [U=0.11] a-hus - A-Hus PASSIVE HOUSE SYSTEM
0703cs03 [U=0.12] Alpha-Beton - PAMAflex Passivhaus-Det
0384cs03 [U=0.12] Beattie - Beattie Passiv Holzbausystem
0923cs03 [U=0.15] Build Smart NA - Build Smart
0903cs03 [U=0.14] Coillte - MEDITE SMARTPLY PROPASSIV
49 / 55
NEW YORK PASSIVE HOUSE
bldgtyp


User-Determined Assemblies?
designPH
designPH main
2.0.06, registered to: ed.may [Unregister 2.0] [Help & Support] [Wiki Manual] [Language: EN]
Overview
Results
Heat balance
Climate
Vent.+IHG
Areas
U-value editor
Assemblies
Components
Shading
Export
▾ U-value editor
Assembly ID: 01ud
Assembly name My New Wall Assembly
Internal insulation?
Heat transfer resistance, inner surface, rsi (m2K/W): 0.13
Additional U-value (W/m2K) 0.0
Heat transfer resistance, outer surface, rso (m2K/W): 0.04
Layer | Partial surface 1 | Lambda value (W/mK) | Partial surface 2 (optional) | Lambda value (W/mK) | Partial surface 3 (optional) | Lambda value (W/mK) | Thickness (mm)
1 Stucco 0.24 0.0 0.0 20.0
2 Insulation 0.04 0.0 0.0 200.0
3 Masonry 2.3 0.0 0.0 200.0
4 0.0 0.0 0.0 0.0
5 0.0 0.0 0.0 0.0
6 0.0 0.0 0.0 0.0
7 0.0 0.0 0.0 0.0
8 0.0 0.0 0.0 0.0
Surface percentage 1: 100.0
Surface percentage 2: 0.0
Surface percentage 3: 0.0
Thickness (cm): 42.0
U-value (W/m2K): 0.187
Error %: 0.000
50 / 55
NEW YORK PASSIVE HOUSE
bldgtyp

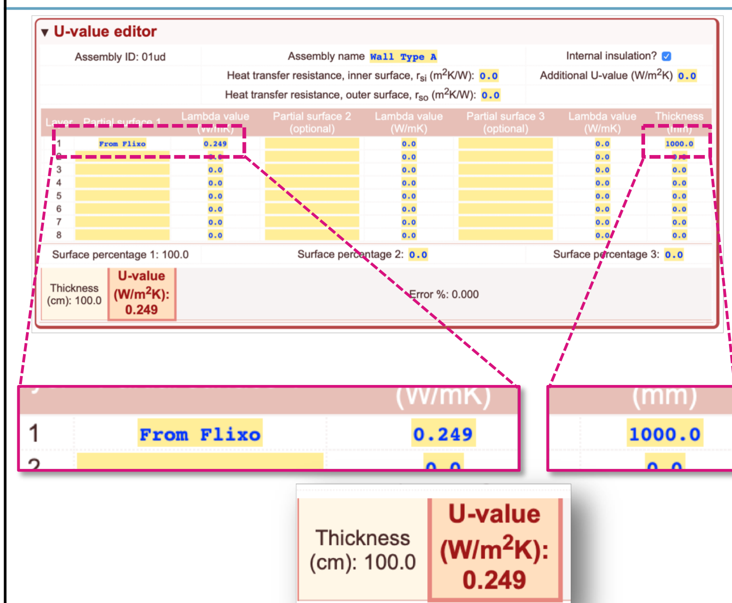
Just like PHPP, build them one layer at a time.

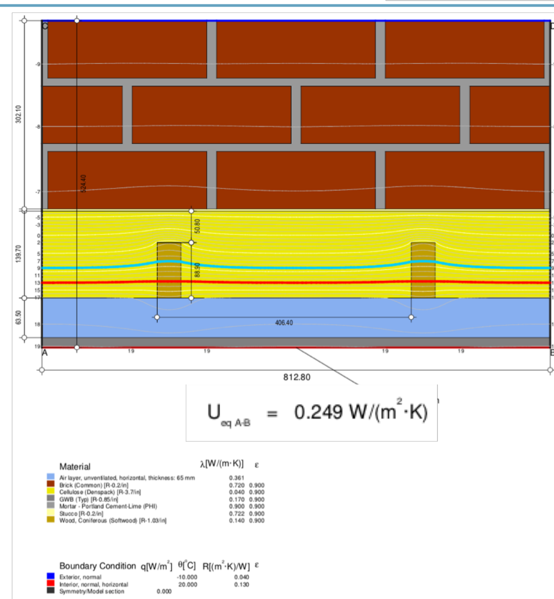
Layer	Partial surface 1	Lambda value (W/mK)	Thickness (mm)
1	Stucco	0.24	20.0
2	Insulation	0.04	200.0
3	Masonry	2.3	200.0
4		0.0	0.0

Thickness (cm):	U-value (W/m²K):
42.0	0.187

NEW YORK PASSIVE HOUSE bldgtyp

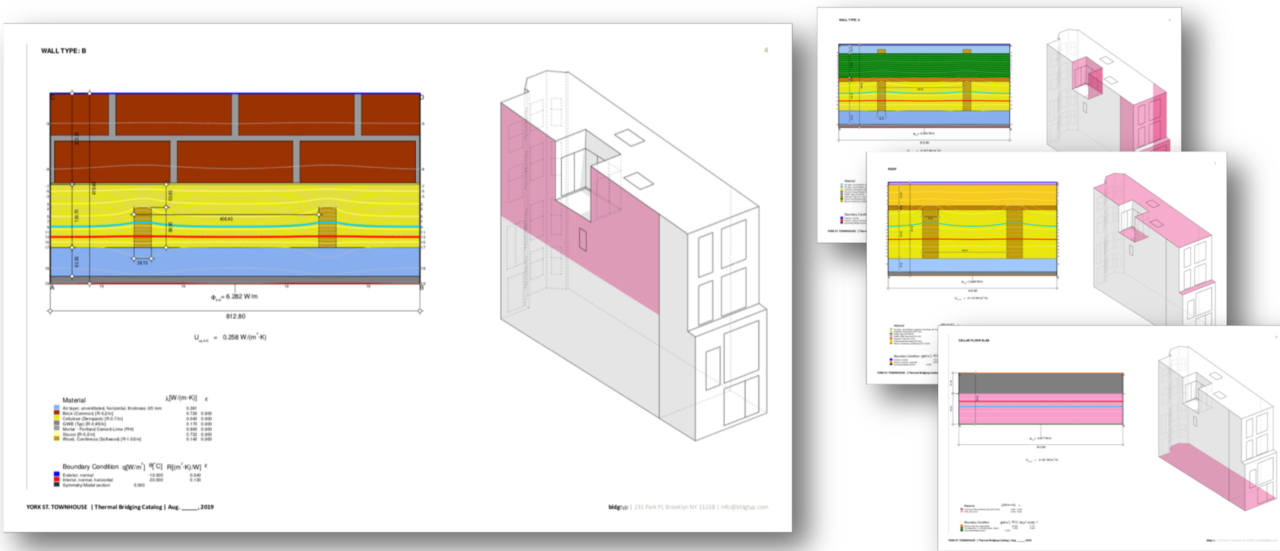
Or just calculate in 2D Simulation





NEW YORK PASSIVE HOUSE bldgtyp

Assembly Catalog

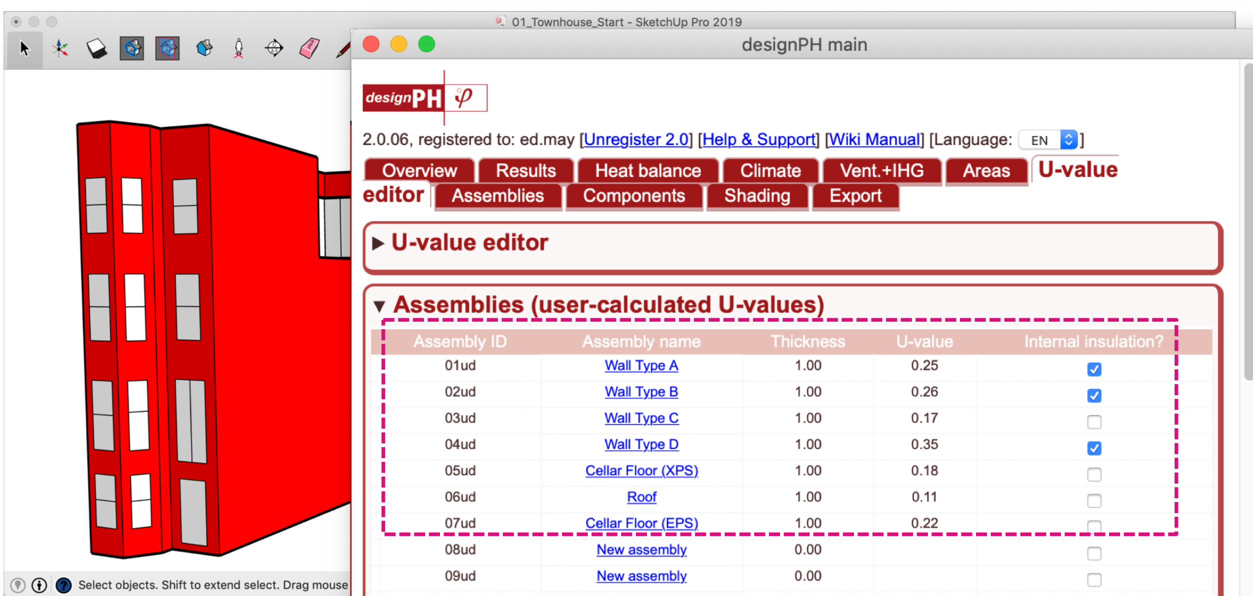


53 / 55

NEW YORK PASSIVE HOUSE

bldgtyp

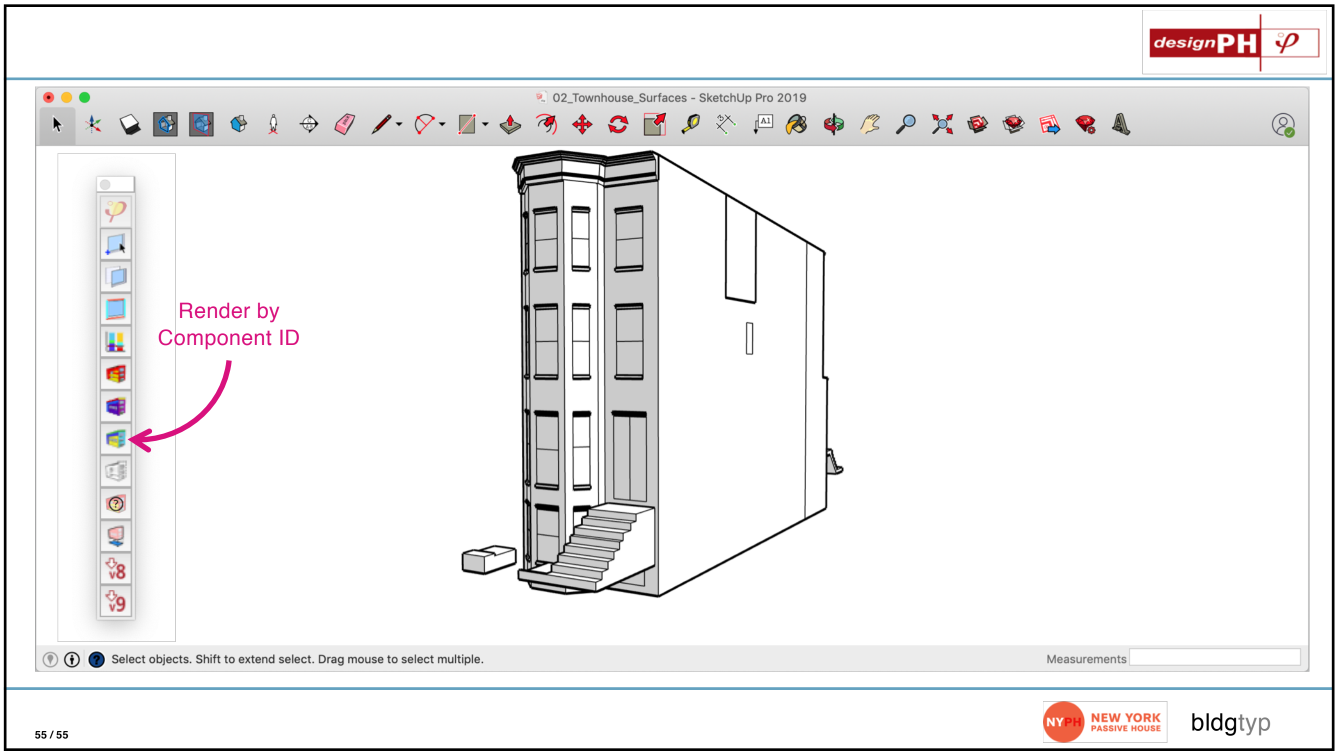
Assembly U-Values



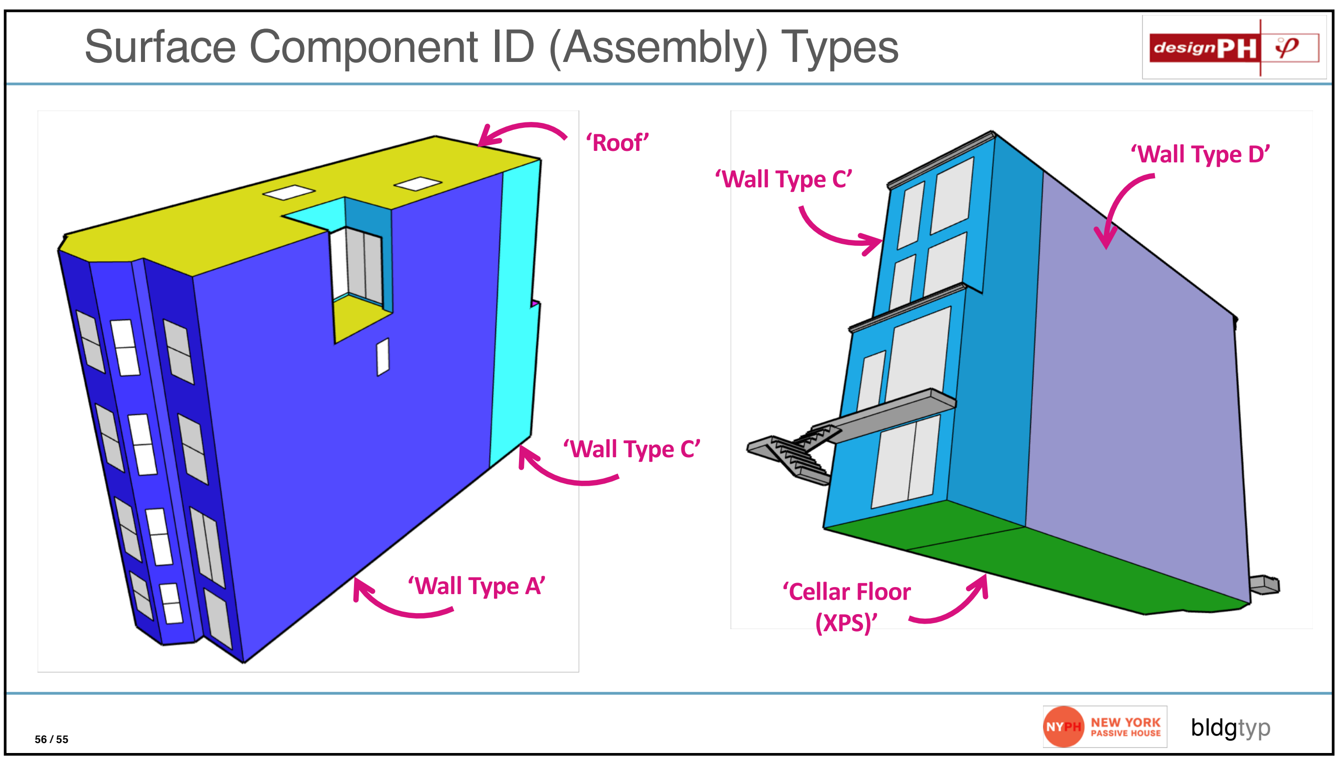
54 / 55

NEW YORK PASSIVE HOUSE

bldgtyp



designPH
02_Townhouse_Surfaces - SketchUp Pro 2019
Render by
Component ID
Select objects. Shift to extend select. Drag mouse to select multiple.
Measurements
55 / 55
NY PH NEW YORK PASSIVE HOUSE
bldgtyp



Surface Component ID (Assembly) Types
designPH
'Roof'
'Wall Type C'
'Wall Type A'
'Wall Type C'
'Wall Type D'
'Cellar Floor
(XPS)'
56 / 55
NY PH NEW YORK PASSIVE HOUSE
bldgtyp

Passive House 2020 – Choose Your Future: A Virtual Conference, Every Wed 1-4pm EST, June 24 – July 29

*Register for our annual online conference, ***Passive House 2020 – Choose Your Future***

57 / 55

bldgtyp