

**ARCH - 753 - 001**  
**Building Performance Simulation**

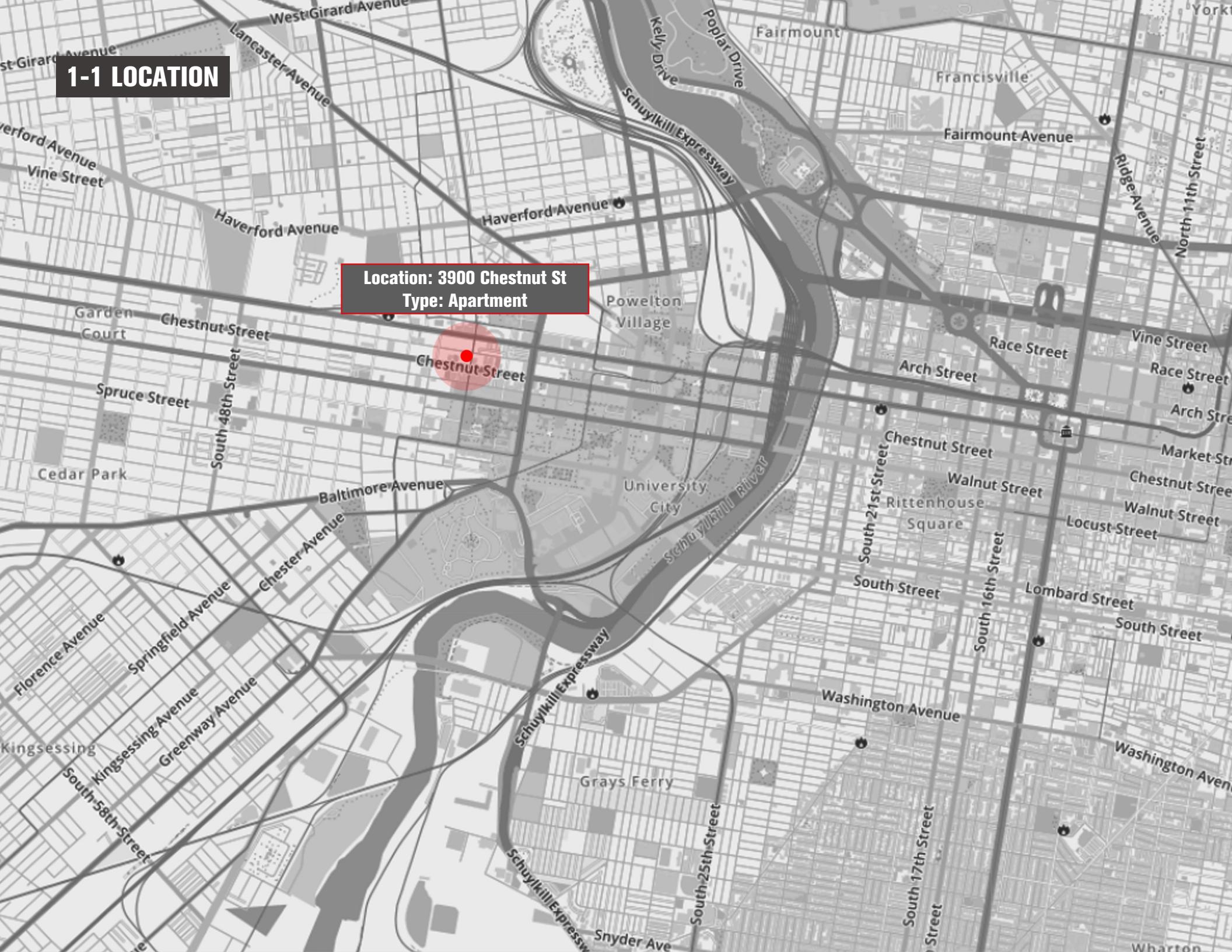
**Final Project**

By Hewen Jiang

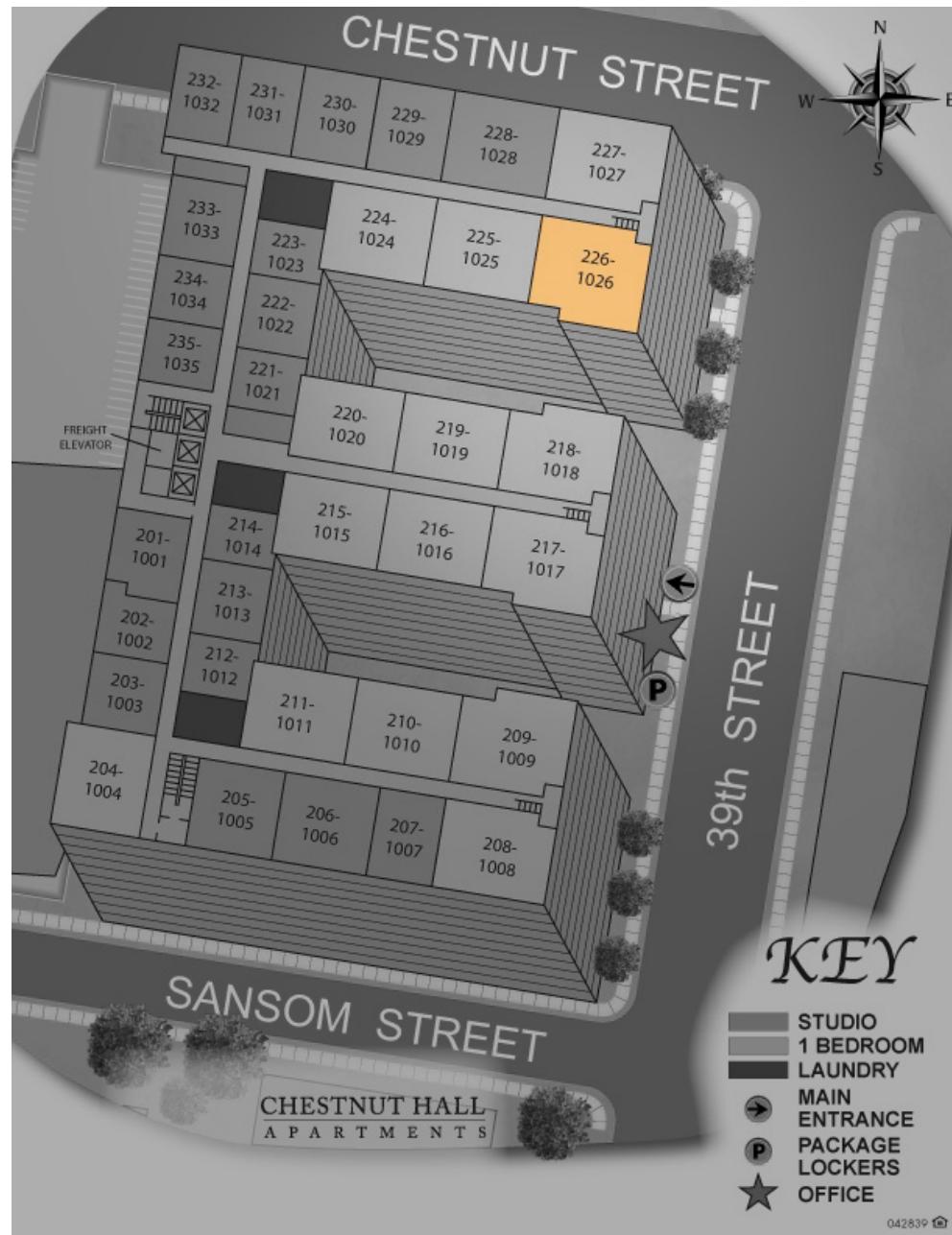
# 1 Room Introduction

## 1-1 LOCATION

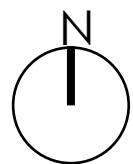
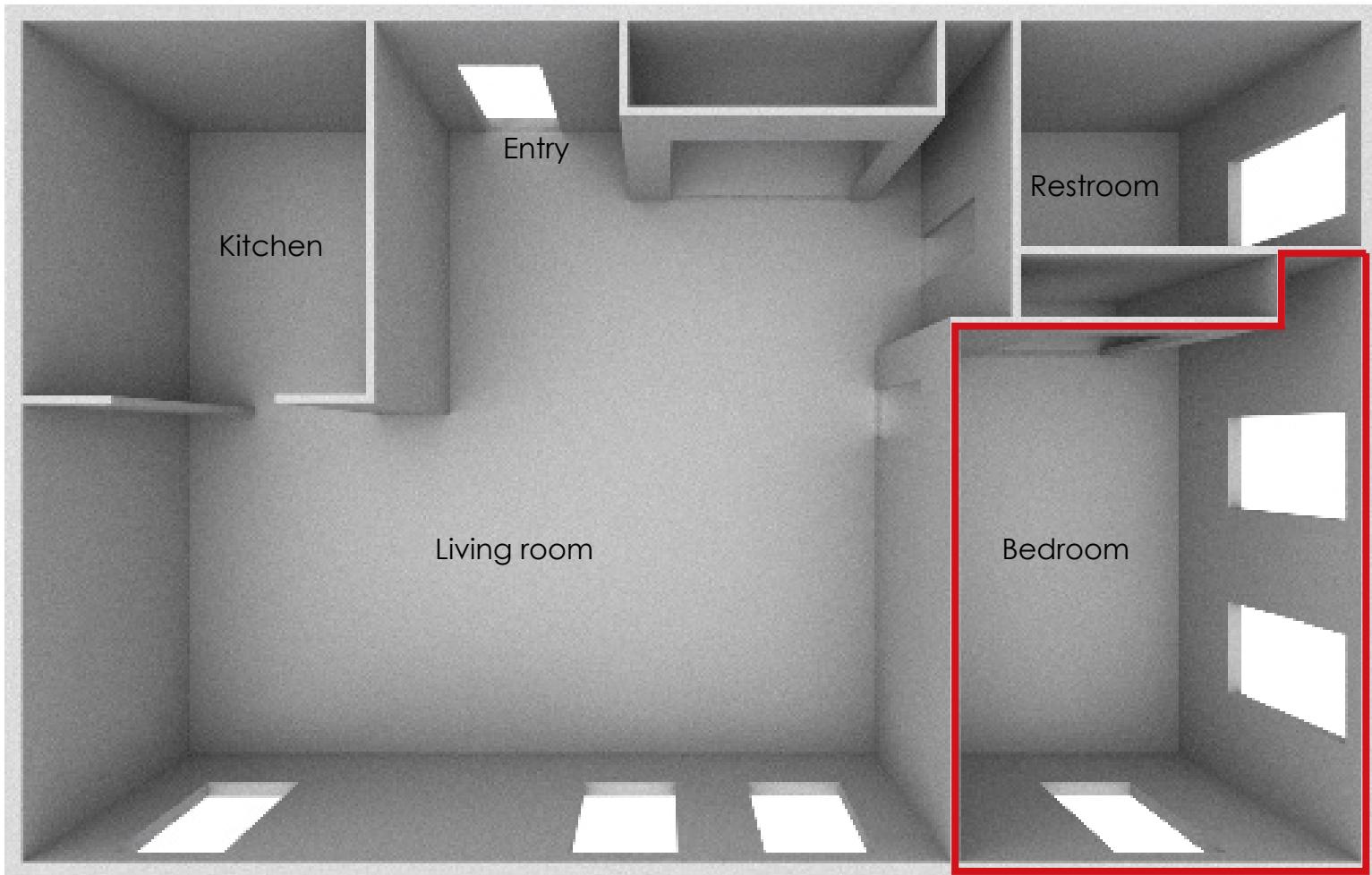
**Location: 3900 Chestnut St**  
**Type: Apartment**



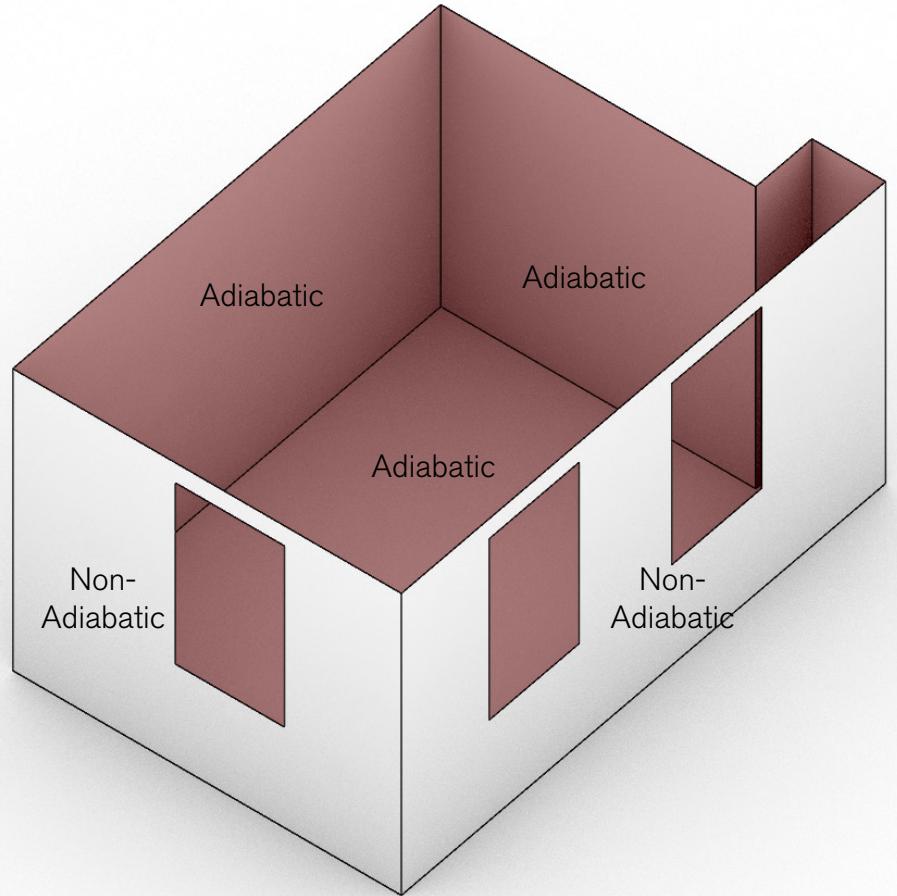
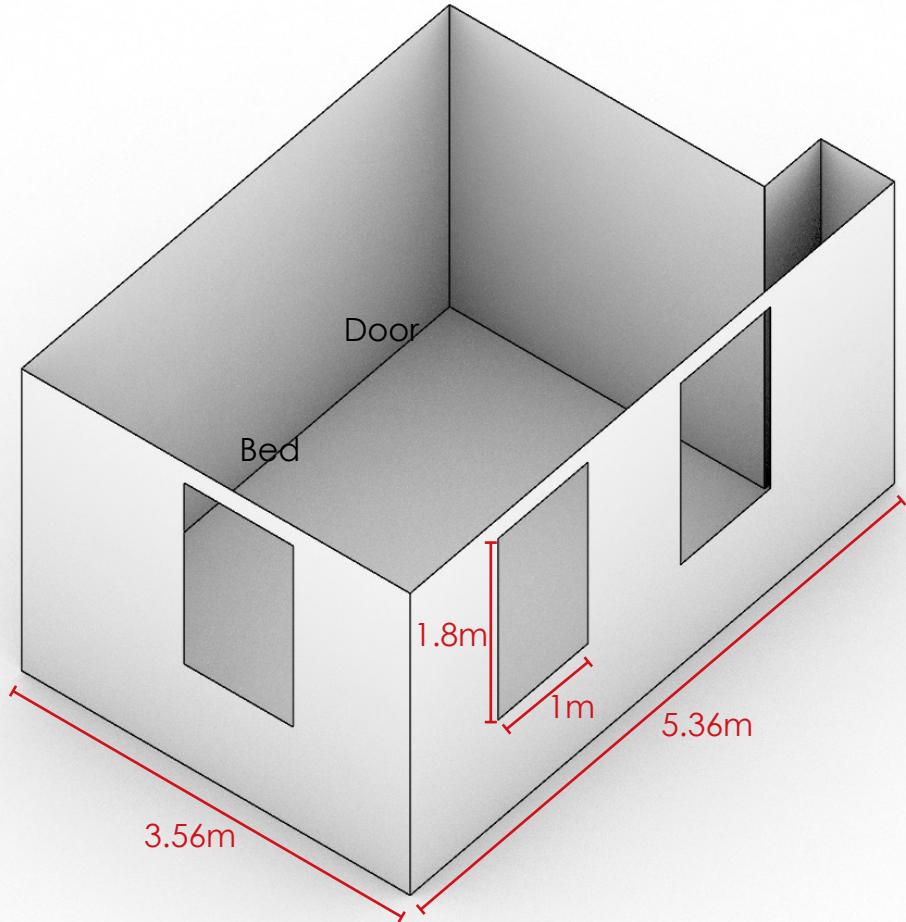
# 1-1 LOCATION



## 1-1 LOCATION

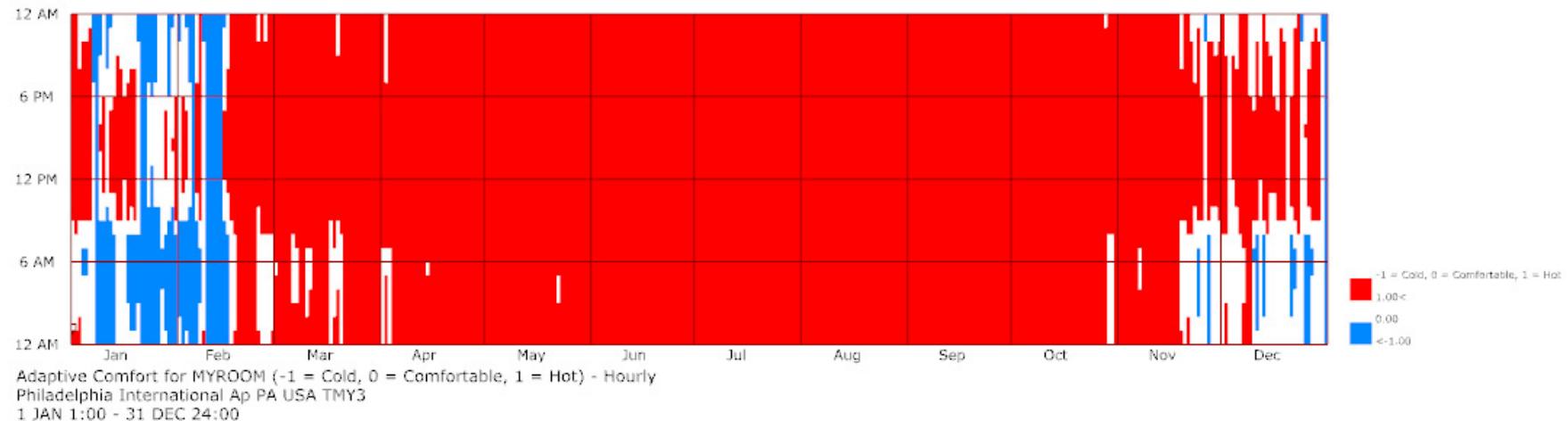


## 1-2 DIMENSION



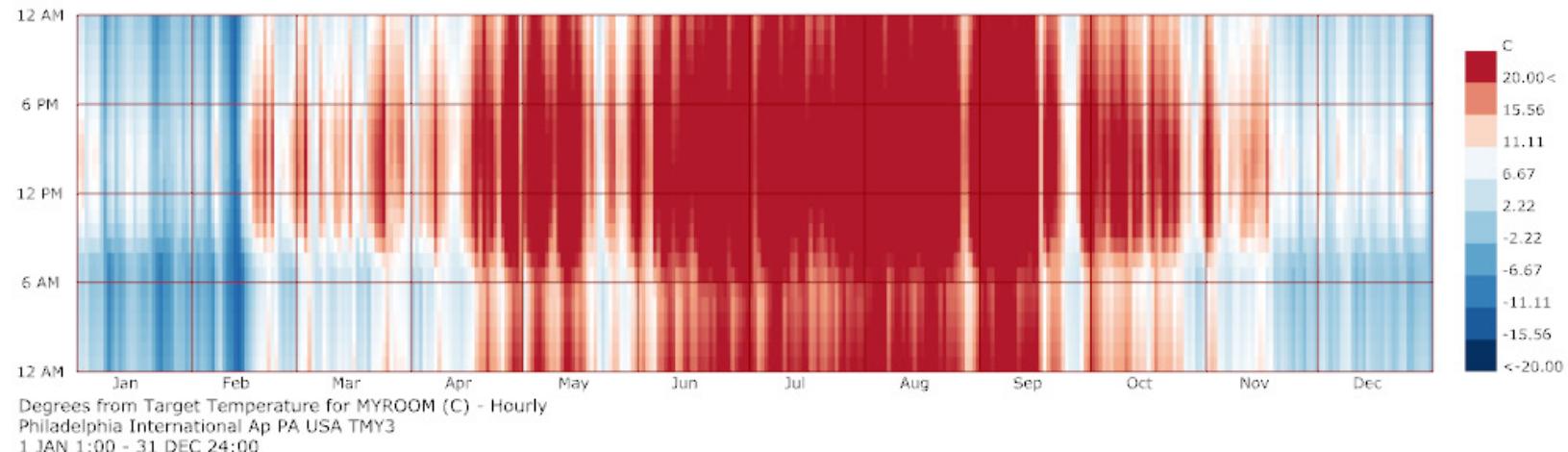
## **2** Conduction & Ventilation

## 2-0 DEFAULT



comfort percentage :11.678082%

hot : 81.860731% cold : 6.461187%



averageFromTarget(abs) :13.132282 Celcius

## 2-1 VARIABLES

### Input Variables:

#### Conduction:

- 0 - default
- 1 - Low R-Value Ashrae 90.1-2010
- 2 - High R-Value Ashrae 90.1-2010

#### Ventilation:

ventilation type: Natural Windows Ventilation  
minIndoorTemp: 15 - 18  
maxIndoorTemp: 25 - 27  
minOutdoorTemp: 20 - 23  
maxOutdoorTemp: 22 - 25

#### Infiltration

Parameter of Midrise Apartment

#### Custom Schedule

0 - 12, 19 - 23 : Occupied  
13 - 17 : Absent

#### Adiabatic

north wall, west wall, ceiling, floor

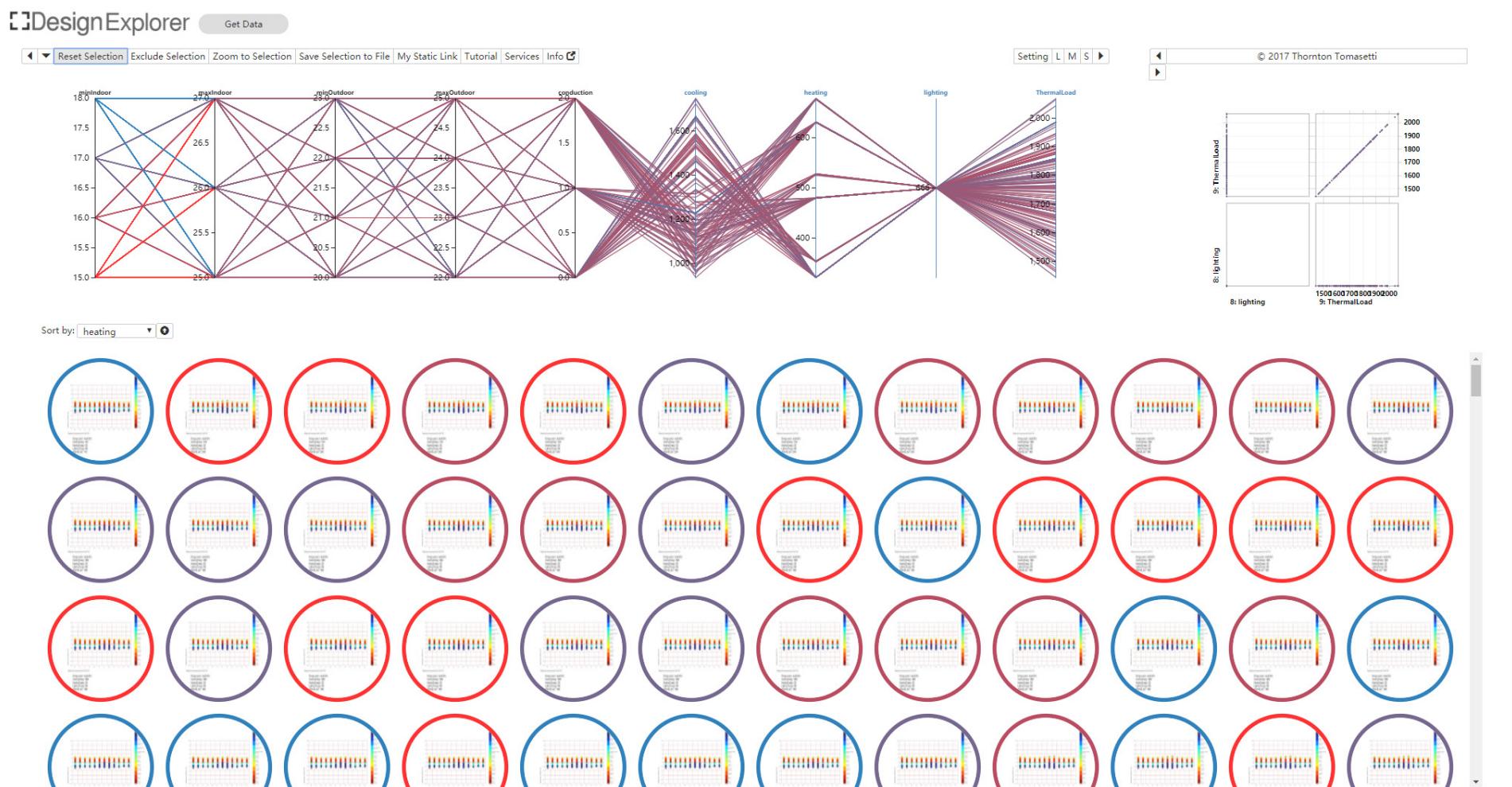
### Output Variables:

Cooling Energy

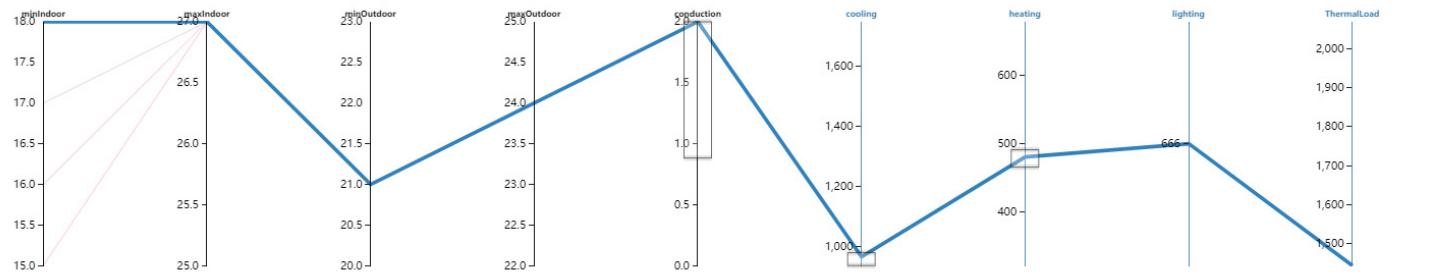
Heating Energy

Thermal Load

## 2-2 DESIGN EXPLORER

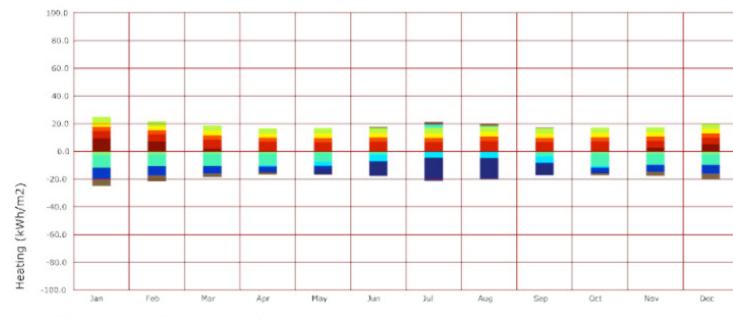


## 2-3 PICK RESULT



2D   
★★★★★

Attributes	
minIndoor	: 18
maxIndoor	: 27
minOutdoor	: 21
maxOutdoor	: 24
conduction	: 2
cooling	: 963
heating	: 480
lighting	: 666
ThermalLoad	: 1442
Rating	: 0



Philadelphia International Ap PA USA TMY3  
Energy used in total(kWh):  
Cooling Energy: 963  
Heating Energy: 480  
Lighting Energy: 666  
ThermalLoad: 1442

### Result:

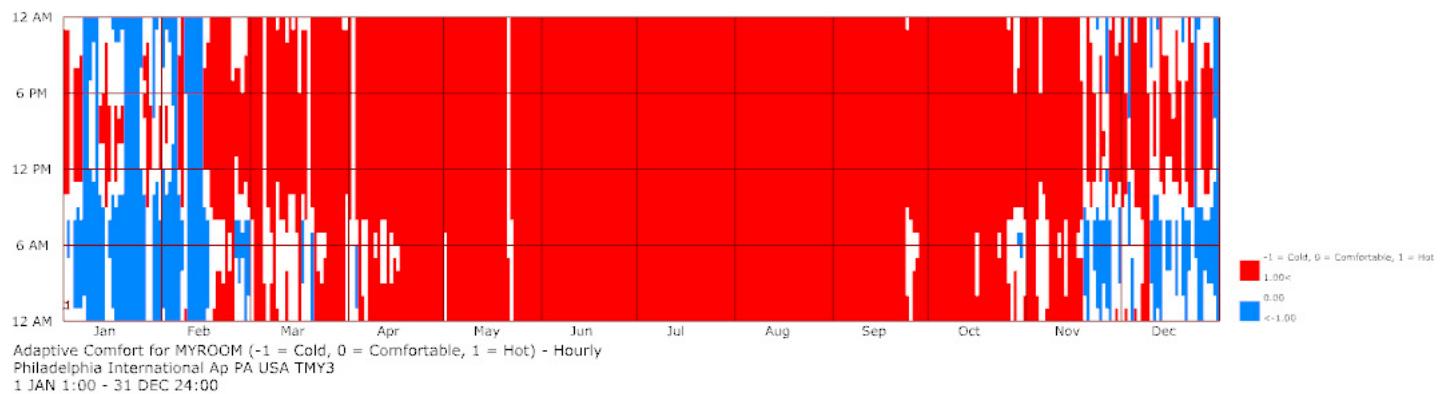
Attributes	
minIndoor	: 18
maxIndoor	: 27
minOutdoor	: 21
maxOutdoor	: 24
conduction	: 2
cooling	: 963
heating	: 480
lighting	: 666
ThermalLoad	: 1442
Rating	: 0

- Pick 1 or 2 in Conduction, means Ashrae material.
- Pick the one uses the lowest heating energy, since in summer I can block the sunshine to improve.
- Pick the one uses the lowest cooling energy.

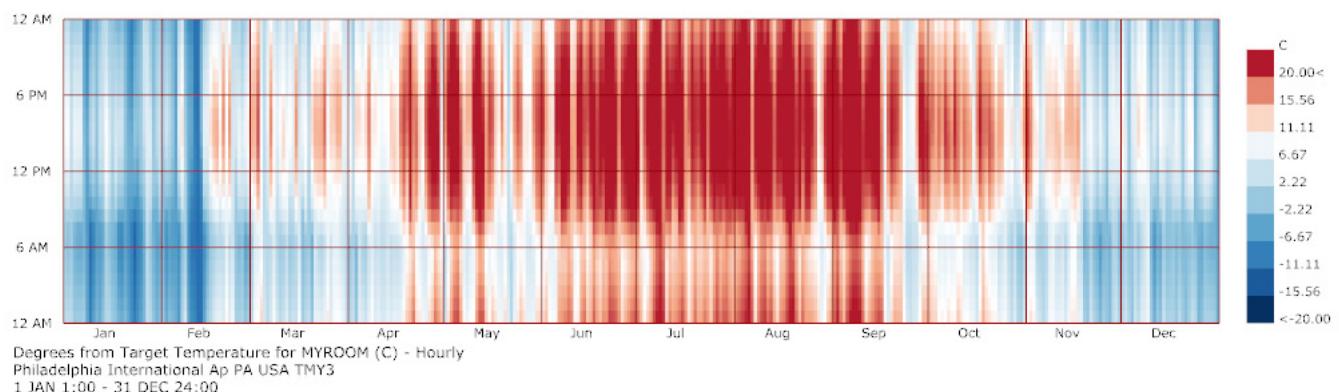
## 2-4 TEST RESULT

### Attributes

```
minIndoor : 18  
maxIndoor : 27  
minOutdoor : 21  
maxOutdoor : 24  
conduction : 2  
cooling : 963  
heating : 480  
lighting : 666  
ThermalLoad : 1442  
Rating : 0
```



comfort percentage :13.995434%  
hot : 75.559361% cold : 10.445205%

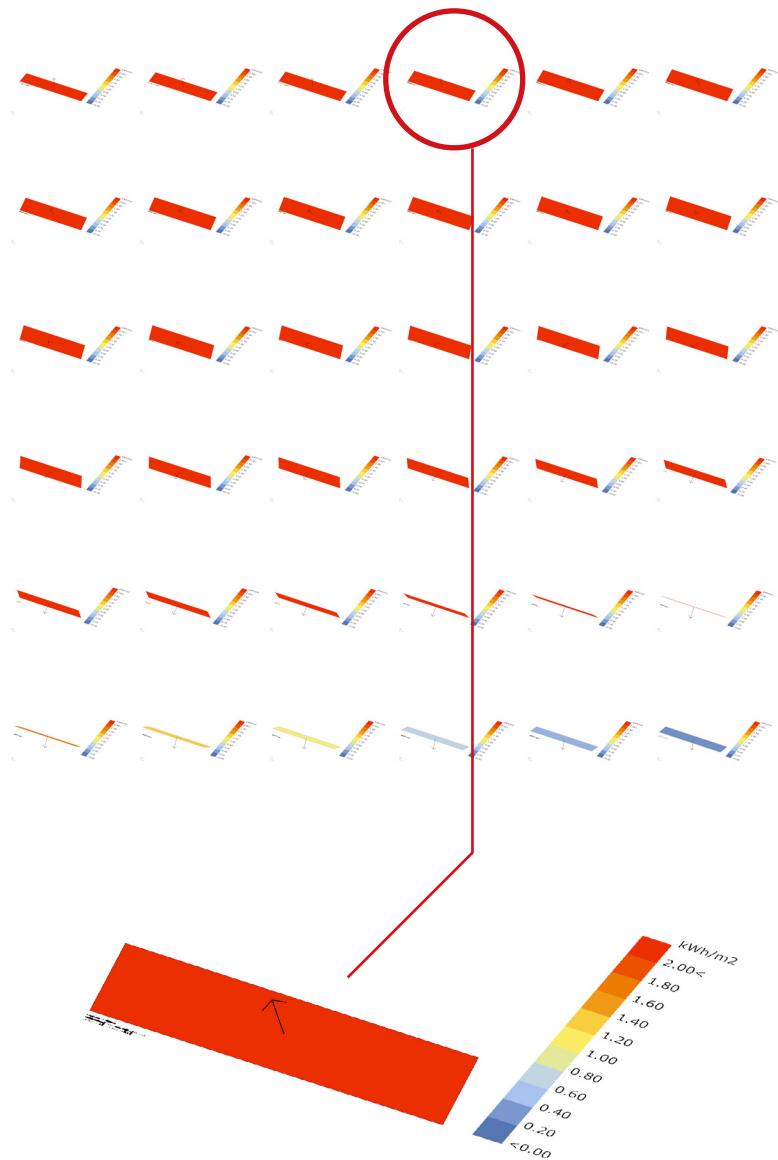


averageFromTarget(abs) :10.186357 Celsius

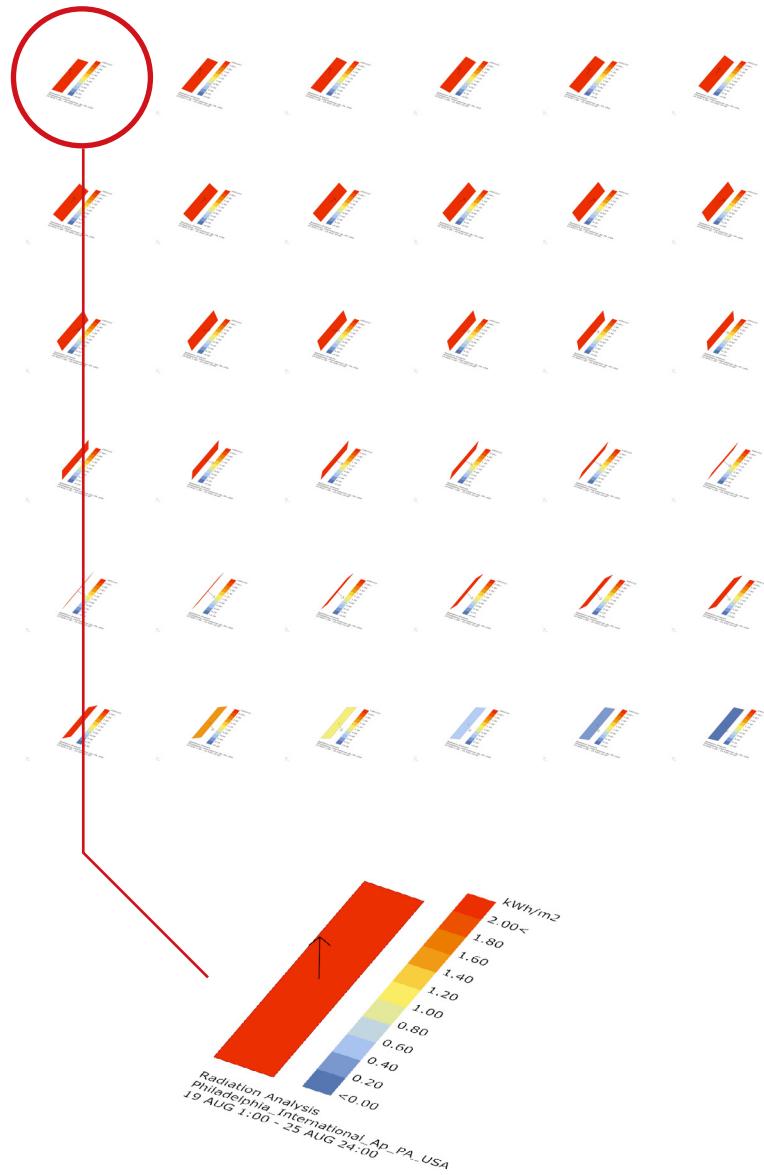
# **3** Add Shading

## 3-1 SHADING ANGLE

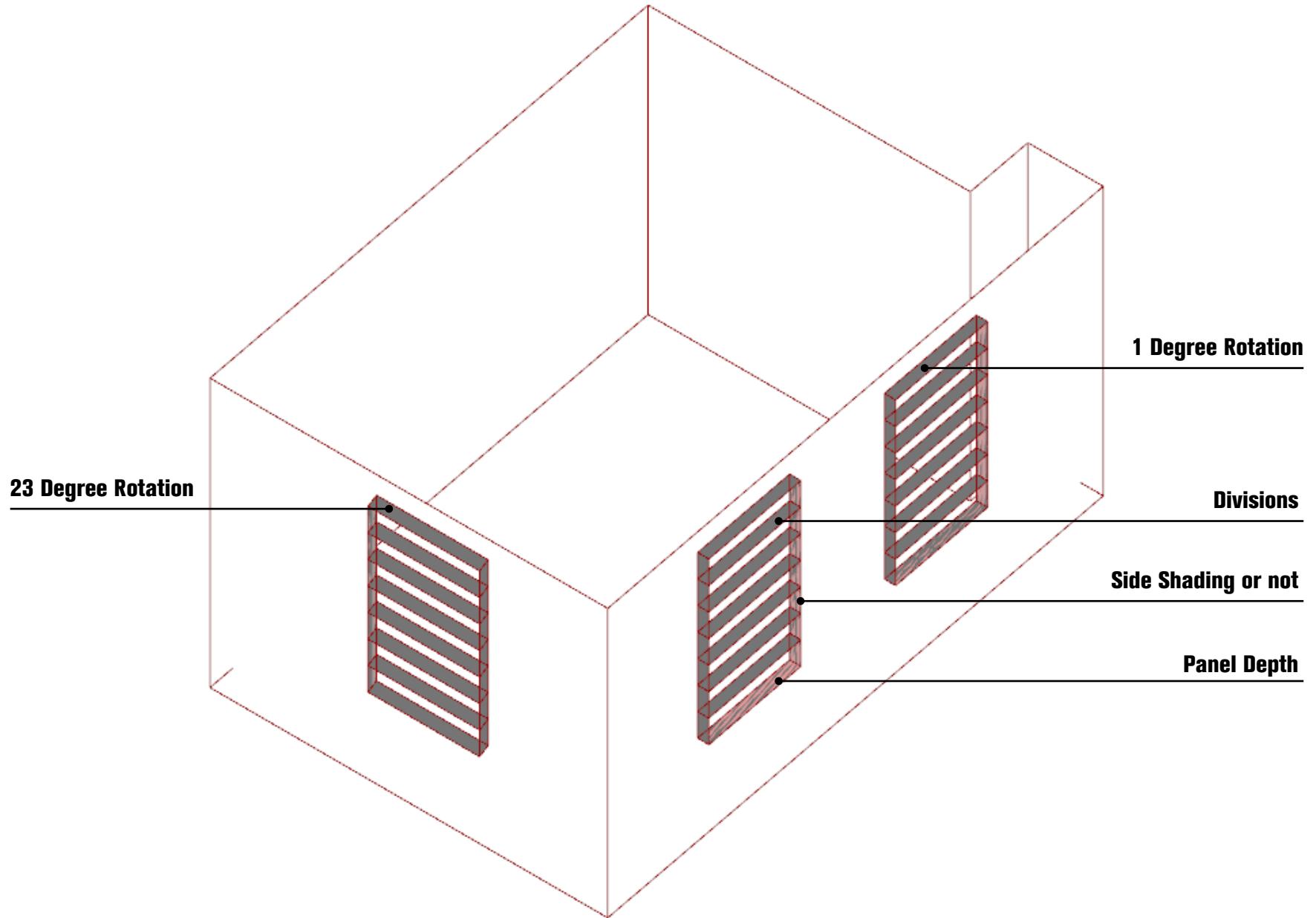
SOUTH SHADING PANEL



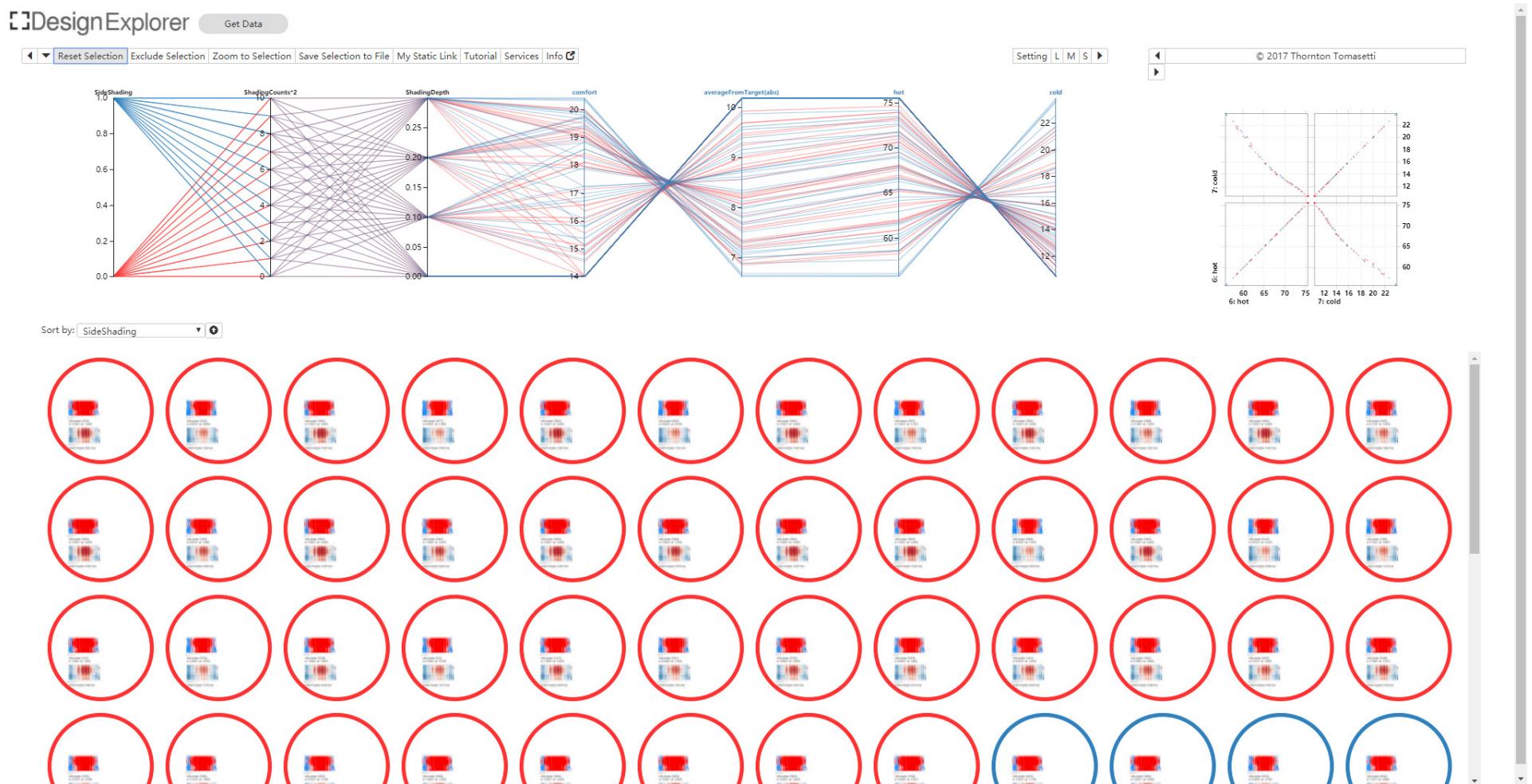
EAST SHADING PANEL



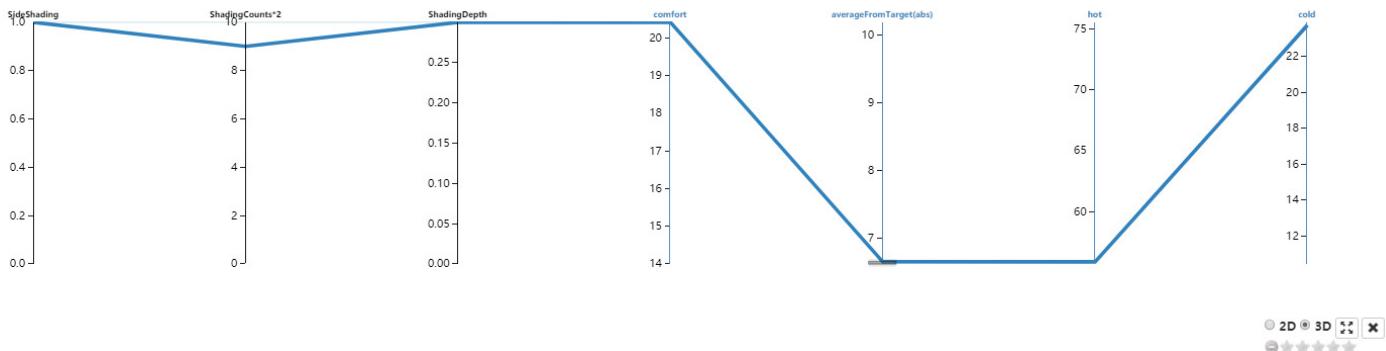
## 3-2 TEST BEST SHADING SETTING



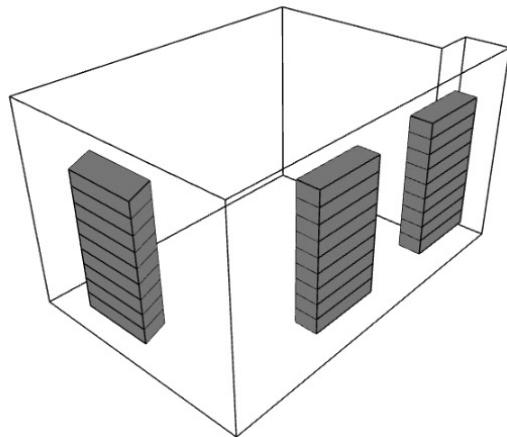
## 3-3 DESIGN EXPLORER



## 3-3 DESIGN EXPLORER



Attributes
SideShading : 1 ShadingCounts*2 : 9 ShadingDepth : 0.3 comfort : 20.422374 averageFromTarget(abs) : 6.642111 hot : 55.821918 cold : 23.755708 Rating : 0

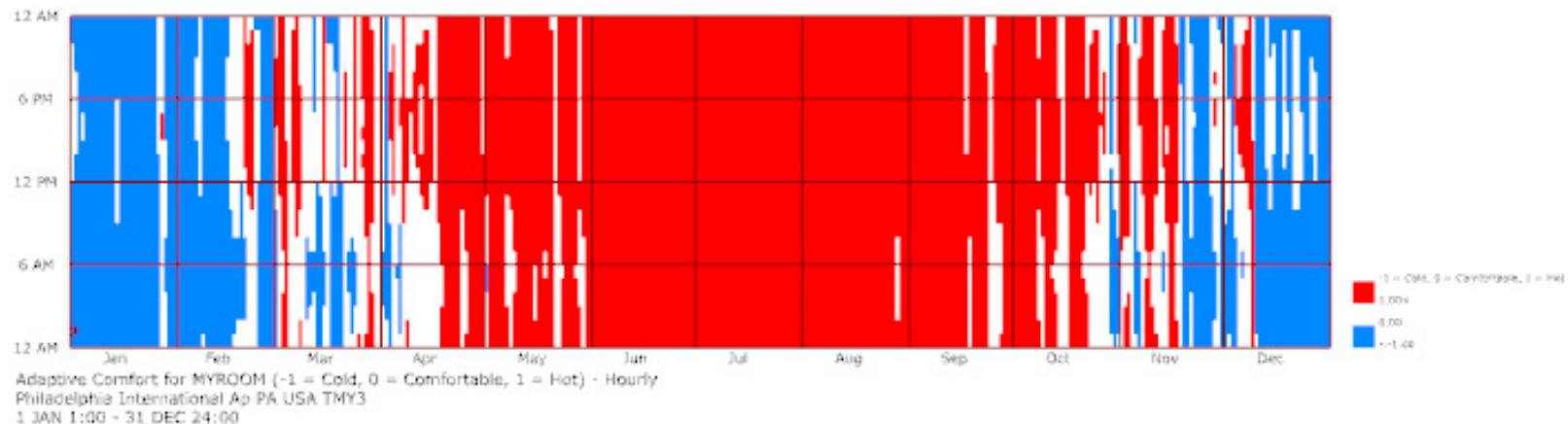


1. Pick the one has the lowest average degree from target and the highest comfort percentage.
2. Pick the one has the least panel area.

### Result:

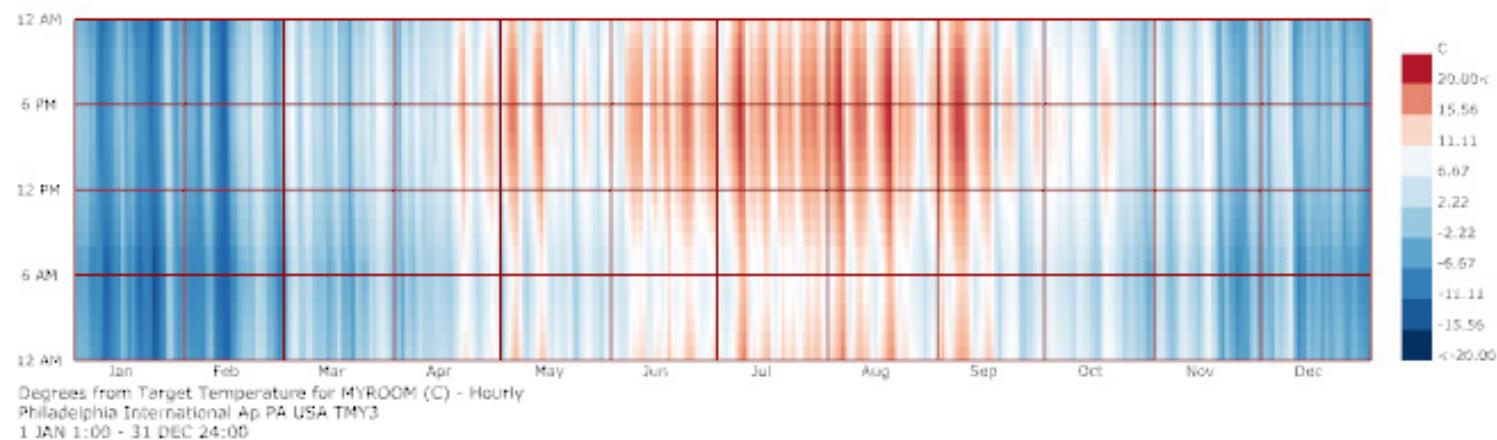
Attributes
SideShading : 1 ShadingCounts*2 : 9 ShadingDepth : 0.3 comfort : 20.422374 averageFromTarget(abs) : 6.642111 hot : 55.821918 cold : 23.755708 Rating : 0

### 3-4 RESULT PARAMETER



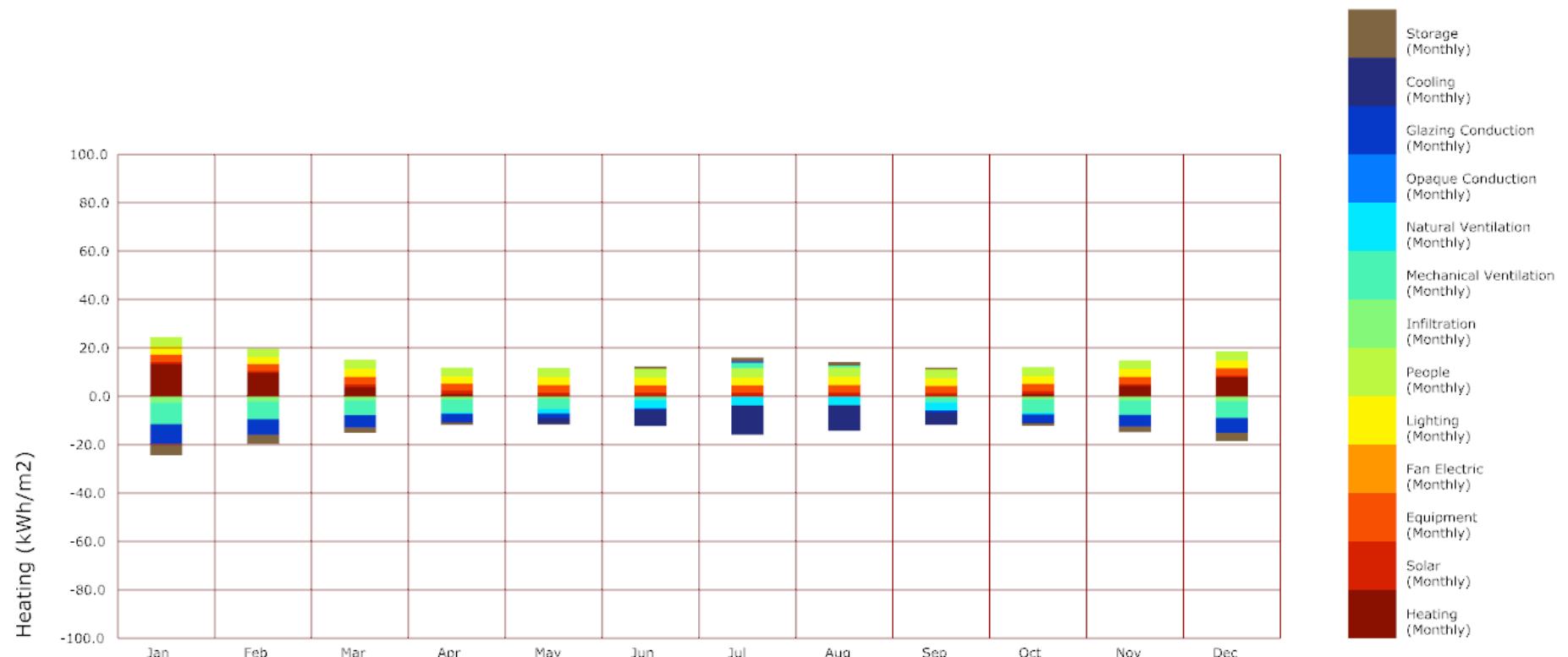
comfort percentage :20.388128%

hot : 55.696347% cold : 23.915525%



averageFromTarget(abs) :6.618524 Celsius

### 3-4 RESULT PARAMETER



Philadelphia International Ap PA USA TMY3

Energy used in total(kWh):

Cooling Energy: 654

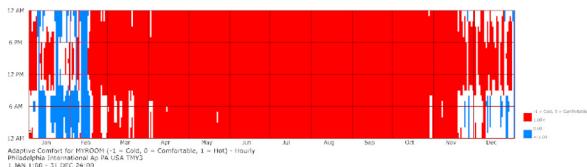
Heating Energy: 709

Lighting Energy: 666

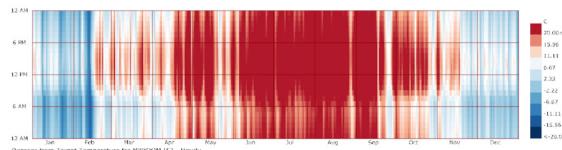
ThermalLoad: 1363

## 3-5 COMPARISON

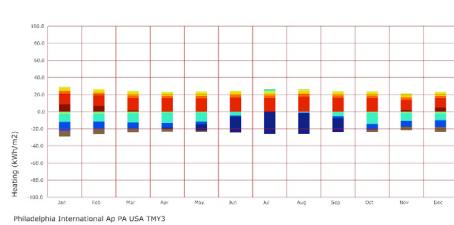
### Default setting without shading



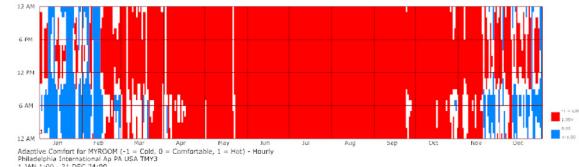
comfort percentage :11.678082%  
hot : 81.860731% cold : 6.461187%



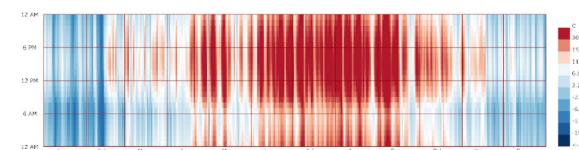
averageFromTarget(abs) :13.132282 Celsius



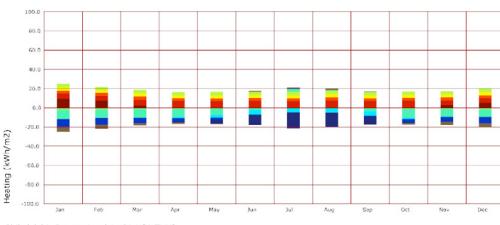
### Changed conduction and ventilation without shading



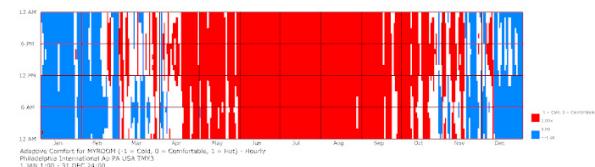
comfort percentage :13.995434%  
hot : 75.559361% cold : 10.445205%



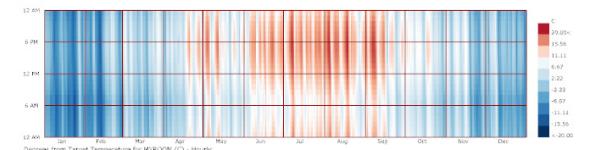
averageFromTarget(abs) :10.186357 Celsius



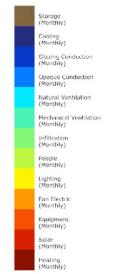
### with shading



comfort percentage :20.388128%  
hot : 55.696347% cold : 23.915525%



averageFromTarget(abs) :6.618524 Celsius

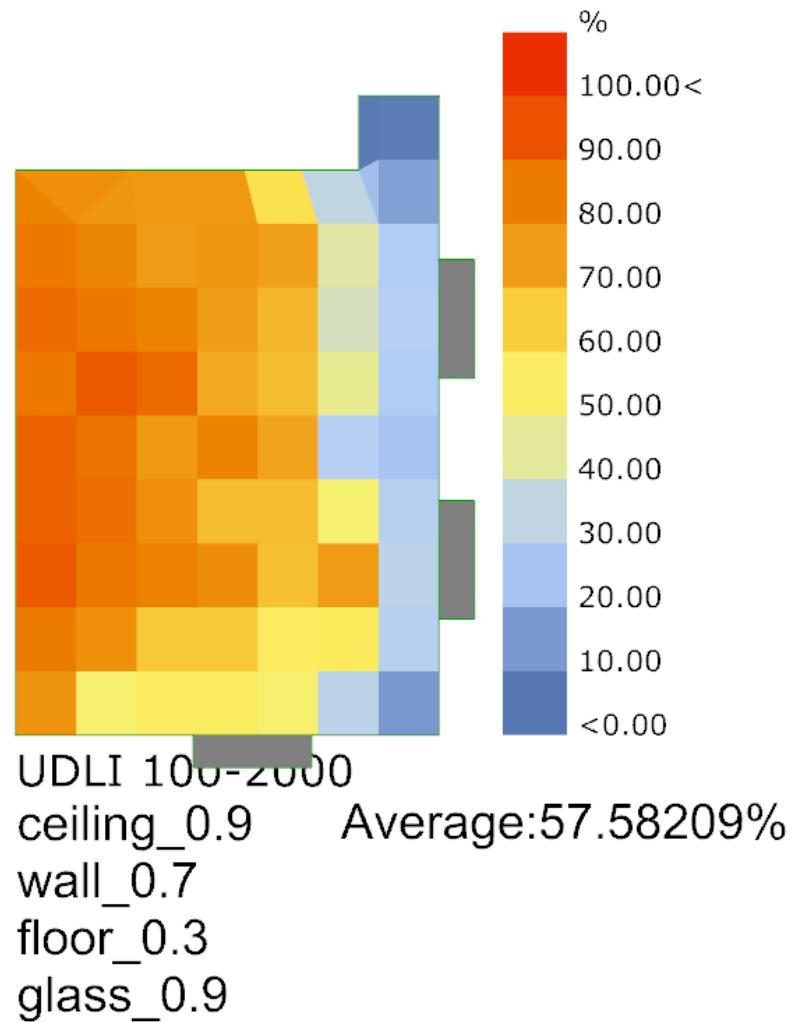
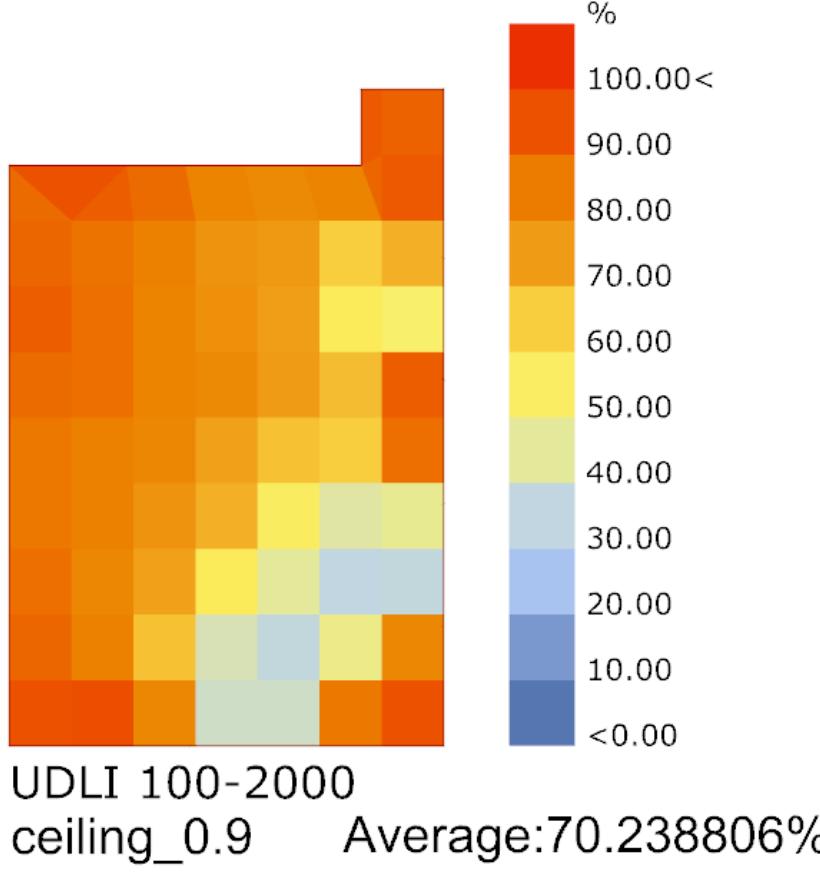


### conclusion:

1. The comfort percent improves from 11.67% to 20.38%.
2. In summer, even there are still many hot days, the degree from target are much lower, means people will feel better in this room.
3. In winter, the cold days become more.
4. In total, the energy used is less.

# **4** Lighting Test

## 4-1 LIGHTING COMPARISON



### conclusion:

Without the shading, there are too much light near the windows.

The UDLI 100-2000 decreases from 70.2% to 57%. But since my table is close to the south side windows, so it is acceptable for me even there is not enough light on east side.

# **5** Change Construction

## 5-1 RETHINK

**Conclusion:**

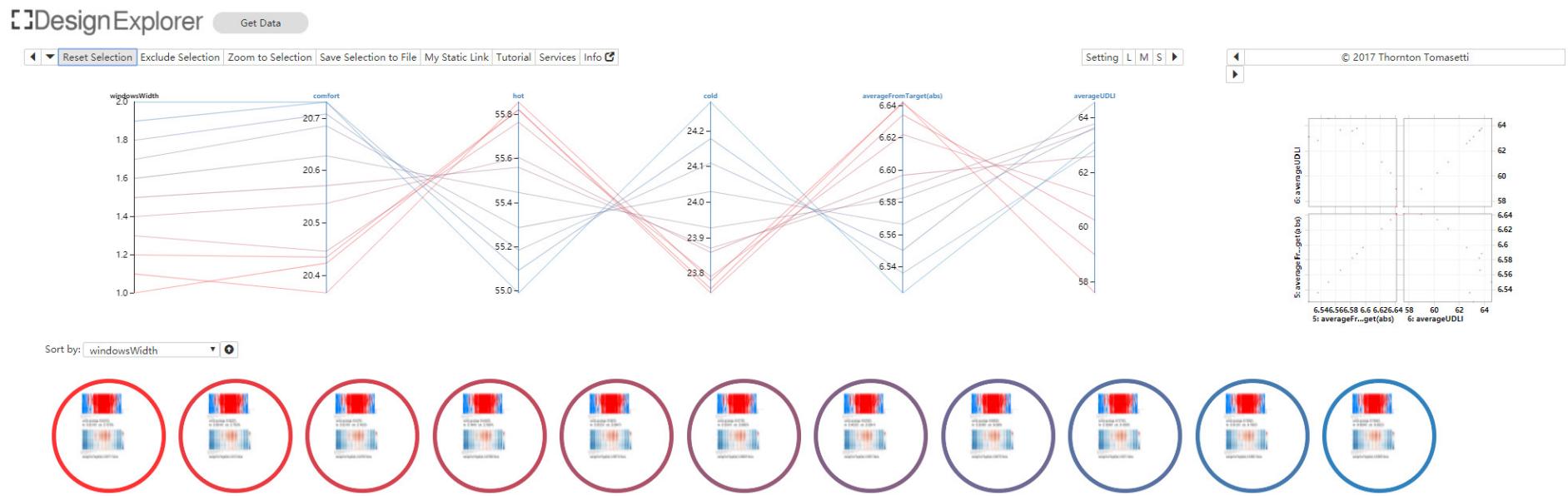
- 1. It is still cold in winter, maybe I should introduce more sunlight in this room.**
- 2. The UDLI in this room is not very satisfying.**



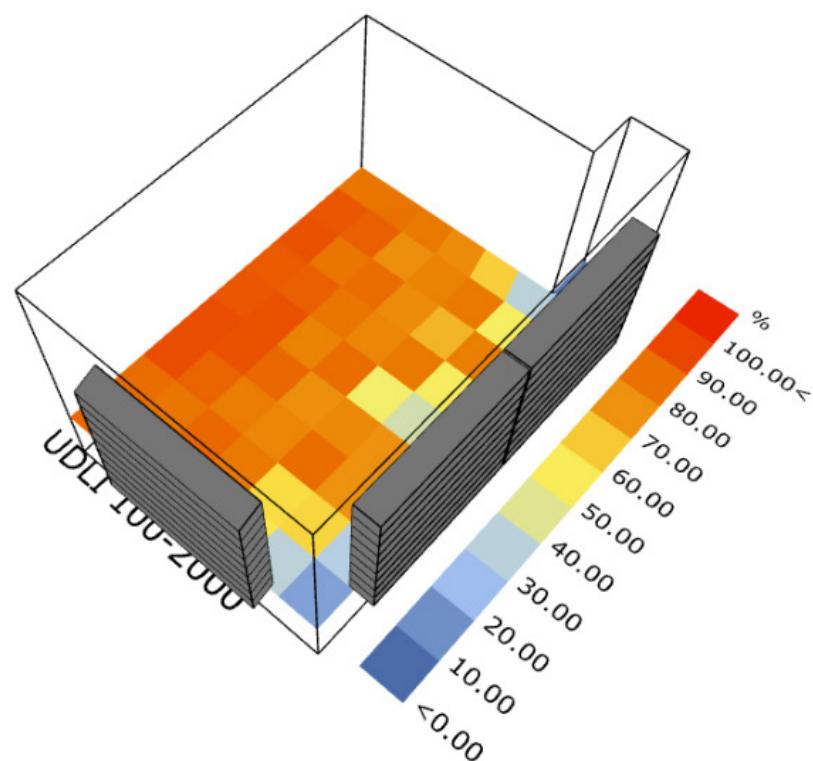
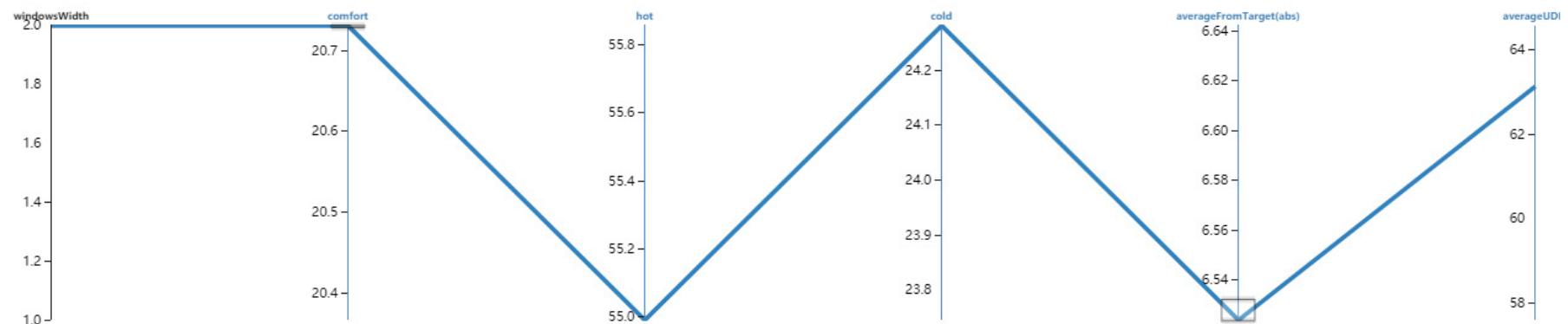
**Action:**

**Increase the windows' width to get more sun light.**

## 5-2 DESIGN EXPLORER



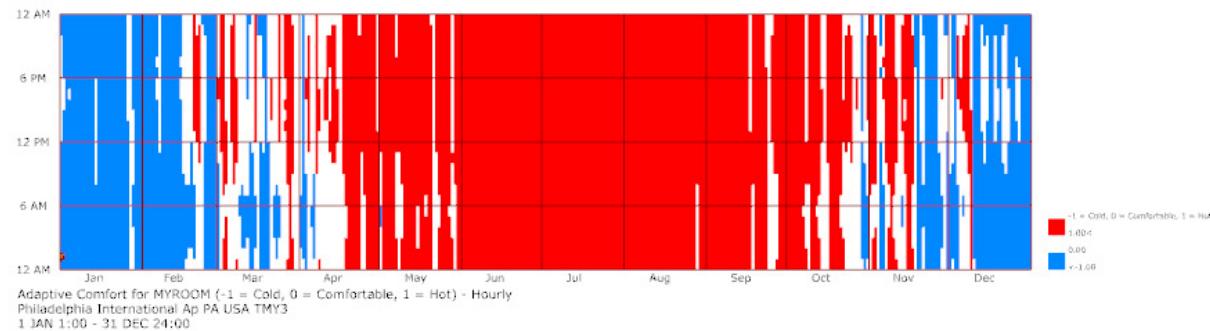
## 5-3 PICK RESULT



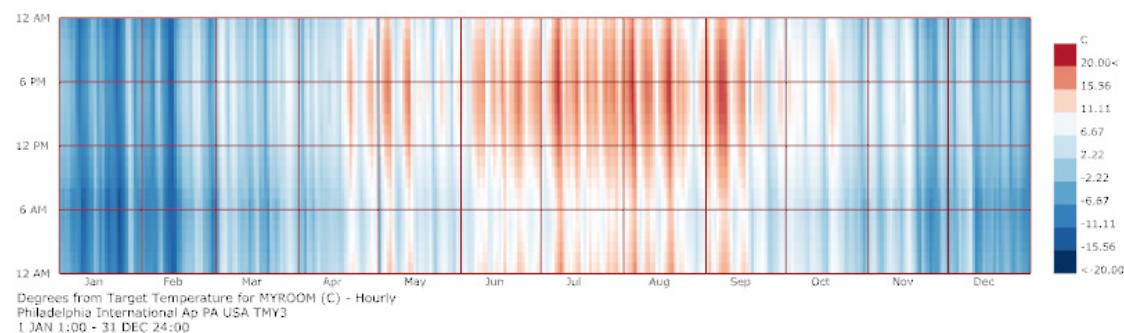
### Attributes

windowsWidth : 2.0  
comfort : 20.730594  
hot : 54.988584  
cold : 24.280822  
averageFromTarget(abs) : 6.523609  
averageUDI : 63.134328  
Rating : 0

## 5-3 PICK RESULT



comfort percentage :20.730594%  
hot : 54.988584% cold : 24.280822%



averageFromTarget(abs) :6.523609 Celcius

## 5-4 CONCLUSION

1. Pick the one has the highest comfort percentage.
2. Pick the lowest average degree from target.

### Result:

#### Attributes

```
windowsWidth : 2.0  
comfort : 20.730594  
hot : 54.988584  
cold : 24.280822  
averageFromTarget(abs) : 6.523609  
averageUDLI : 63.134328  
Rating : 0
```

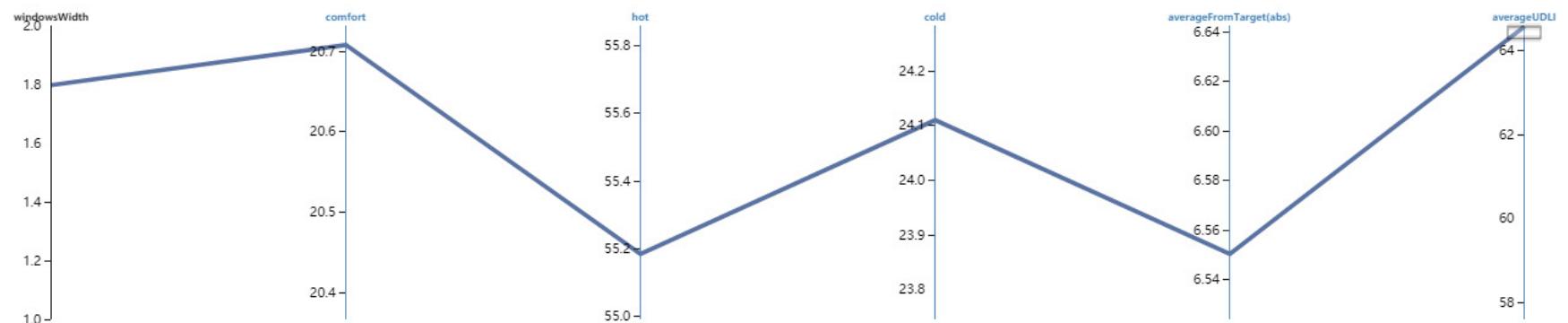
#### Conclusion:

When I make the windows twice bigger, it becomes the best solution in terms of comfort percentages.

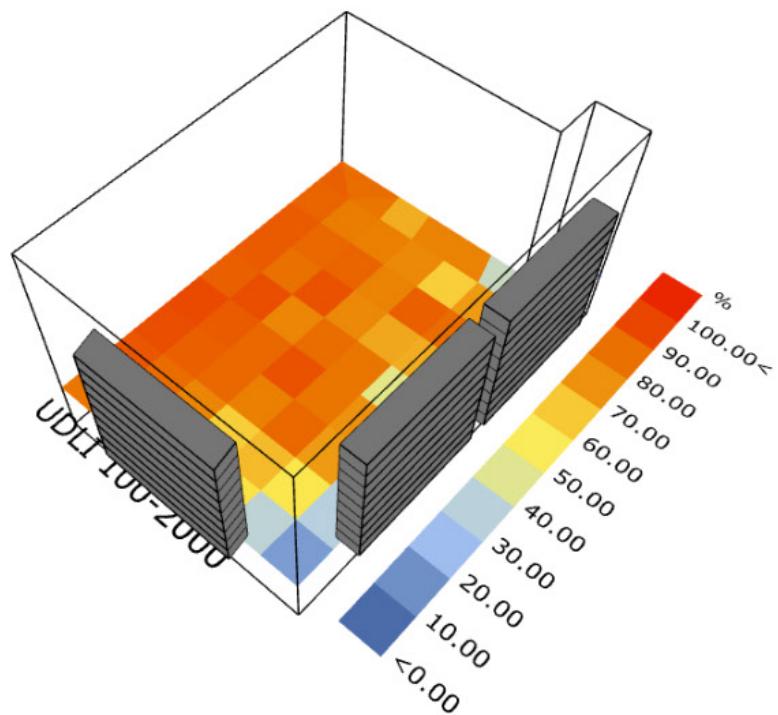
Ironically, it makes more cold days but less hot days, because it makes better ventilation.

It is not the best solution in terms of UDLI, but 63% is quite close to the original UDLI.

## 5-3 PICK RESULT

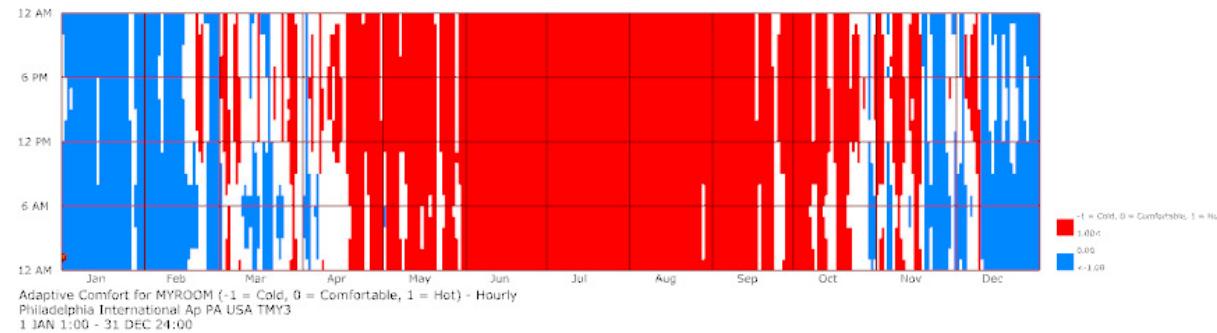


2D  
3D  
Rating: 0

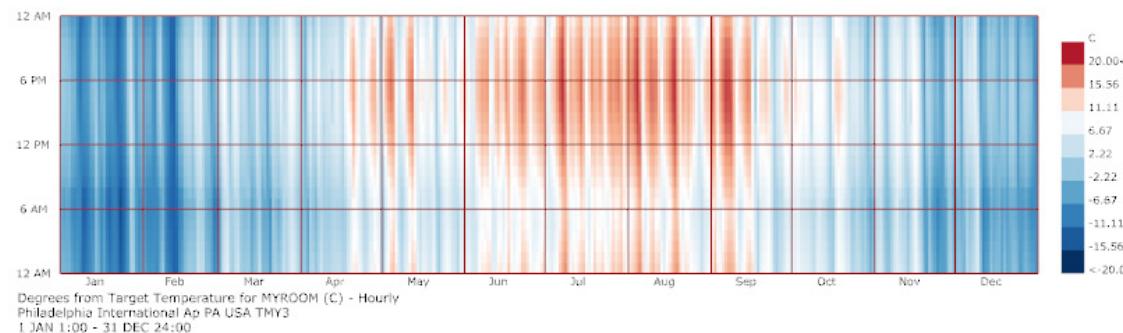


Attributes
windowsWidth : 1.8
comfort : 20.707763
hot : 55.182648
cold : 24.109589
averageFromTarget(abs) : 6.55011
averageUDLI : 64.58209
Rating : 0

## 5-3 PICK RESULT



comfort percentage :20.707763%  
hot : 55.182648% cold : 24.109589%



averageFromTarget(abs) :6.55011 Celcius

## 5-4 CONCLUSION

1. Pick the one has the highest UDLI.

**Conclusion:**

This is the 2nd best solution.

It has the best UDLI, and not bad comfort percentage.

**Result:**

Attributes
<b>windowsWidth</b> : 1.8 <b>comfort</b> : 20.707763 <b>hot</b> : 55.182648 <b>cold</b> : 24.109589 <b>averageFromTarget(abs)</b> : 6.55011 <b>averageUDLI</b> : 64.58209 <b>Rating</b> : 0