

WEEK ASSIGNMENT 6

Task 1

Considering the same example you solved in the previous assignment (radiative heat transfer between two parallel plates), how many shields with epsilon = 0.1 should you add in order to have the new heat transfer rate to be 1% of the case without shields ?

$$\varepsilon_1=0.1$$

$$\varepsilon_2=0.1$$

$$\sigma=5.670*10^{-8} \text{W/m}^2\text{K}^4$$

When the $\varepsilon_1=\varepsilon_2=0.1$;

$$\dot{Q}_{12} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} = A * 5.67 * 10^{-8} * \frac{800^4 - 500^4}{\frac{1}{0.1} + \frac{1}{0.1} - 1} = A * 1035.72 \text{ W/m}^2$$

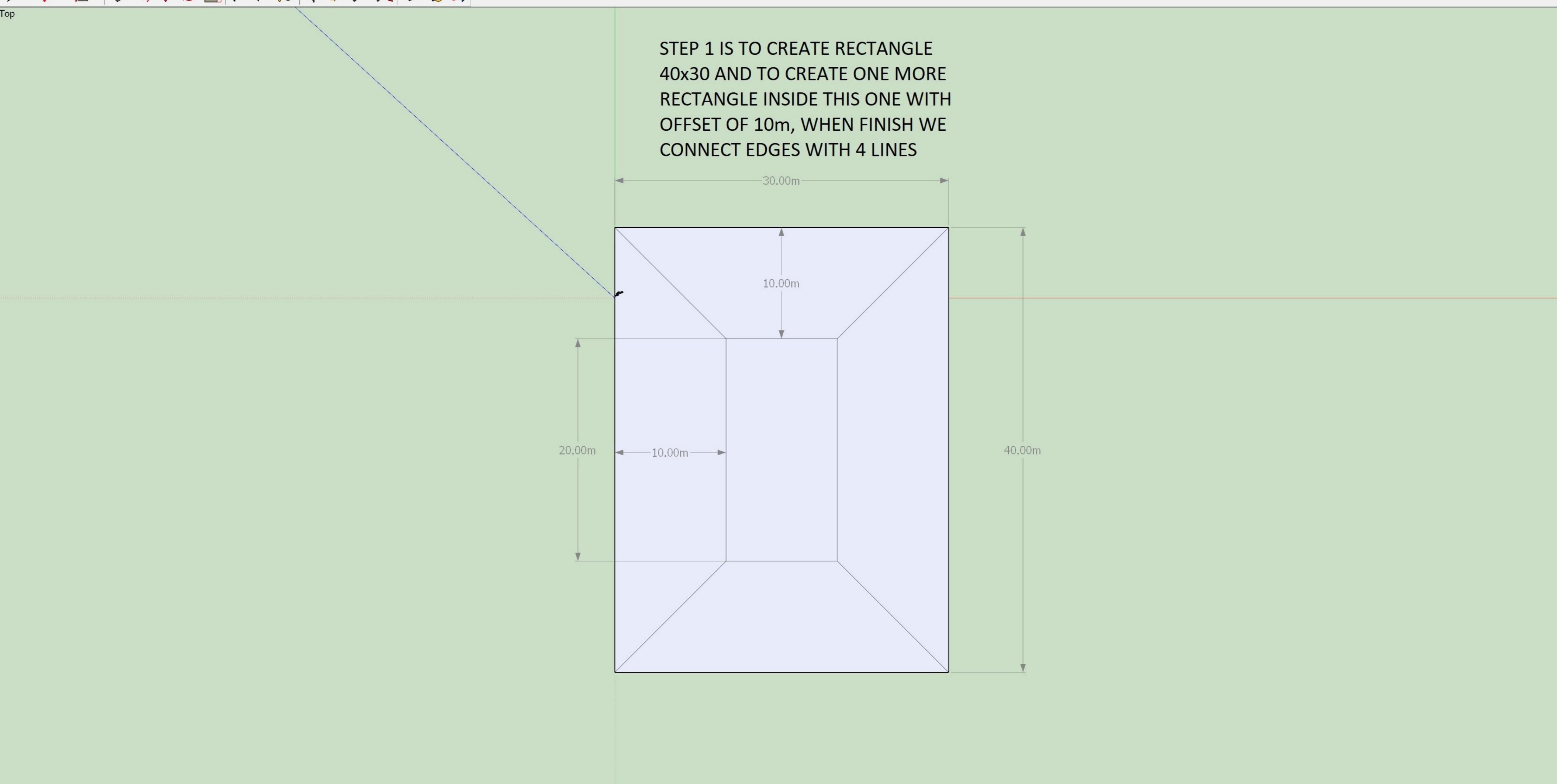
$$\dot{Q}_{N \text{ shields}} = \frac{A\sigma(T_1^4 - T_2^4)}{(N+1)\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1} = \frac{1}{N+1} * \dot{Q} \text{ no shields}$$

$$\dot{Q}_{12} \text{ from previous case} = 1035.72 \text{ AW/m}^2$$

$$1\% \text{ of } \dot{Q}_{12} - 36.25 \text{ AW/m}^2$$

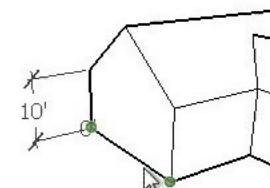
$$10.36 = \frac{1}{N+1} * 1036$$

N=99shields



Default Tray

- Entity Info
- Materials
- Components
- Styles
- Shadows
- ▼ Instructor



Dimension Tool

Place Dimension entities.

Tool Operation

1. Click at starting point of dimension.
2. Move cursor.
3. Click at ending point of dimension.
4. Move cursor perpendicular to dimension.
5. Click to fix position of dimension string.
6. Esc = Cancel operation.

Modifier Keys

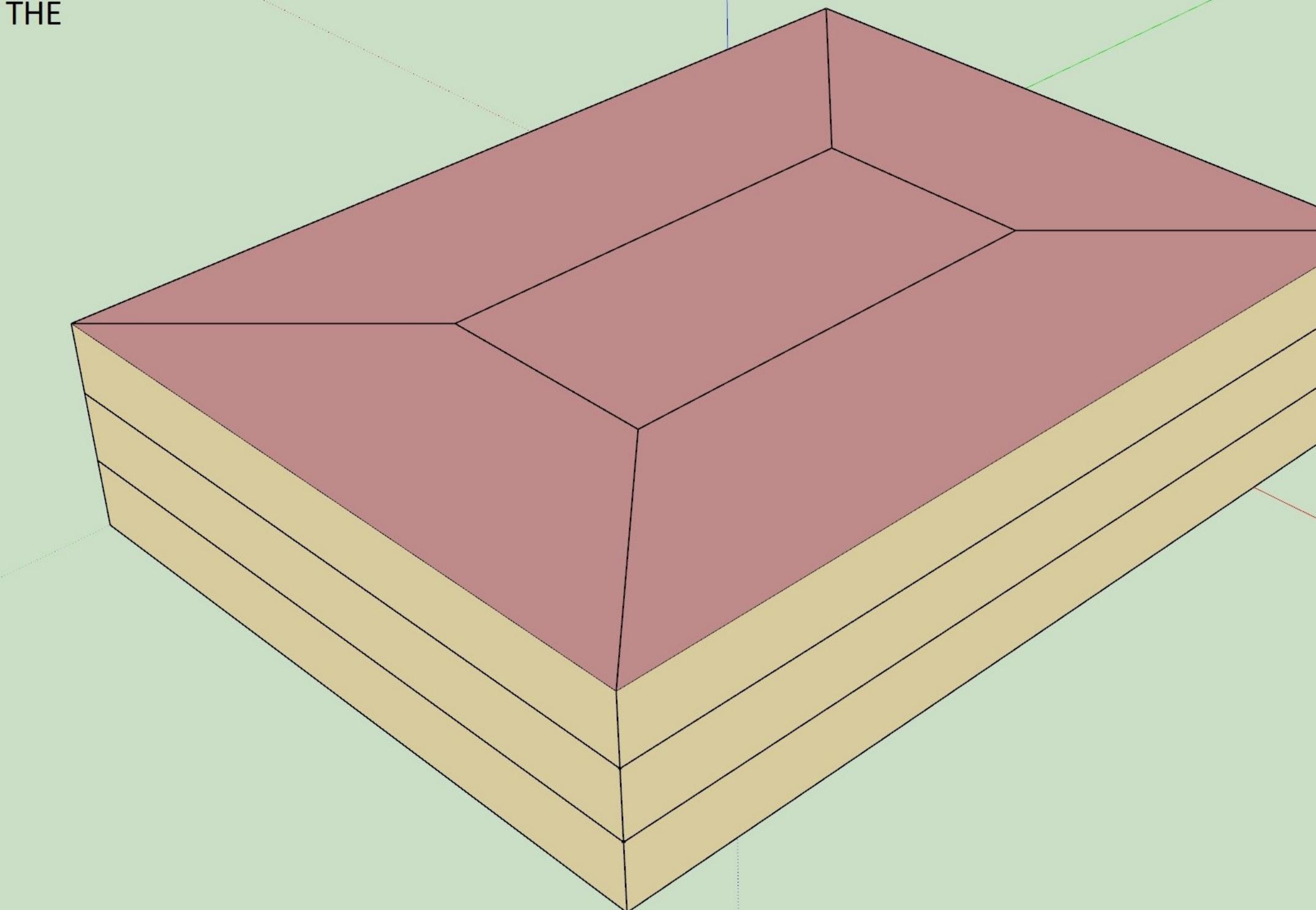
None.

[Click to learn about more](#)

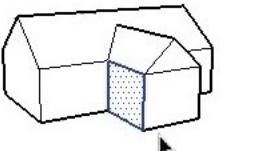


SELECTING THE
DIAGRAM AND USING
OPTION CREATE
SPACES FROM
DIAGRAM THE

WITH INFO TOOL WE ARE
ABLE TO SEE
INFORMATIONS OF EACH
SURFACE OF THE
BUILDING



Default Tray
► Entity Info
► Materials
► Components
► Styles
► Shadows
▼ Instructor



Select Tool

Select entities to modify when using other tools or commands.

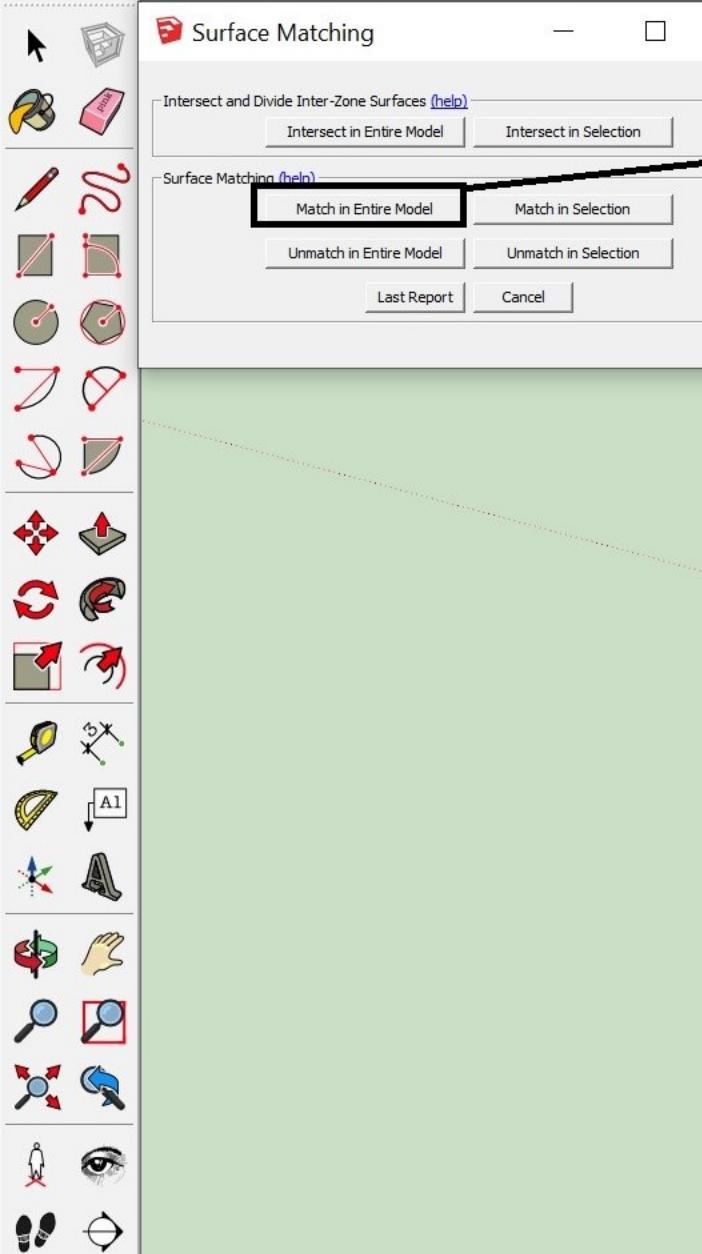
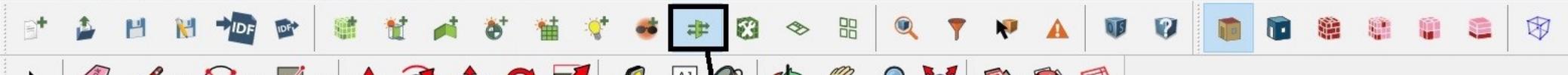
Tool Operation

1. Click on an entity.

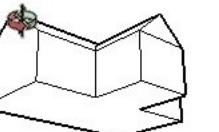
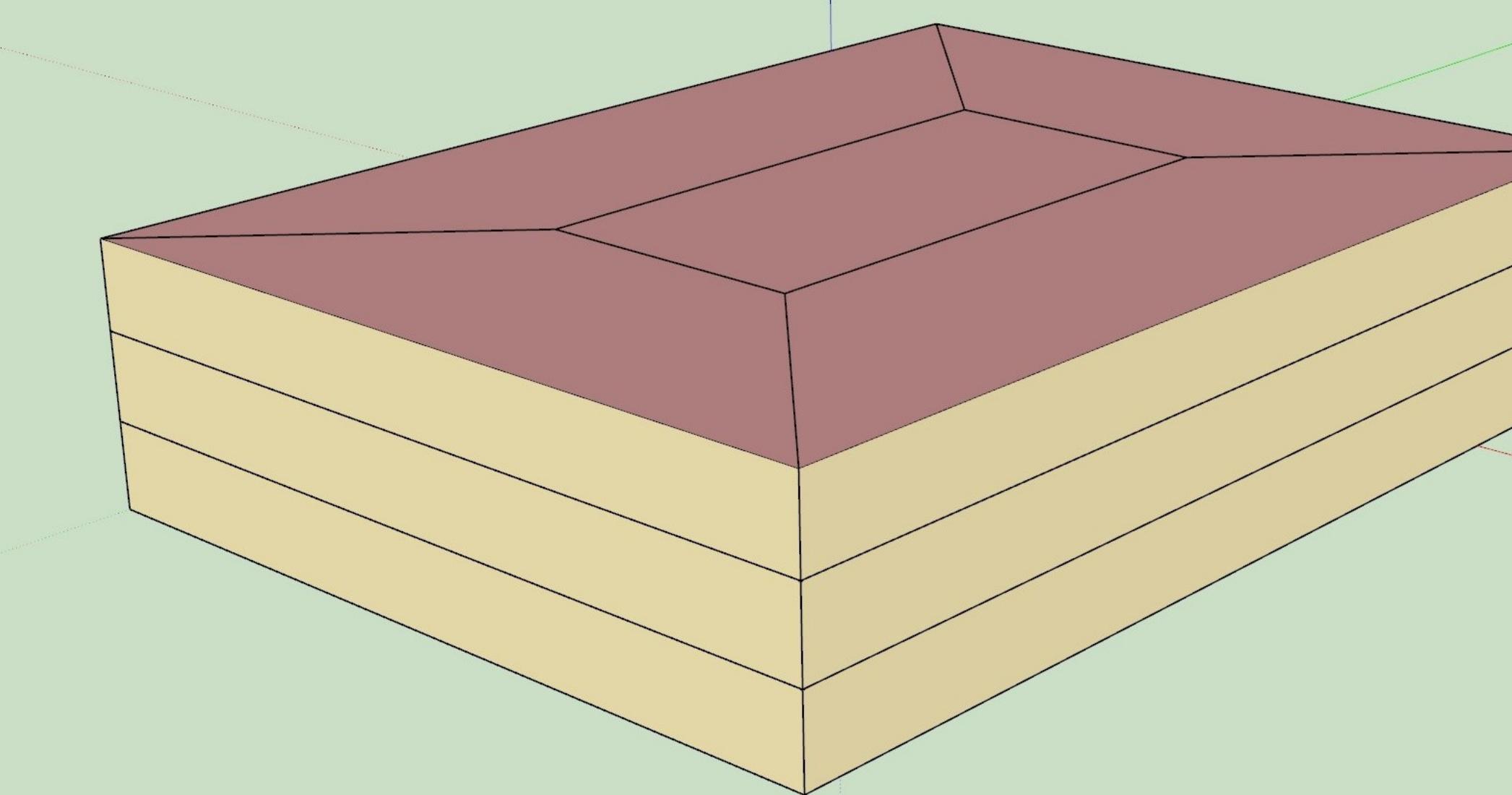
Modifier Keys

Ctrl = Add an entity to set of selected entities
Shift+Ctrl = Subtract an entity from set of selected entities
Shift = Toggle whether an entity is within set of selected entities
Ctrl+A = Select all visible entities in model

[Click to learn about more advanced operations...](#)



USING THIS SURFACE
MATCHING TOOL WE
MAKE SURE THAT WE
DO NOT HAVE
WINDOWS INSIDE THE
BUILDING



Orbit Tool

Rotate camera about model.

Tool Operation

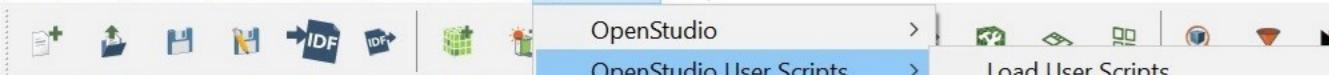
1. Click anywhere in drawing area.
2. Move cursor in any direction to rotate around center of drawing area.

Modifier Keys

Shift = Pan Tool
Ctrl = Suspend gravity (do not try to keep vertical edges up and down)

[Click to learn about more advanced operations...](#)

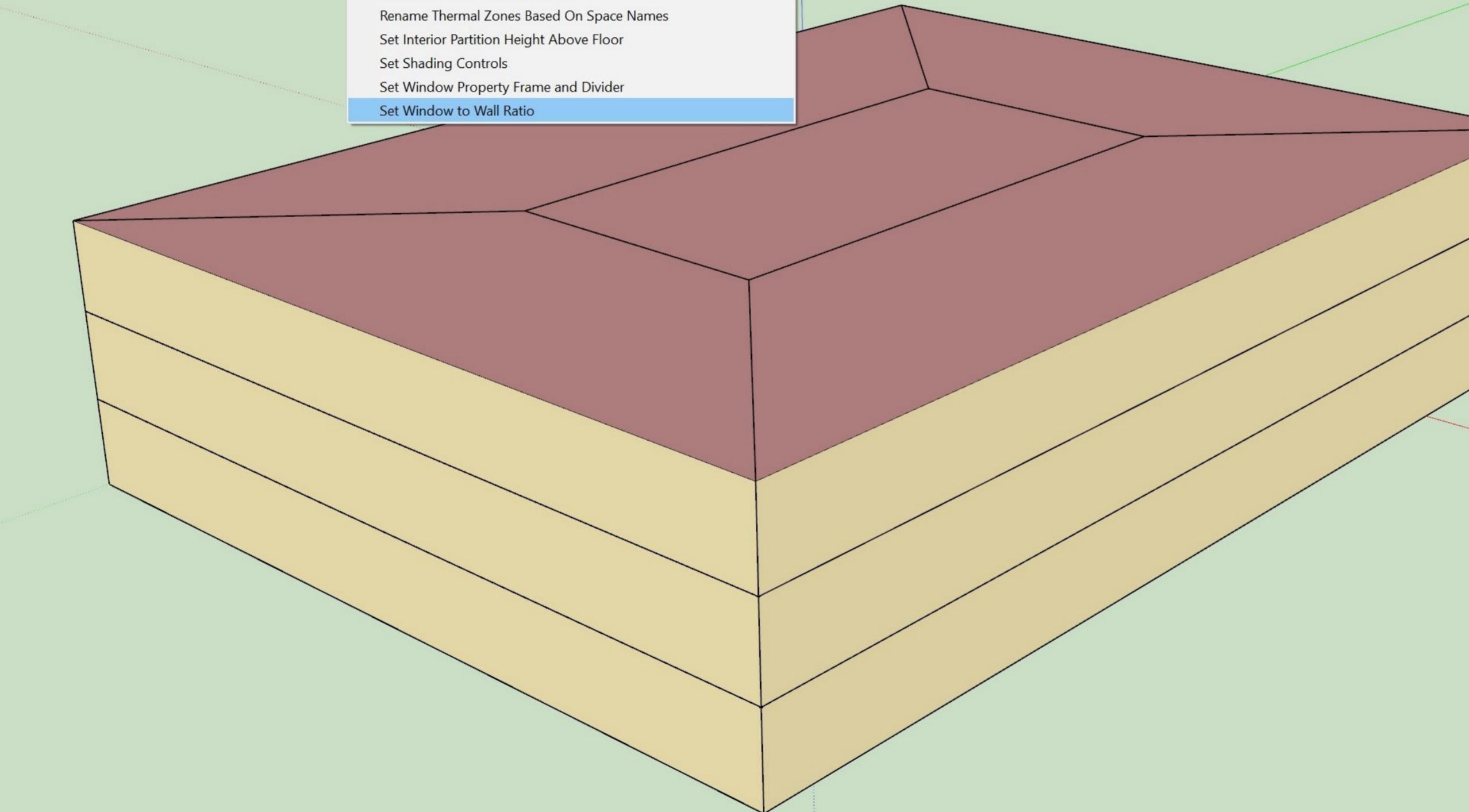
File Edit View Camera Draw Tools Window Extensions Help



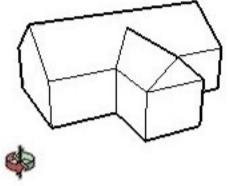
OpenStudio
OpenStudio User Scripts
Alter or Add Model Elements
Building Component Library
Create Standard Building Shapes
Experimental Workflow
On Demand Template Generators
Reports
Visualization

Add New Thermal Zone For Spaces With No Thermal Zone
Add Overhangs by Projection Factor
Add Photovoltaics
Add Shading Controls
Assign Building Stories
Change Shading Type
Cleanup Origins
Export Selected Spaces to a new External Model
Merge Spaces From External File
Make Selected Surfaces Adiabatic and Assign a Construction
Move Selected Surfaces to New Space
Remove Hard Assigned Constructions
Remove Loads Directly Assigned to Spaces
Remove Orphan Photovoltaics
Remove Orphan SubSurfaces
Remove Photovoltaics
Remove Unused ThermalZones
Rename Thermal Zones Based On Space Names
Set Interior Partition Height Above Floor
Set Shading Controls
Set Window Property Frame and Divider
Set Window to Wall Ratio

WITH THIS TOOL WE ADD
WINDOWS



Default Tray
Entity Info
Materials
Components
Styles
Shadows
Instructor



Orbit Tool
Rotate camera about model.

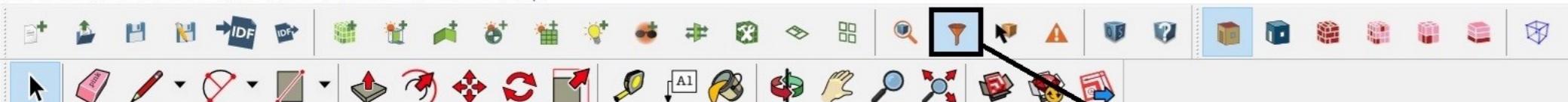
Tool Operation

1. Click anywhere in drawing area.
2. Move cursor in any direction to rotate around center of drawing area.

Modifier Keys

Shift = Pan Tool
Ctrl = Suspend gravity (do not try to keep vertical edges up and down)

Click to learn about more advanced operations...



TO CREATE EXTERNAL SHADING WE NEED TO CHOOSE ALL OF THE SURFACES EXCEPT THE NORTH

The image shows a 3D architectural model in a software interface. The model consists of a main rectangular volume with a pink top surface and a thick base composed of several horizontal layers in blue and yellow. A callout line points from the text "TO CREATE EXTERNAL SHADING WE NEED TO CHOOSE ALL OF THE SURFACES EXCEPT THE NORTH" to the pink top surface of the building.

Surface Search

Surface Search [help]

Class:

Name:

Type:

Construction:

Outside Boundary Condition:

Sun Exposure:

Wind Exposure:

Surface Orientation:

from 90 to 270 (Clockwise) - North is 0 degrees

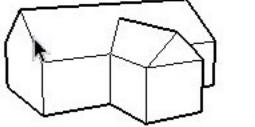
Exclude Horizontal Surfaces

Only Show Non-Convex Surfaces

Only Show Surfaces With More Than 5 Vertices

Search Entire Model Search Selection Unhide All Last Report Cancel

Default Tray	
►	Entity Info
►	Materials
►	Components
►	Styles
►	Shadows
▼	Instructor



Select Tool

Select entities to modify when using other tools or commands.

Tool Operation

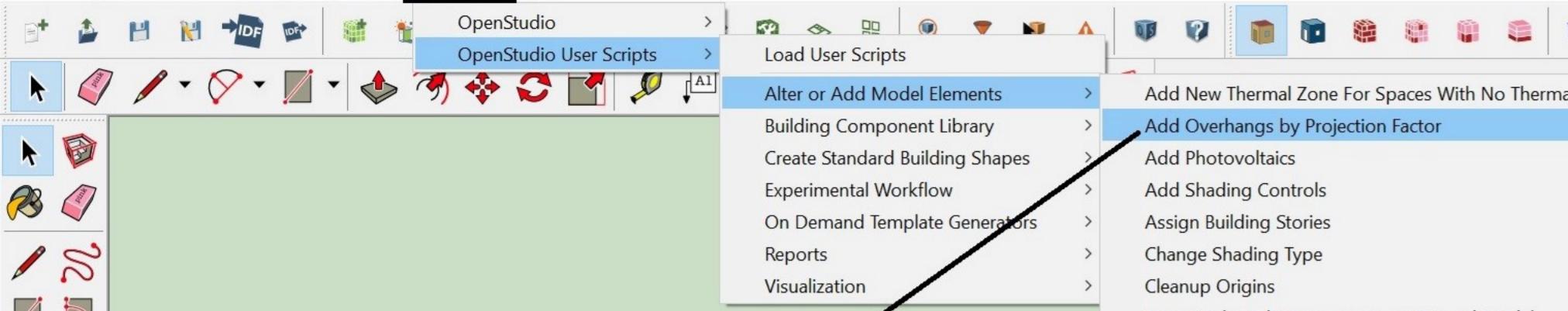
1. Click on an entity.

Modifier Keys

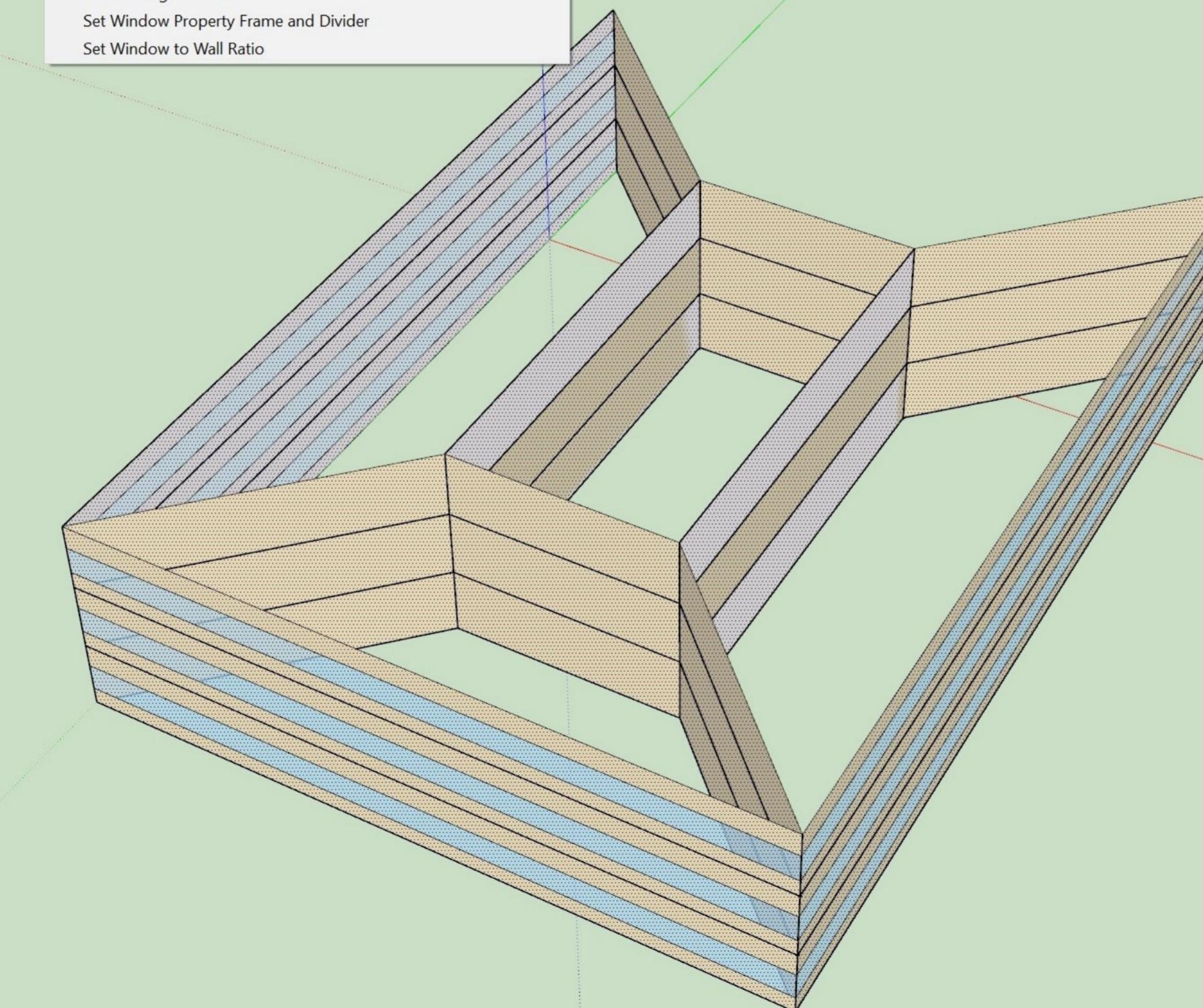
Ctrl = Add an entity to set of selected entities
Shift+Ctrl = Subtract an entity from set of selected entities
Shift = Toggle whether an entity is within set of selected entities
Ctrl+A = Select all visible entities in model

Click to learn about more advanced operations...

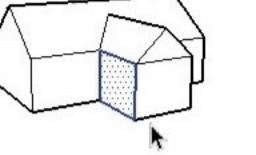
File Edit View Camera Draw Tools Window Extensions Help



NOW WE ARE ADDING
OVERHANG WHICH IS EXTERNAL
SHADING



Default Tray	
► Entity Info	x
► Materials	x
► Components	x
► Styles	x
► Shadows	x
▼ Instructor	x



Select Tool

Select entities to modify when using other tools or commands.

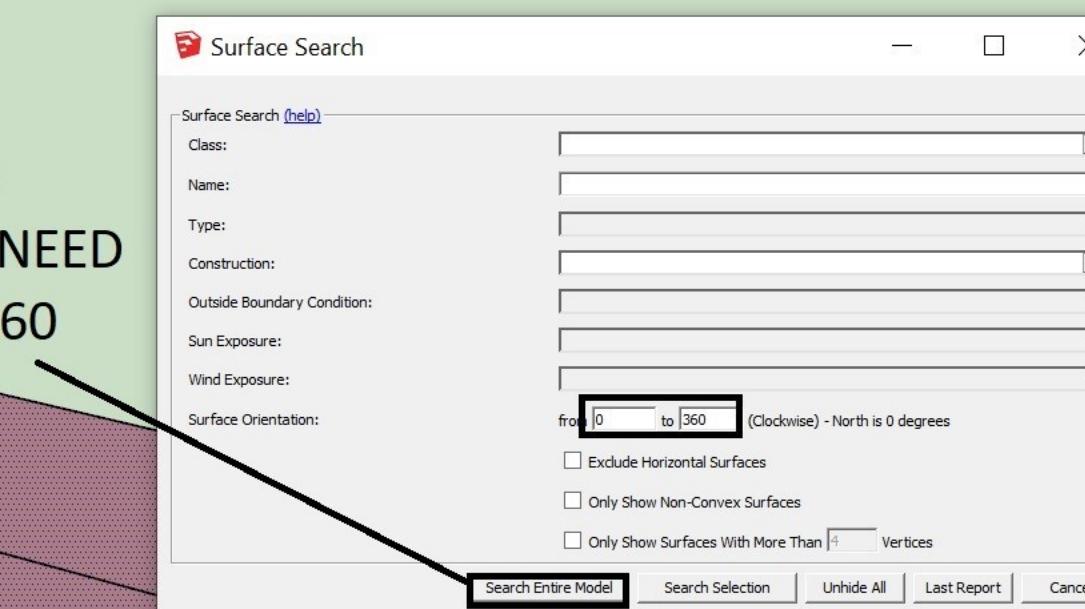
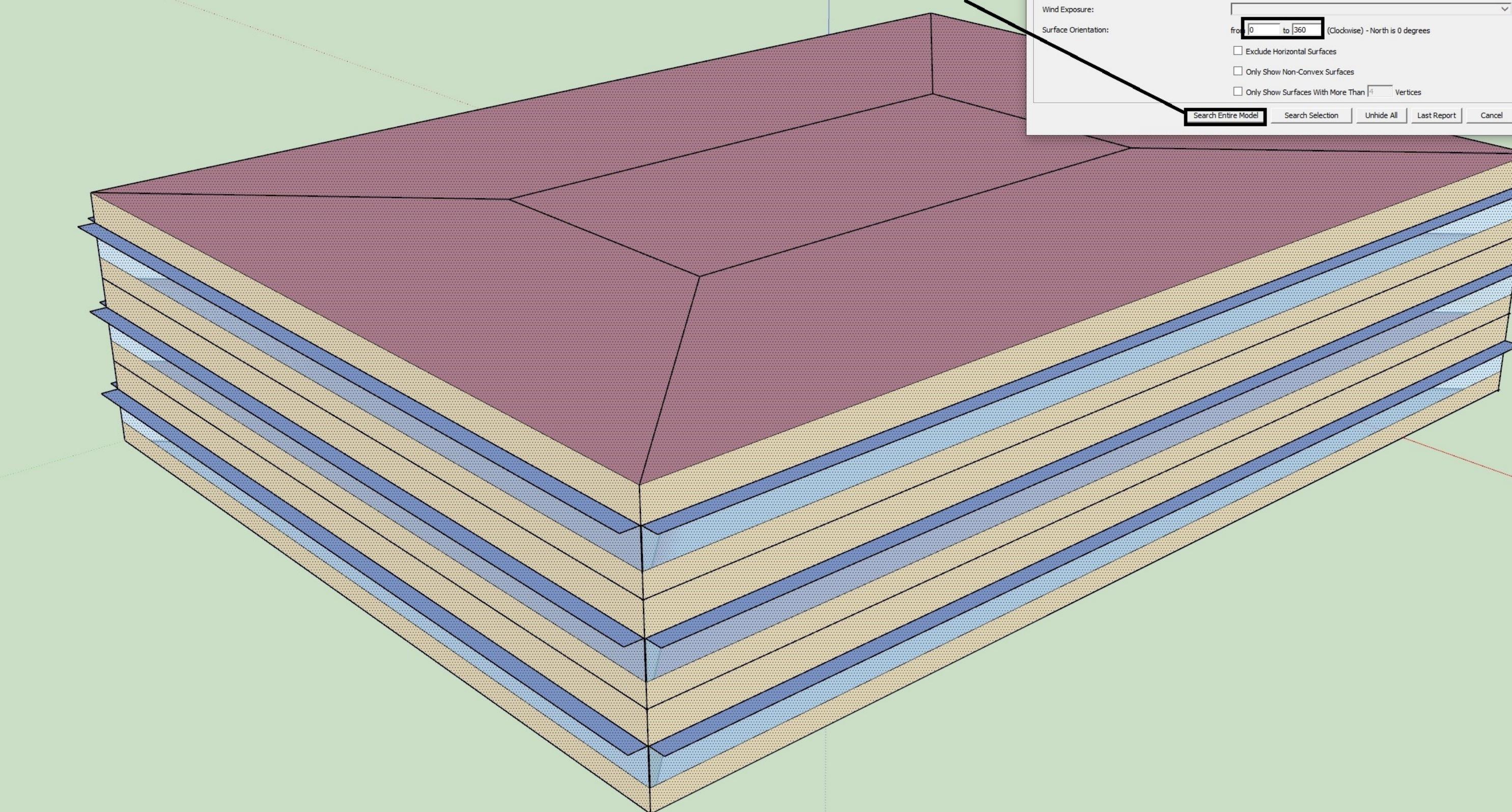
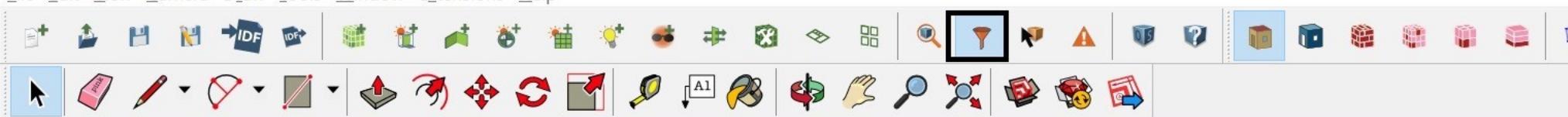
Tool Operation

1. Click on an entity.

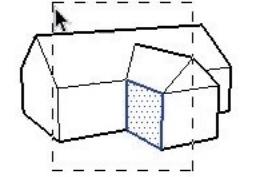
Modifier Keys

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Shift+Ctrl = Subtract an entity from set of selected entities
Shift = Toggle whether an entity is within set of selected entities
Ctrl+A = Select all visible entities in model

Click to learn about more advanced operations...

**Default Tray**

- Entity Info
- Materials
- Components
- Styles
- Shadows
- ▼ Instructor

**Select Tool**

Select entities to modify when using other tools or commands.

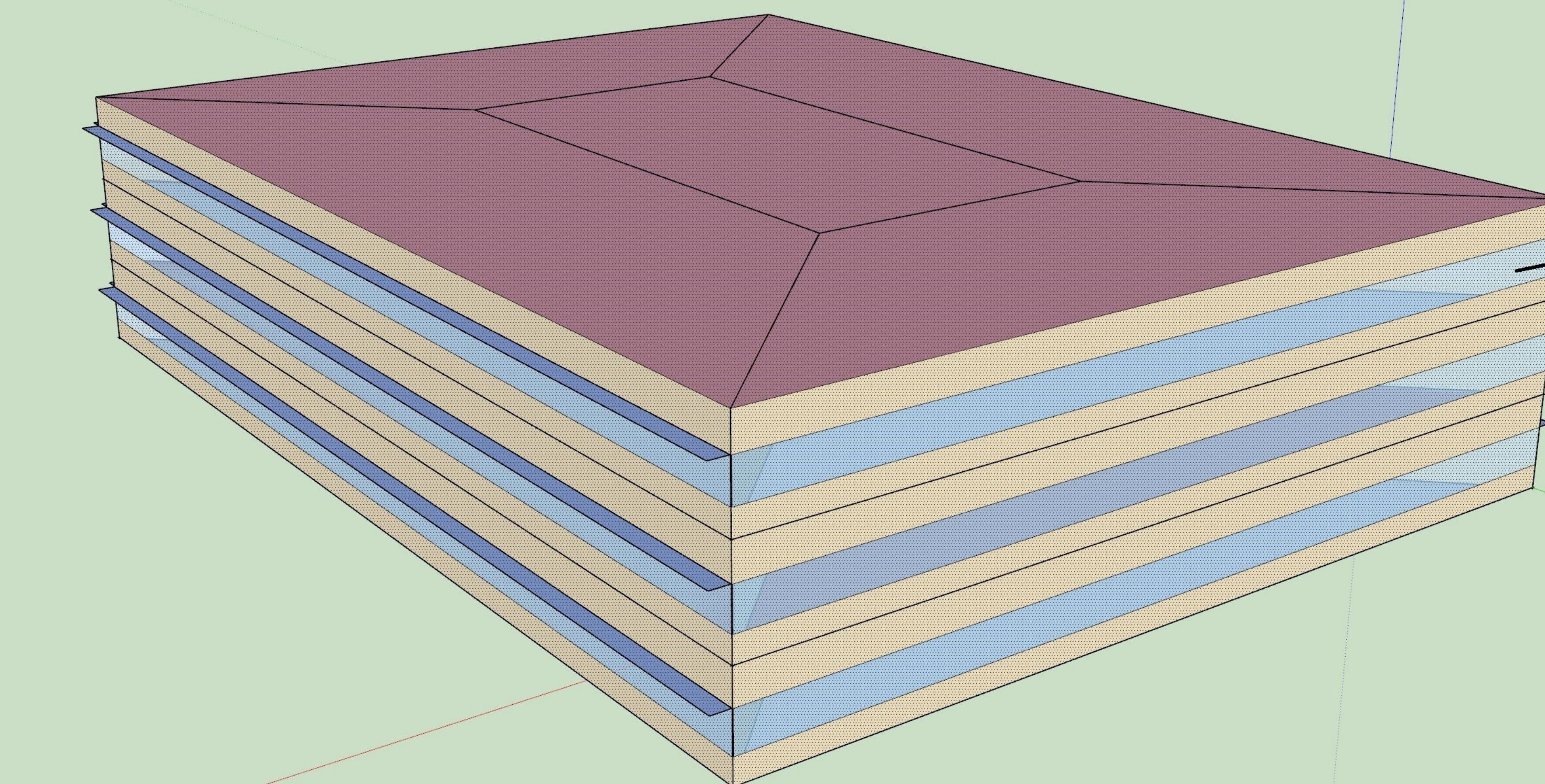
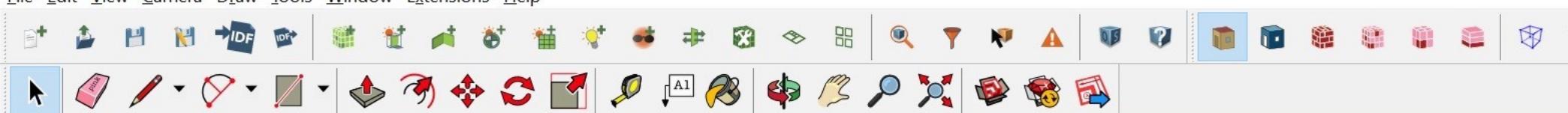
Tool Operation

1. Click on an entity.

Modifier Keys

Ctrl = Add an entity to set of selected entities
Shift+Ctrl = Subtract an entity from set of selected entities
Shift = Toggle whether an entity is within set of selected entities
Ctrl+A = Select all visible entities in model

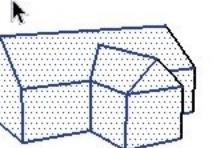
Click to learn about more advanced operations...



THIS SURFACE (NORTH)
IS THE ONLY SURFACE
WHICH DOES NOT
HAVE SHADING

Default Tray

- Entity Info
- Materials
- Components
- Styles
- Shadows
- ▼ Instructor



Select Tool

Select entities to modify when using other tools or commands.

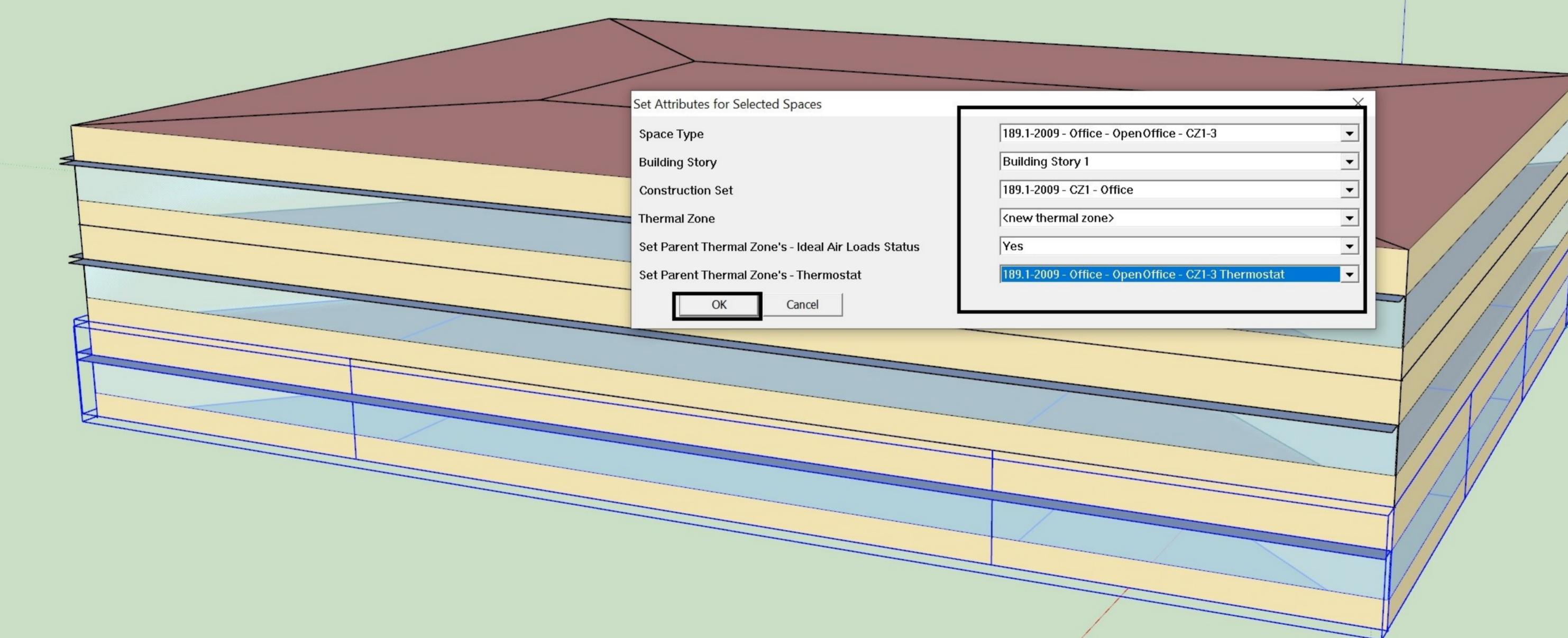
Tool Operation

1. Click on an entity.

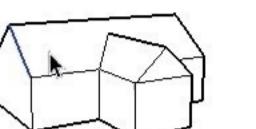
Modifier Keys

- Ctrl = Add an entity to set of selected entities
- Shift+Ctrl = Subtract an entity from set of selected entities
- Shift = Toggle whether an entity is within set of selected entities
- Ctrl+A = Select all visible entities in model

Click to learn about more advanced operations...



NOW WE ADD
SPECIFICATIONS OF
CHOOSING SPACES OF
EACH THERMAL ZONE



Select Tool

Select entities to modify when using other tools or commands.

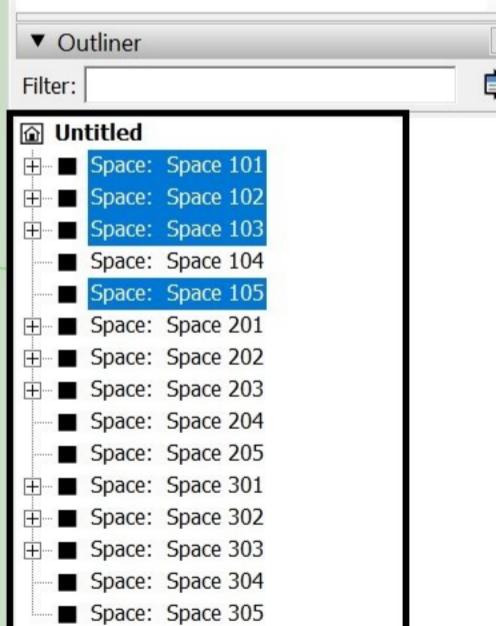
Tool Operation

- Click on an entity.

Modifier Keys

Ctrl = Add an entity to set of selected entities
Shift+Ctrl = Subtract an entity from set of selected entities
Shift = Toggle whether an entity is within set of selected entities
Ctrl+A = Select all visible entities in model

[Click to learn about more advanced operations...](#)



Site Weather File & Design Days Life Cycle Costs Utility Bills

Weather File

Name: Piacenza
Latitude: 44.92
Longitude: 9.73
Elevation: 134
Time Zone: 1
Download weather files at www.energyplus.gov

Measure Tags (Optional):

ASHRAE Climate Zone:
CEC Climate Zone:

Design Days

Design Days

Date	Temperature	Humidity	Pressure Wind Precipitation	Solar	Custom	
Design Day Name		All	Day Of Month	Month	Day Type	Daylight Saving Time Indicator
			<input type="checkbox"/> Apply to Selected	<input type="checkbox"/> Apply to Selected	<input type="checkbox"/> Apply to Selected	<input type="checkbox"/>
Piacenza Ann Clg .4% Condns DB=>MWB	<input type="checkbox"/>	21		8	SummerDesignDay	<input type="checkbox"/>
Piacenza Ann Clg .4% Condns DP=>MDB	<input type="checkbox"/>	21		8	SummerDesignDay	<input type="checkbox"/>
Piacenza Ann Clg .4% Condns Enth=>MDB	<input type="checkbox"/>	21		8	SummerDesignDay	<input type="checkbox"/>
Piacenza Ann Clg .4% Condns WB=>MDB	<input type="checkbox"/>	21		8	SummerDesignDay	<input type="checkbox"/>
Piacenza Ann Htg 99.6% Condns DB	<input type="checkbox"/>	21		1	WinterDesignDay	<input type="checkbox"/>
Piacenza Ann Htg Wind 99.6% Condns WS=>MCDB	<input type="checkbox"/>	21		1	WinterDesignDay	<input type="checkbox"/>
Piacenza Ann Hum_n 99.6% Condns DP=>MCDB	<input type="checkbox"/>	21		1	WinterDesignDay	<input type="checkbox"/>

Select Year by:

Calendar Year

First Day of Year

Daylight Savings Time:

Starts

Define by Day of The Week And Month

Define by Date

Ends

Define by Day of The Week And Month

Define by Date

My Model Library Edit



Run



Finished

Warnings: 24

Errors: 0

Output

```
Warming up {5}
Warming up {6}
Starting Simulation at 08/21 for PIACENZA ANN CLG .4% CONDNS DP=>MDB
Initializing New Environment Parameters
```

```
Warming up {1}
Warming up {2}
Warming up {3}
Warming up {4}
Warming up {5}
Warming up {6}
```

```
Starting Simulation at 08/21 for PIACENZA ANN CLG .4% CONDNS ENTH=>MDB
Initializing New Environment Parameters
```

```
Warming up {1}
Warming up {2}
Warming up {3}
Warming up {4}
Warming up {5}
Warming up {6}
```

```
Starting Simulation at 08/21 for PIACENZA ANN CLG .4% CONDNS WB=>MDB
Initializing New Environment Parameters
```

```
Warming up {1}
Warming up {2}
Warming up {3}
Warming up {4}
Warming up {5}
Warming up {6}
```

```
Starting Simulation at 01/21 for PIACENZA ANN HTG 99.6% CONDNS DB
Initializing New Environment Parameters
```

```
Warming up {1}
Warming up {2}
Warming up {3}
Warming up {4}
Warming up {5}
Warming up {6}
```

```
Starting Simulation at 01/21 for PIACENZA ANN HTG WIND 99.6% CONDNS WS=>MCDB
Initializing New Environment Parameters
```

```
Warming up {1}
Warming up {2}
Warming up {3}
Warming up {4}
Warming up {5}
Warming up {6}
```

```
Starting Simulation at 01/21 for PIACENZA ANN HUM_N 99.6% CONDNS DP=>MCDB
Initializing New Environment Parameters
```

```
Warming up {1}
Warming up {2}
Warming up {3}
Warming up {4}
Warming up {5}
Warming up {6}
```

```
Starting Simulation at 01/01 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=01/21
Continuing Simulation at 01/21 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=02/10
Continuing Simulation at 02/10 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=03/02
Continuing Simulation at 03/02 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=03/22
Continuing Simulation at 03/22 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=04/11
Continuing Simulation at 04/11 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=05/01
Continuing Simulation at 05/01 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=05/21
Continuing Simulation at 05/21 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=06/10
Continuing Simulation at 06/10 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=06/30
Continuing Simulation at 06/30 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=07/20
Continuing Simulation at 07/20 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=08/09
Continuing Simulation at 08/09 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=08/29
Continuing Simulation at 08/29 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=09/18
Continuing Simulation at 09/18 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=10/08
Continuing Simulation at 10/08 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=10/28
Continuing Simulation at 10/28 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=11/17
Continuing Simulation at 11/17 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=12/07
Continuing Simulation at 12/07 for RUN PERIOD 1
```

```
Updating Shadowing Calculations, Start Date=12/27
Continuing Simulation at 12/27 for RUN PERIOD 1
```

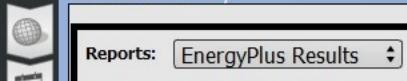
```
Writing tabular output file results using HTML format.
Computing Life Cycle Costs and Reporting
```

```
Writing final SQL reports
EnergyPlus Run Time=00hr 00min 7.02sec
```

```
Script executing from: C:/Users/Ira Kovinic/AppData/Local/Temp/OpenStudio.y27308/resources/run/6-UserScript-0
Found UserScript 'OpenStudio Results'.
result = true
```

```
Processed 1 base script and 0 merged scripts
```

AFTER THIS STEP WE JUST RUN THE MODEL



Reports: EnergyPlus Results

Open ResultsViewer
for Detailed Reports[Table of Contents](#)

Program Version:EnergyPlus, Version 8.5.0-c87e61b44b, YMD=2019.11.12 22:51

[Table of Contents](#)

Tabular Output Report in Format: HTML

[Table of Contents](#)

Building: Building 1

[Table of Contents](#)

Environment: RUN PERIOD 1 ** Piacenza - ITA IGDG WMO#=160840

[Table of Contents](#)

Simulation Timestamp: 2019-11-12 22:51:51

[Table of Contents](#)

Report: Annual Building Utility Performance Summary

[Table of Contents](#)

For: Entire Facility

[Table of Contents](#)

Timestamp: 2019-11-12 22:51:51

[Table of Contents](#)

Values gathered over 8760.00 hours

[Table of Contents](#)

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1417.50	472.50	472.50
Net Site Energy	1417.50	472.50	472.50
Total Source Energy	4018.10	1339.37	1339.37
Net Source Energy	4018.10	1339.37	1339.37

AND THE FINAL RESULTS CAN BE SEEN IN THE
LAST TAB, WE CHOOSE REPORTS FROM
ENERGYPLUS RESULTS!

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Building Area

	Area [m2]
Total Building Area	3000.00
Net Conditioned Building Area	3000.00
Unconditioned Building Area	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	356.80	0.00
Cooling	0.00	0.00	0.00	298.57	0.00	0.00
Interior Lighting	371.18	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	390.95	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Use	562.10	0.00	0.00	298.57	356.80	0.00

IN THE LAST TAB WE CAN SEE FINAL RESULTS

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m ²]	Energy Per Conditioned Building Area [MJ/m ²]
Total Site Energy	1417.50	472.50	472.50
Net Site Energy	1417.50	472.50	472.50
Total Source Energy	4018.10	1339.37	1339.37
Net Source Energy	4018.10	1339.37	1339.37

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Building Area

	Area [m ²]
Total Building Area	3000.00
Net Conditioned Building Area	3000.00
Unconditioned Building Area	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m ³]
Heating	0.00	0.00	0.00	0.00	356.80	0.00
Cooling	0.00	0.00	0.00	298.57	0.00	0.00
Interior Lighting	371.18	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	390.95	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00