BUILDING PERFORMANCE SIMULATION
ARCH-753 Fall 2017

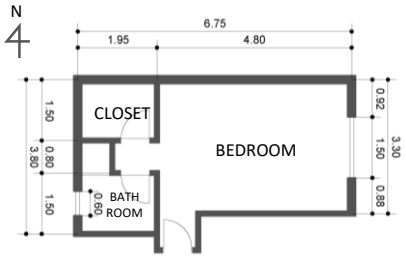
—

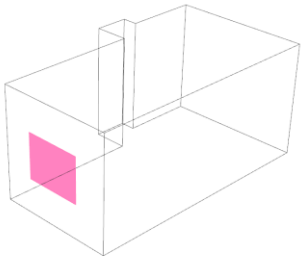
ASSIGNMENT 8

Hwang, Youngjin

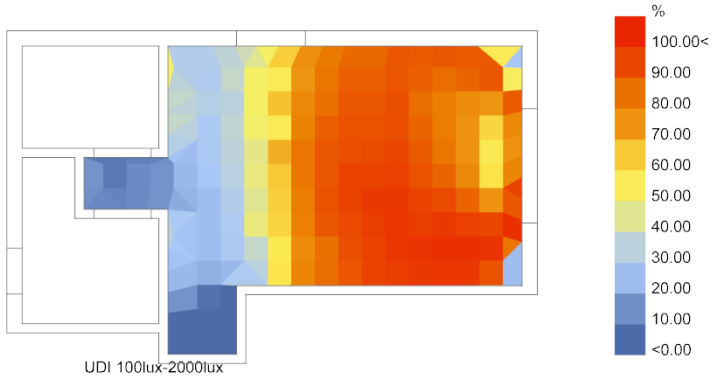
Baseline Simulation_Original Room

Original Room



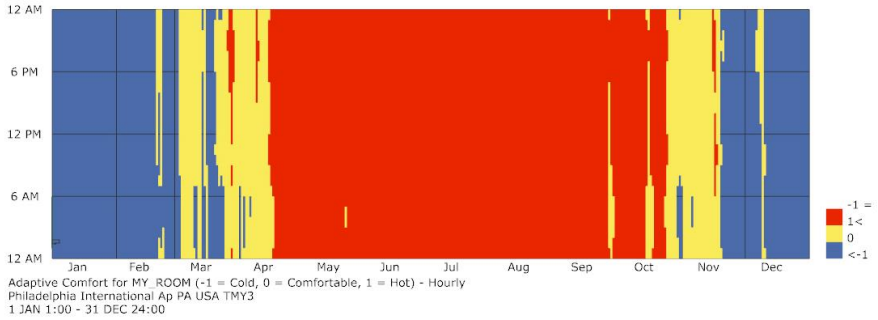


UDI Analysis (100<2000lux)

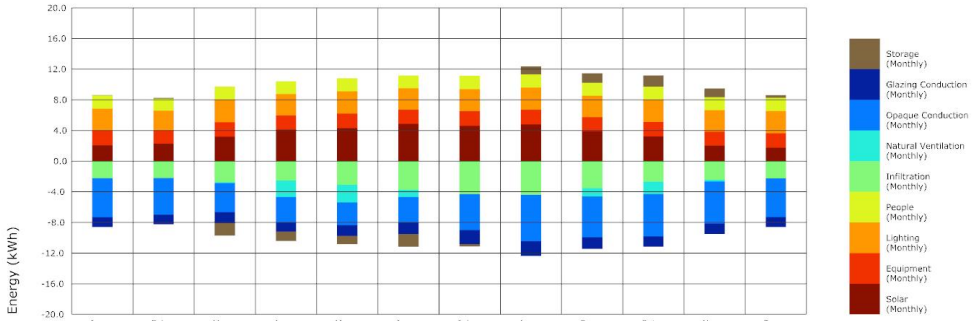


%of total area **30%**
% of area meets the UDI 100<2000lux
for over 75% of time
47%

Adaptive Comfort Graph



Energy Balance Chart



*No apply natural ventilation

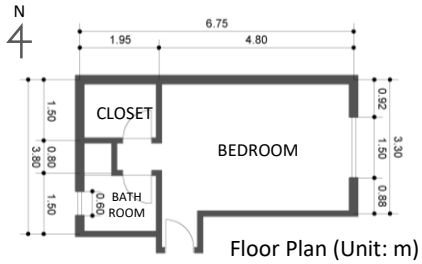
Exterior wall R-VALUE: 2.18
Window U-VALUE: 2.37

% comfortable time 17.9
Hot stress 52.2
Cold stress 29.9

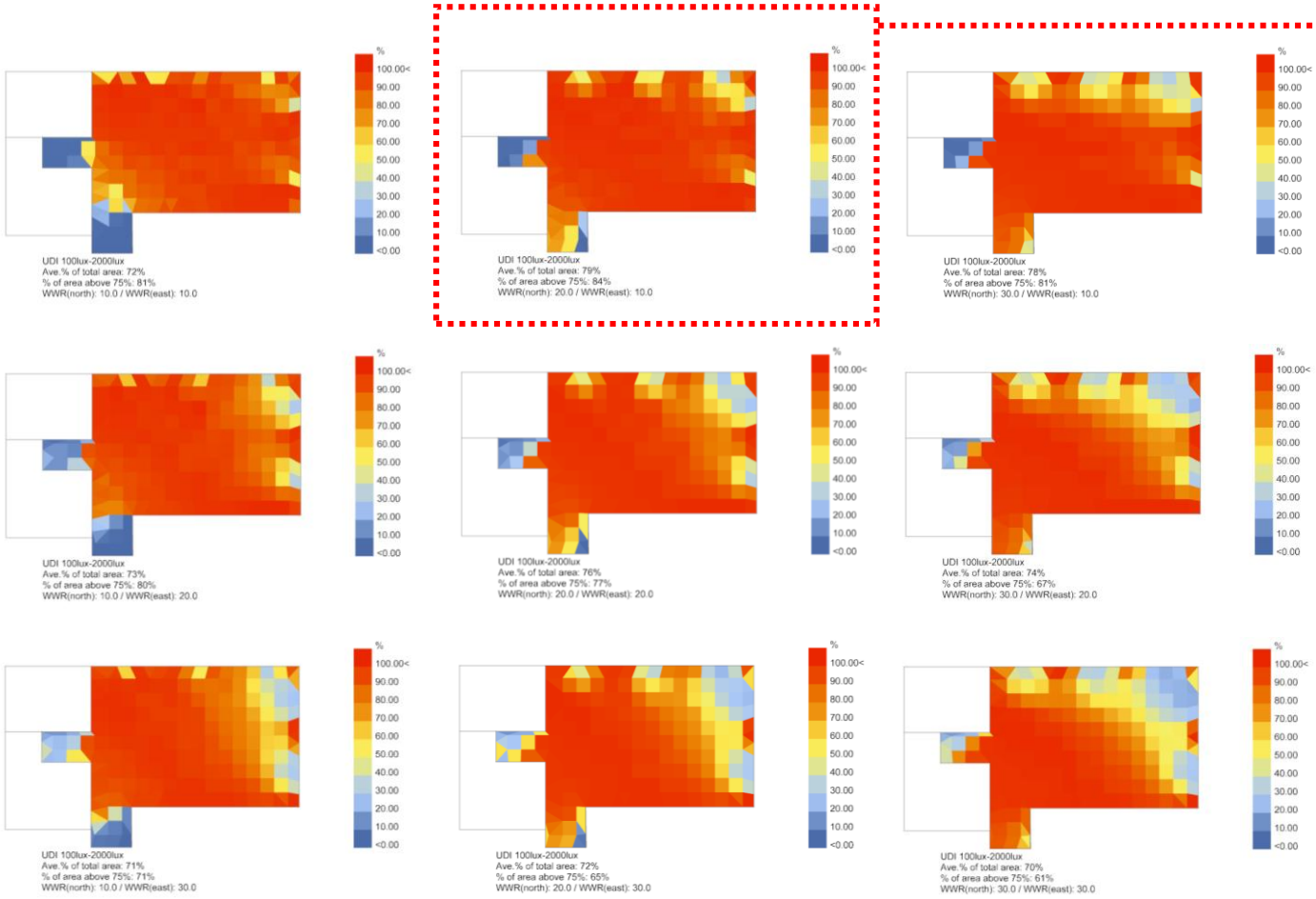
Re-Design with UDI Optimization

Evaluation of UDI upon WWR on North and East Facade

The room has both east and north façades. To optimize UDI from the previous proposed design, geometry of the room has been changed. WWR of north and east façade has a specific range, 10%-30%, since the WWR of the original window facing the east is around 30%. If the WWR is above 30%, there would be over-lit, and daylight will not be provided evenly due to the depth of the room. For these reasons, UDI is evaluated upon the WWR of the north side and the east.

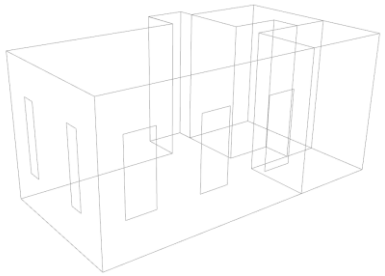


Floor Plan (Unit: m)



BEST RESULT
WWR(north): 20%
WWR(east): 10%

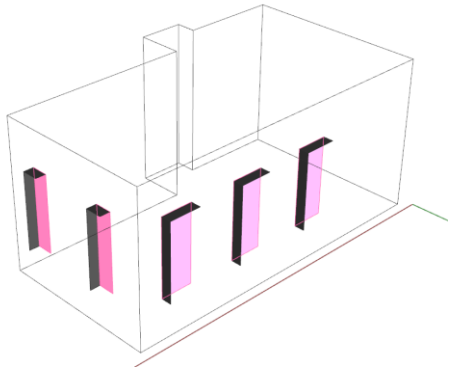
% of total area **79%**
% of area achieving above 75% **84%**



Analysis Result of My New Room 1

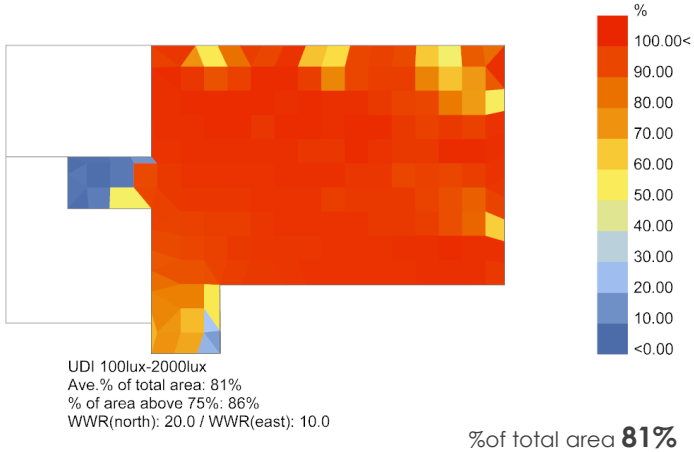
The objective of this assignment challenges one more step to maximize the indoor human comfort through various factors re-organization.

Newly Designed Room



UDI Analysis (100<2000lux)

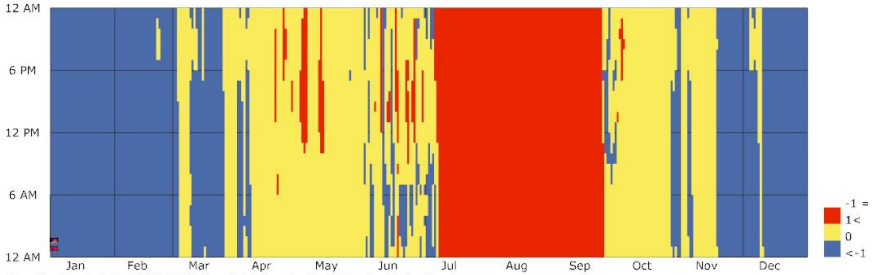
With Shading Devices



UDI 100lux-2000lux
Ave.% of total area: 81%
% of area above 75%: 86%
WWR(north): 20.0 / WWR(east): 10.0

%of total area **81%**
% of area meets the UDI 100<2000lux
for over 75% of time
86%

Adaptive Comfort Graph



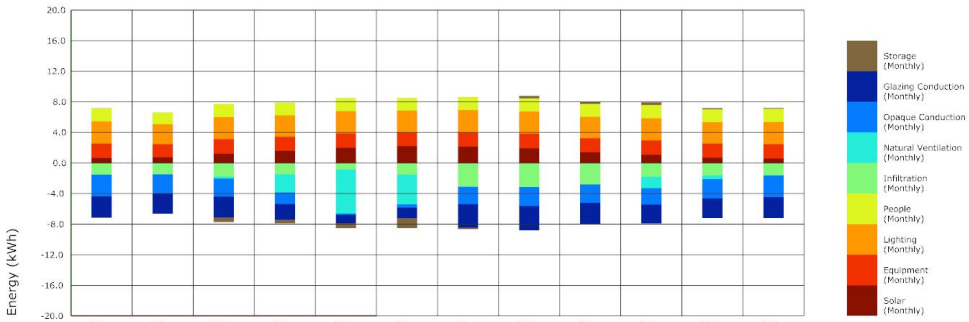
Adaptive Comfort for MY_ROOM (-1 = Cold, 0 = Comfortable, 1 = Hot) - Hourly
Philadelphia International Ap PA USA TMY3
1 JAN 1:00 - 31 DEC 24:00

Min. Indoor Temp for NV: 21℃
Max. Indoor Temp for NV: 29 ℃
Min. Outdoor Temp for NV: 17 ℃
Max. Outdoor Temp for NV: 30 ℃
Infiltration rate: 0.0001(㎥/s per ㎡)

Exterior wall R-VALUE: 4.74
Window U-VALUE: 1.99

% comfortable time 38
Hot stress 24
Cold stress 38

Energy Balance Chart



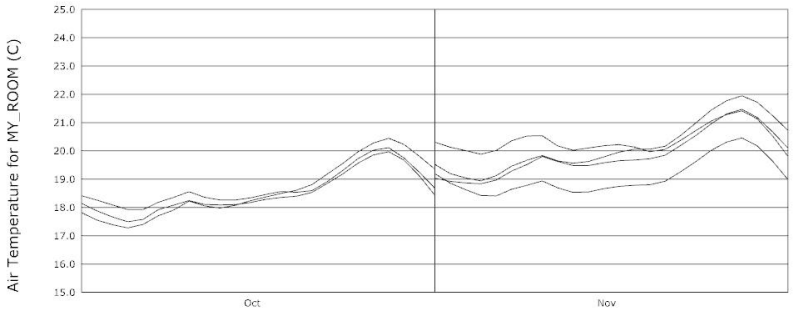
Total Solar Energy Gain 366kWh
Total Light energy Gain 549kWh

Analysis Result of My New Room – typical week result

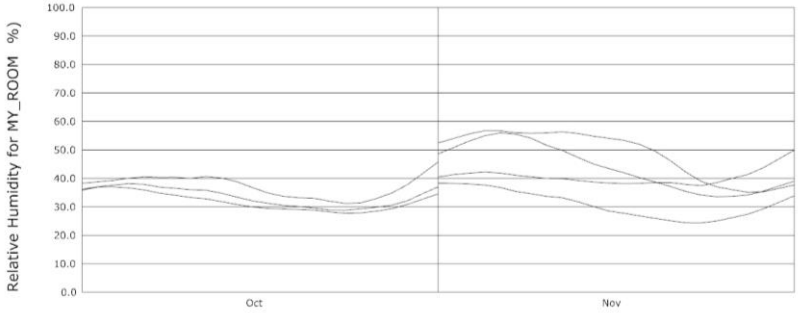
Typical Week of Philadelphia

October 29 – November 4 (7days)

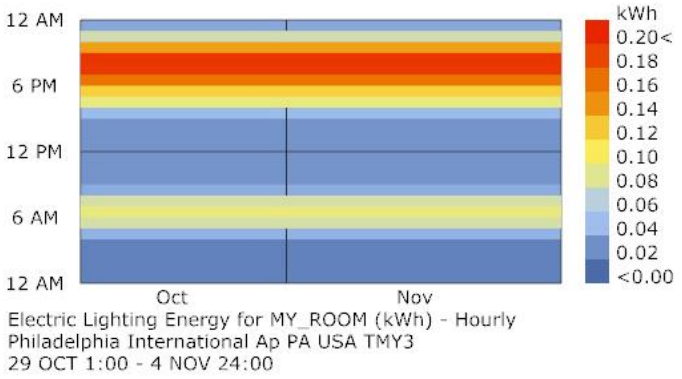
Average indoor temperature: 19.3 ℃



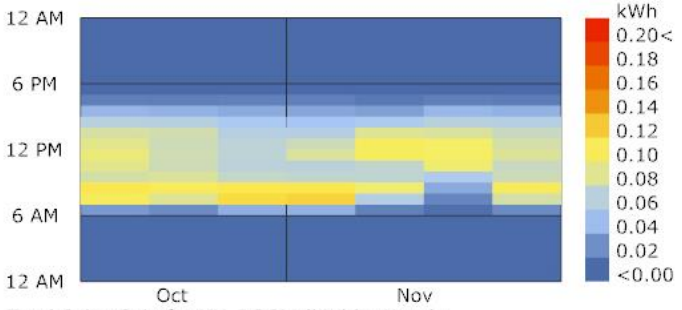
Average indoor Relative Humidity: 38.1 ℃



Total Solar Energy Gain 4.6kWh
Total Light energy Gain 10.5kWh

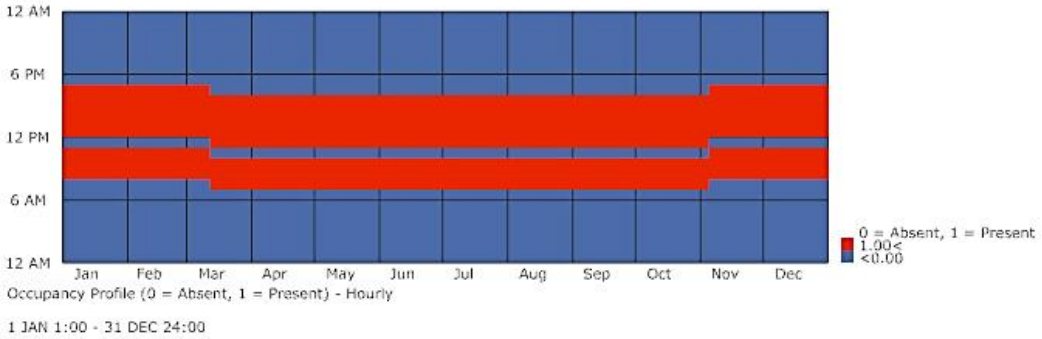


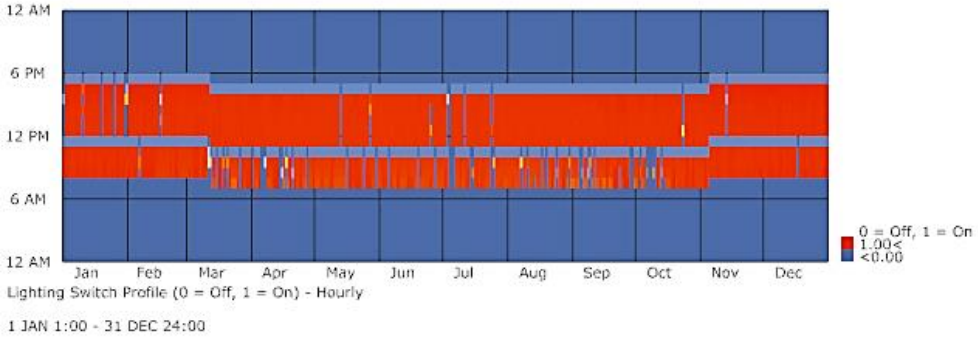
Electric Lighting Energy for MY_ROOM (kWh) - Hourly
Philadelphia International Ap PA USA TMY3
29 OCT 1:00 - 4 NOV 24:00



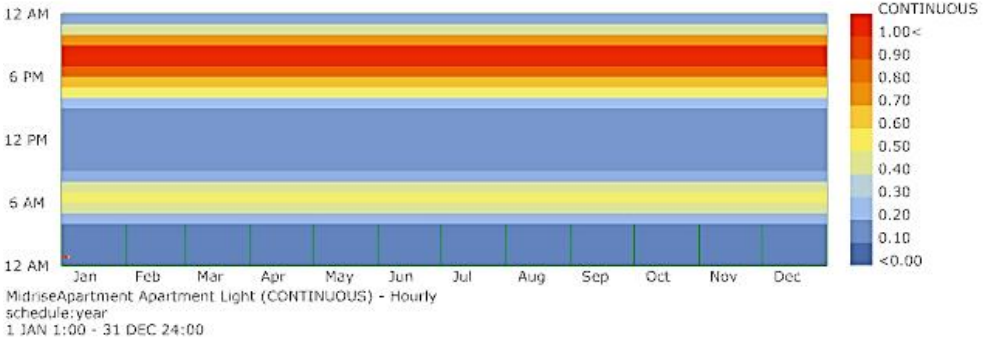
Total Solar Gain for MY_ROOM (kWh) - Hourly
Philadelphia International Ap PA USA TMY3
29 OCT 1:00 - 4 NOV 24:00

+ Lighting & Occupancy Schedule





Midrise Apartment Zone Schedule (Apartment only)

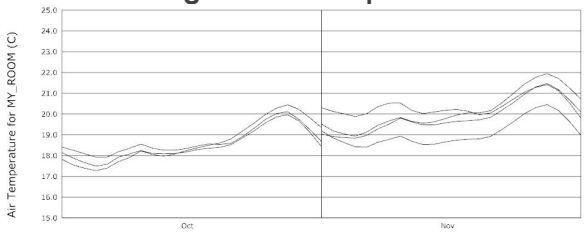


typical week result + Lighting & Occupancy Schedule

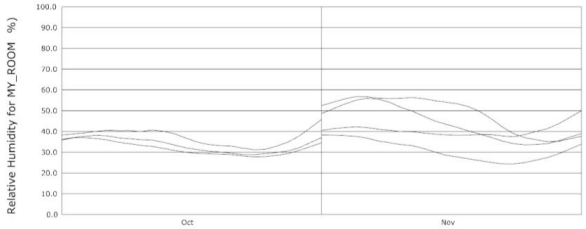
October 29 – November 4 (7days)

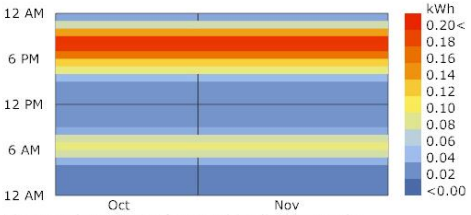
The result without schedule adjustment

Average indoor temperature: 19.3 ℃



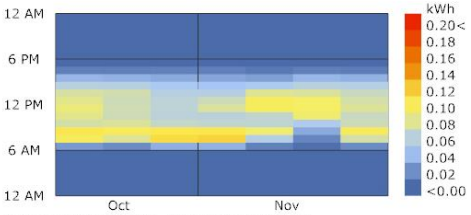
Average indoor Relative Humidity: 38.1 ℃





Electric Lighting Energy for MY_ROOM (kWh) - Hourly
Philadelphia International Ap PA USA TMY3
29 OCT 1:00 - 4 NOV 24:00

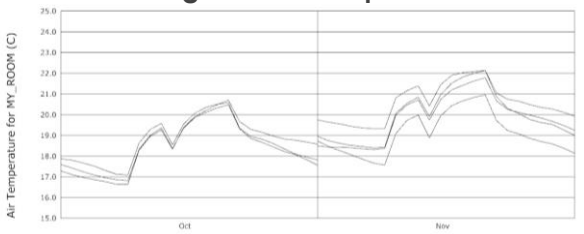
Total Solar Energy Gain
4.6kWh
Total Light energy Gain
10.5kWh
Annual Total Light Energy Gain
549kWh



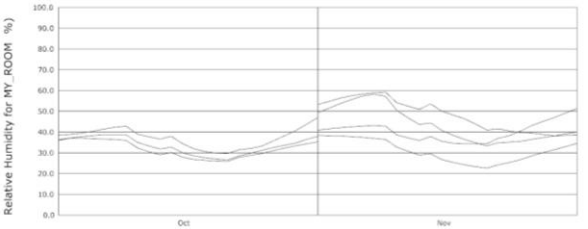
Total Solar Gain for MY_ROOM (kWh) - Hourly
Philadelphia International Ap PA USA TMY3
29 OCT 1:00 - 4 NOV 24:00

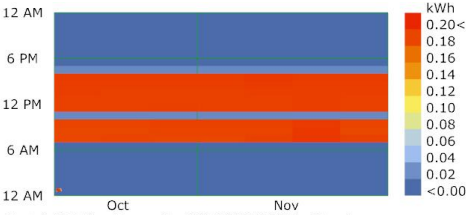
The result with schedule adjustment

Average indoor temperature: 19.3 ℃



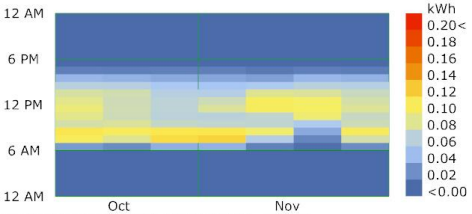
Average indoor Relative Humidity: 37.9 ℃





Electric Lighting Energy for MY_ROOM (kWh) - Hourly
Philadelphia International Ap PA USA TMY3
29 OCT 1:00 - 4 NOV 24:00

Total Solar Energy Gain
4.6kWh
Total Light energy Gain
10.5kWh
Annual Total Light Energy Gain
508kWh(-8%)

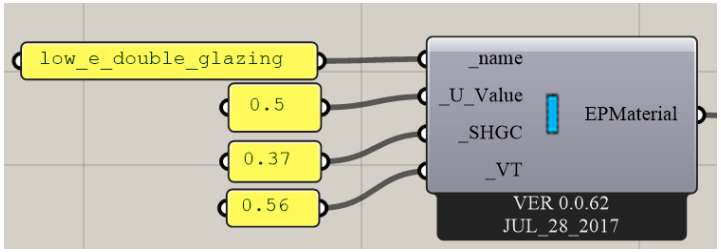


Total Solar Gain for MY_ROOM (kWh) - Hourly
Philadelphia International Ap PA USA TMY3
29 OCT 1:00 - 4 NOV 24:00

typical week result + Lighting & Occupancy Schedule + Room Properties

October 29 – November 4 (7days)

1. Window properties upgrade



2. Change of natural ventilation range

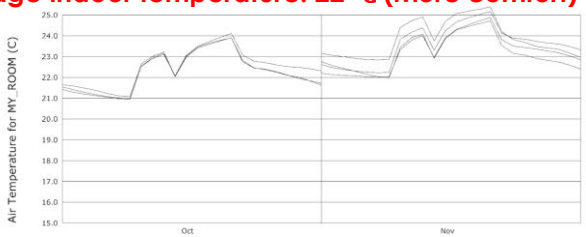
*Since HVAC is not conditioned, natural ventilation will be set to maximum indoor temperature. Moreover, Minimum outdoor temperature is relatively lower than common because of maximizing natural cooling.

Min. Indoor Temp for NV: 21℃
Max. Indoor Temp for NV: 29 ℃
Min. Outdoor Temp for NV: 17 ℃ **(Common Setting with HVAC)**
Max. Outdoor Temp for NV: 30 ℃
Infiltration rate: 0.0001(㎥/s per ㎡)

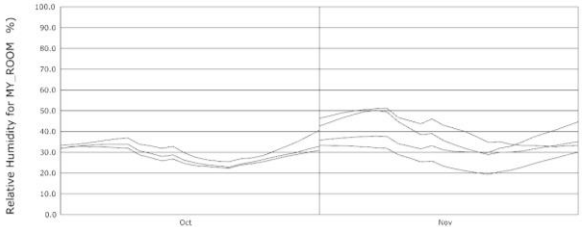
Min. Indoor Temp for NV: 24℃
Max. Indoor Temp for NV: 53 ℃
Min. Outdoor Temp for NV: 10 ℃
Max. Outdoor Temp for NV: 30 ℃
Infiltration rate: 0.0001(㎥/s per ㎡)

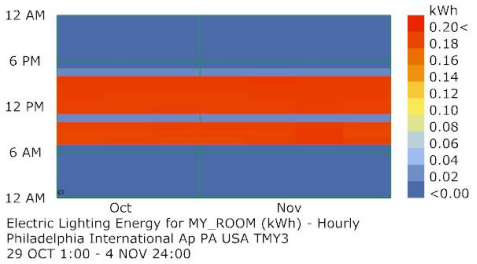
The result with schedule adjustment (2)

Average indoor temperature: 22 ℃ (More comfort)

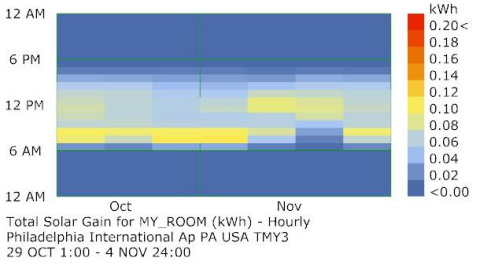


Average indoor Relative Humidity: 33 ℃ (More dry, but OK)



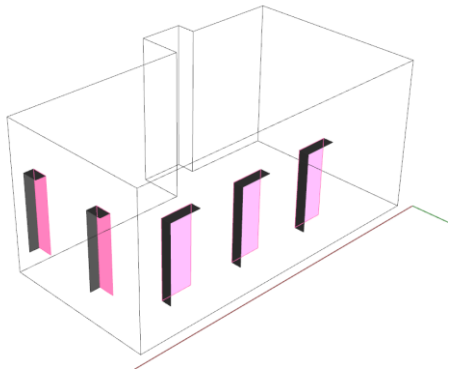


Total Solar Energy Gain
4kWh
Total Light energy Gain
10.5kWh
Annual Total Light Energy Gain
508kWh(-8%)
Annual Total Solar Energy Gain
320kWh(-12.5%)

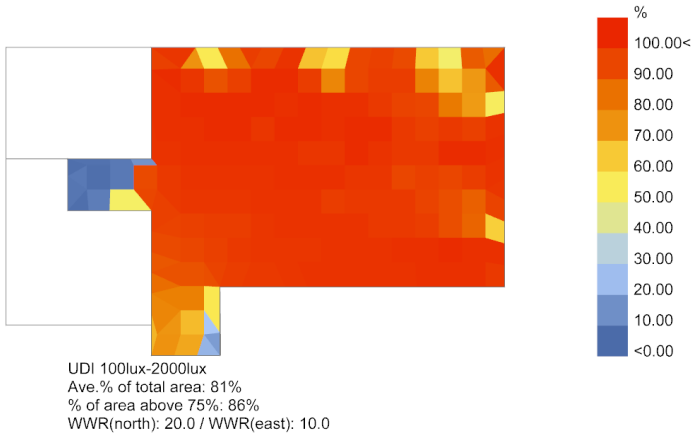


Analysis Result of My New Room 2

Newly Designed Room

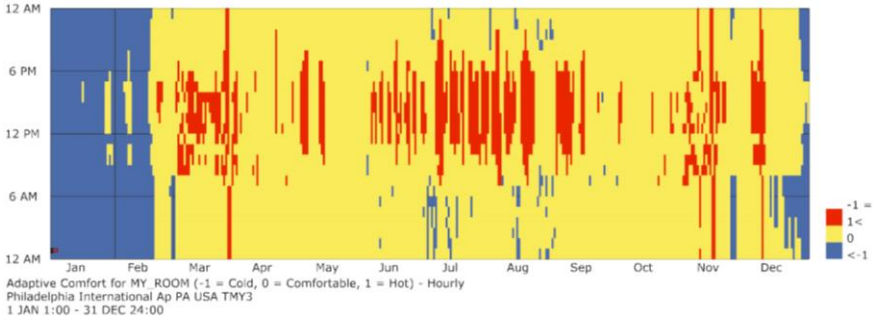


UDI Analysis (100<2000lux)



%of total area **81%**
% of area meets the UDI 100<2000lux for over 75% of time
86%

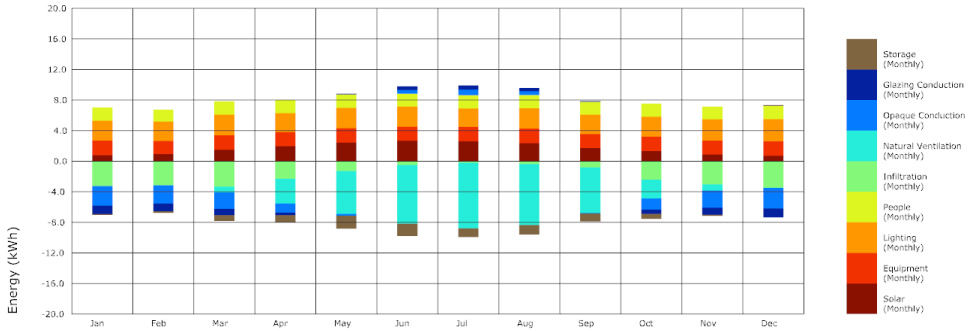
Adaptive Comfort Graph



Min. Indoor Temp for NV: 24℃
Max. Indoor Temp for NV: 53 ℃
Min. Outdoor Temp for NV: 10 ℃
Max. Outdoor Temp for NV: 30 ℃
Infiltration rate: 0.0001(㎥/s per ㎡)

Exterior wall R-VALUE: 4.74
Window Properties
U-Value 0.5/SHGC 0.37/VT 0.56
% comfortable time 70
Hot stress 15
Cold stress 15

Energy Balance Chart



Total Solar Energy Gain 320kWh
Total Light energy Gain 508kWh