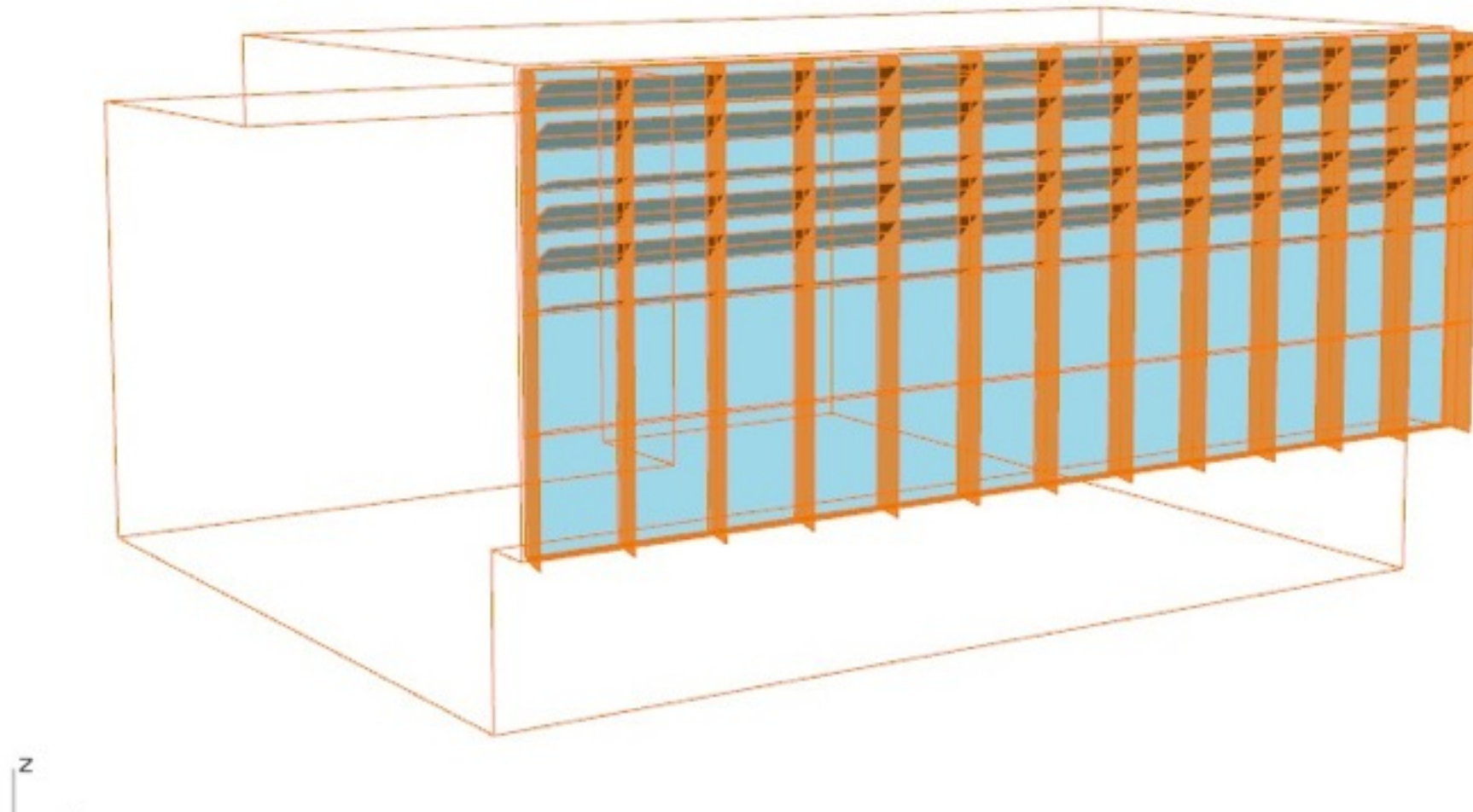


Shading Grid

Natural Ventilation and Indoor Comfort

JeeEun Lee

11/16/15



This shading is designed to obtain maximum hours of indoor comfort **without HVAC system.**

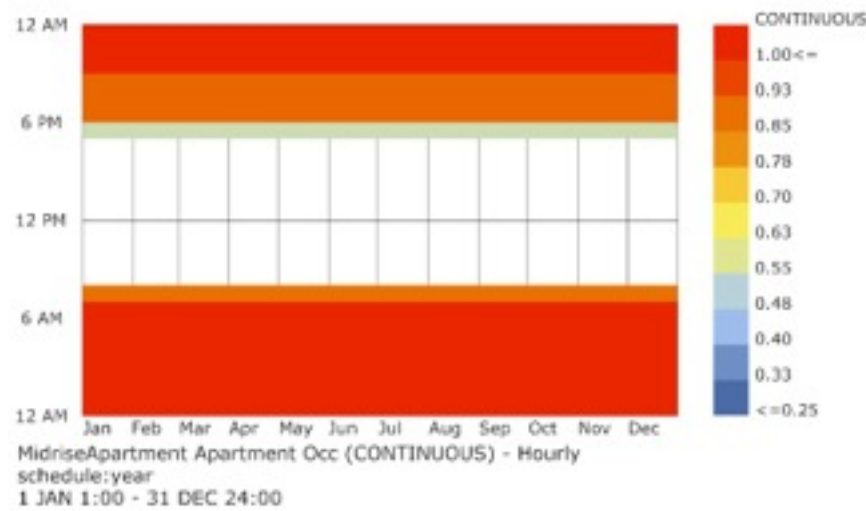
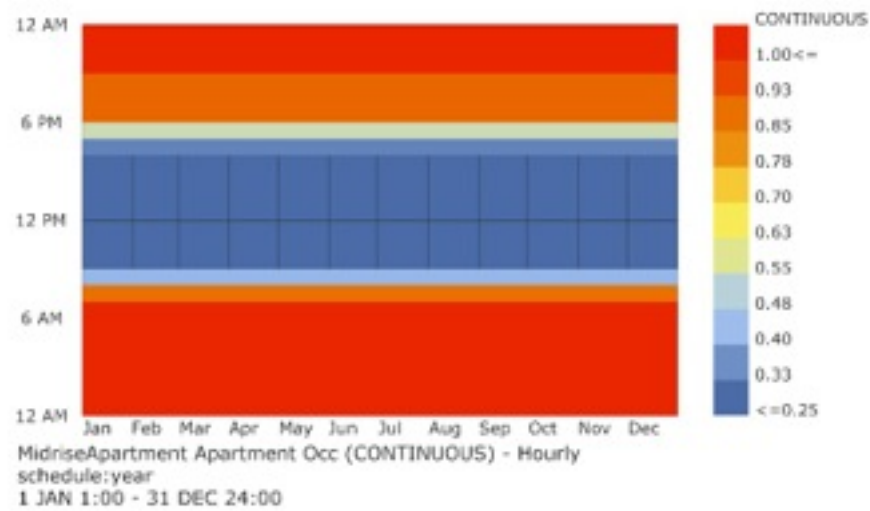
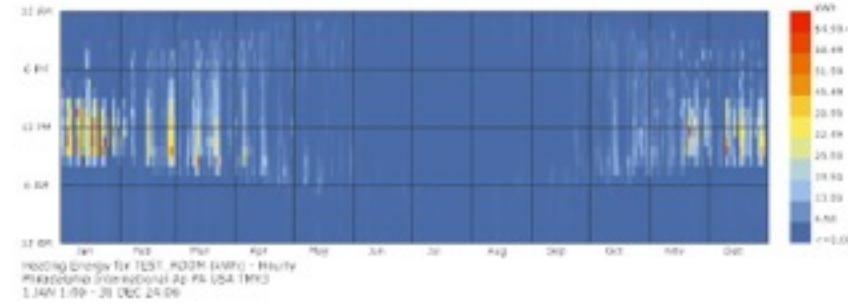
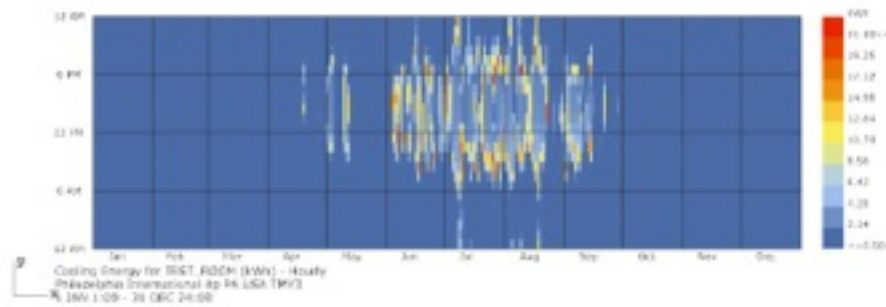
The shading has been optimized by calculating of comfort hours depending on the depth of three kinds of shading elements.

Adaptive Comfort: 95%, PMV Comfort: 49%

These numbers show the percent of comfort hours during occupancy hours throughout of a year.

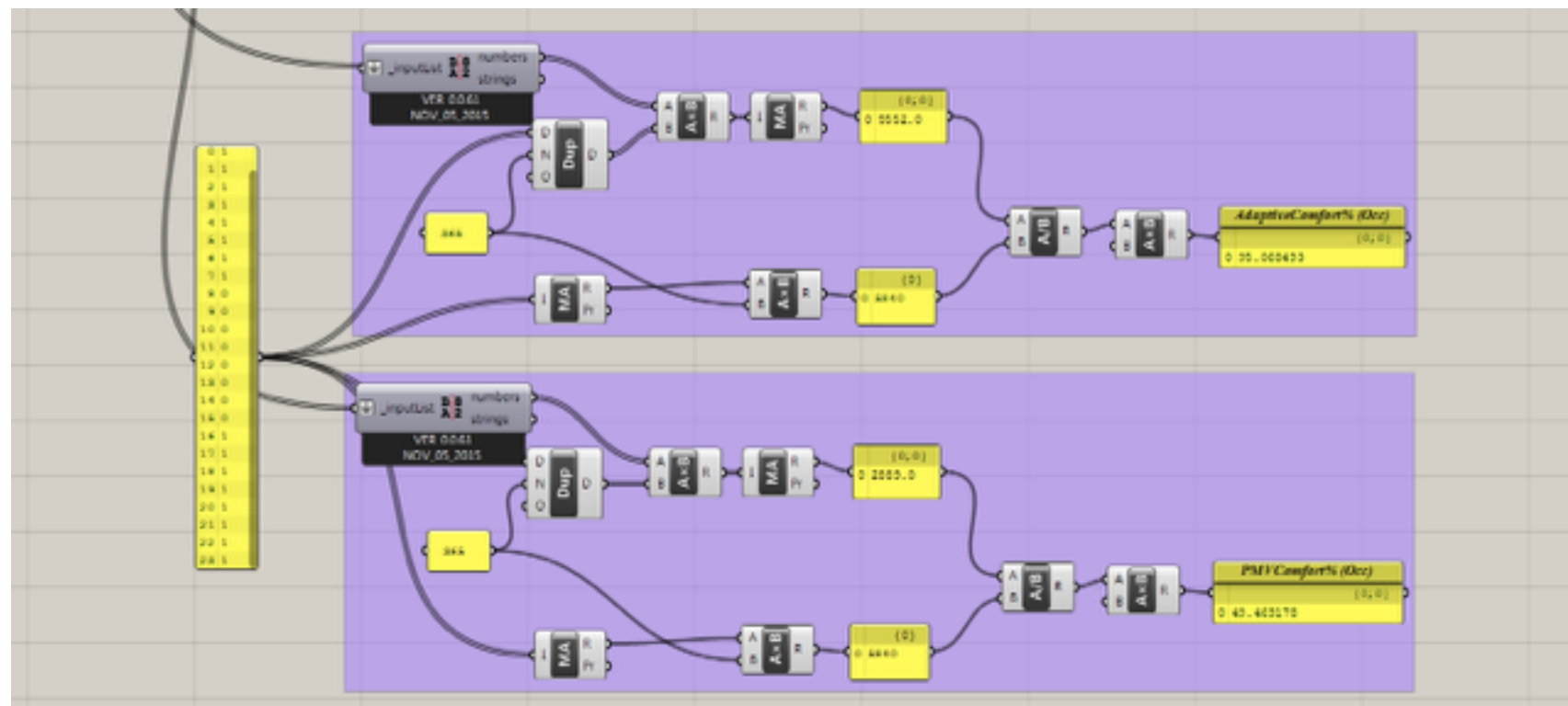
Occupancy Schedule

Energy Load Without Shading



To combine the occupancy schedule and comfort calculation result, it is only considering the hours that has more than 0.5 value of continuous occupation at Mid-Rised-Apartment Program.

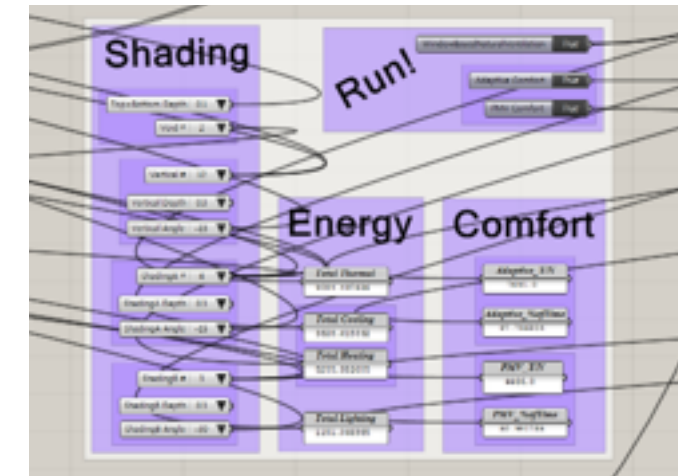
The hours include 0 am ~ 8 am and 5 pm ~ 12 am.



To apply the occupancy schedule upon the comfort calculation, the hours that comfortable during the occupation schedule have been added all them together, and then divided by the whole occupation hours.

Optimization Process

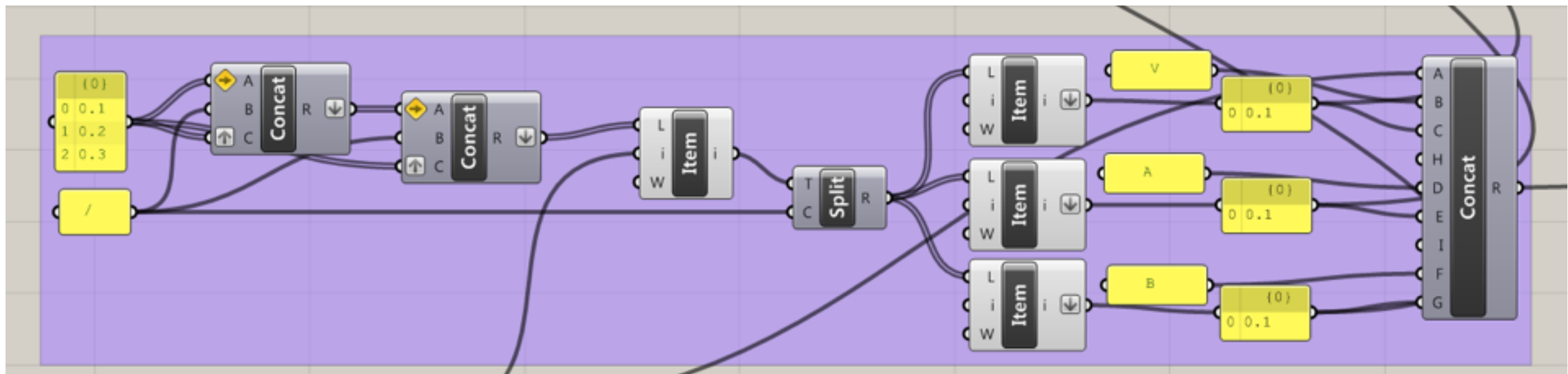
FileName	AdaptiveComfort%	AdaptiveComfort%(Occ)	PMVComfort%	PMVComfort%(Occ)
0 1.0V0.2A0.1B0.1	0 81.464467	0 92.208904	0 53.538813	0 53.219178
1 2.0V0.3A0.1B0.1	1 84.178082	1 93.493151	1 52.648402	1 51.900685
2 3.0V0.1A0.2B0.1	2 80.148402	2 90.958904	2 54.058174	2 53.80137
3 4.0V0.2A0.2B0.1	3 82.808219	3 92.722603	3 53.481735	3 52.773973
4 5.0V0.3A0.2B0.1	4 85.273973	4 94.160959	4 52.16895	4 51.164384
5 6.0V0.1A0.3B0.1	5 81.289954	5 91.369863	5 54.189498	5 53.493151
6 7.0V0.2A0.3B0.1	6 84.02948	6 93.356164	6 53.025114	6 52.157534
7 8.0V0.3A0.3B0.1	7 85.97032	7 94.537671	7 52.134703	7 50.821918
8 9.0V0.1A0.1B0.2	8 80.399543	8 91.284247	8 53.835616	8 53.527397
9 10.0V0.2A0.1B0.2	9 82.842466	9 92.688356	9 53.219178	9 52.517123
10 11.0V0.3A0.1B0.2	10 85.296804	10 94.092466	10 52.100457	10 51.14726
11 12.0V0.1A0.2B0.2	11 81.575342	11 91.763699	11 53.995434	11 53.270548
12 13.0V0.2A0.2B0.2	12 84.02948	12 93.373288	12 52.968037	12 52.037671
13 14.0V0.3A0.2B0.2	13 85.958904	13 94.417808	13 51.997717	13 50.753425
14 15.0V0.1A0.3B0.2	14 82.785388	14 92.39726	14 53.812785	14 52.825342
15 16.0V0.2A0.3B0.2	15 85.194064	15 94.109589	15 52.614155	15 51.284247
16 17.0V0.3A0.3B0.2	16 87.009132	16 94.828767	16 51.472603	16 50.034247
17 18.0V0.1A0.1B0.3	17 81.472603	17 91.917808	17 53.475799	17 53.099315
18 19.0V0.2A0.1B0.3	18 83.961187	18 93.441781	18 52.794804	18 52.003425
19 20.0V0.3A0.1B0.3	19 86.210046	19 94.640411	19 51.643836	19 50.599315
20 21.0V0.1A0.2B0.3	20 82.614155	20 92.277397	20 53.515982	20 52.534247
21 22.0V0.2A0.2B0.3	21 85.045662	21 93.938356	21 52.671233	21 51.489726
22 23.0V0.3A0.2B0.3	22 86.860731	22 94.657534	22 51.347032	22 49.94863
23 24.0V0.1A0.3B0.3	23 84.006849	23 93.133562	23 53.082192	23 52.020548
24 25.0V0.2A0.3B0.3	24 86.289954	24 94.657534	24 52.237443	24 50.753425
25 26.0V0.3A0.3B0.3	25 87.794804	25 95.068493	25 50.981735	25 49.469178
26 0.0V0.1A0.1B0.1	26 78.487215	26 90.428082	26 54.063927	26 54.092466



Optimized Shading Design

Since there are too many parameters that can be manipulated, this simulation is only based on the variations of shading depth.

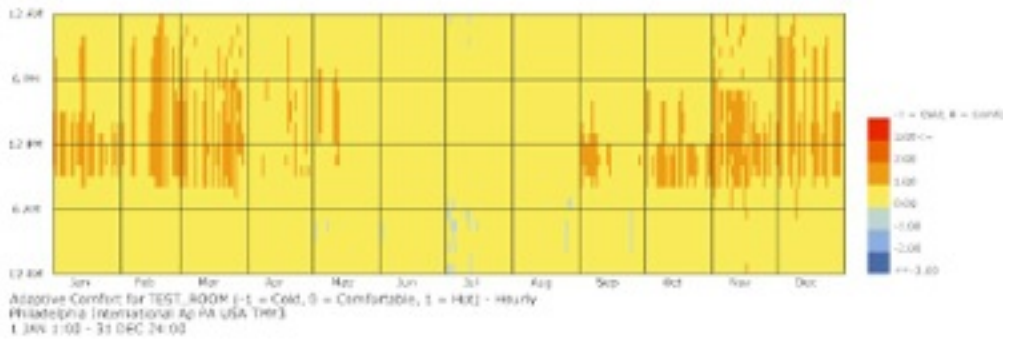
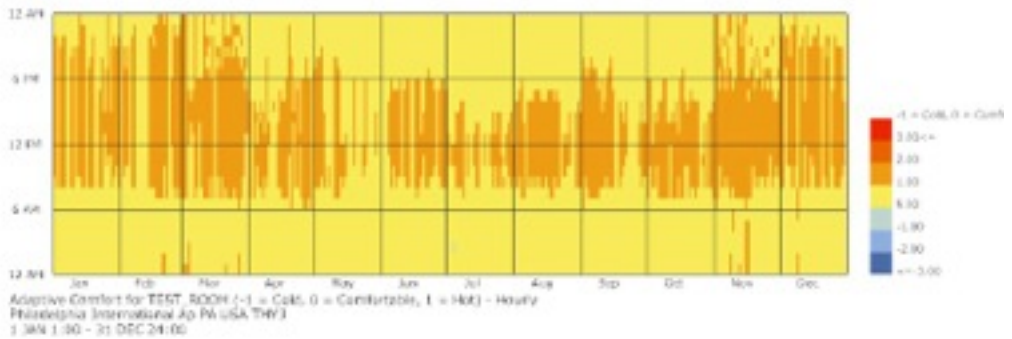
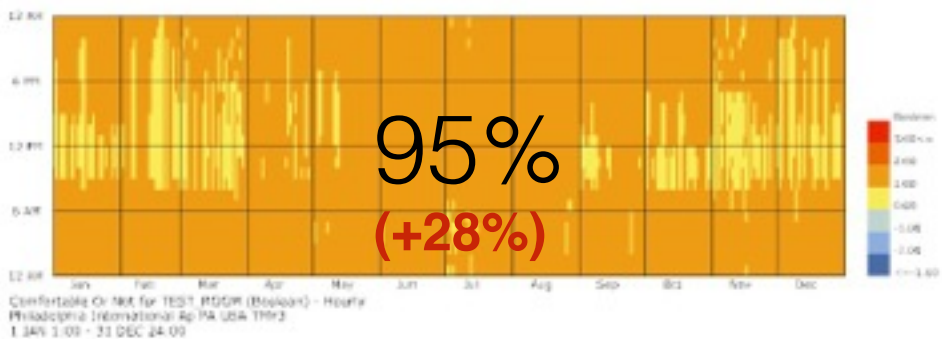
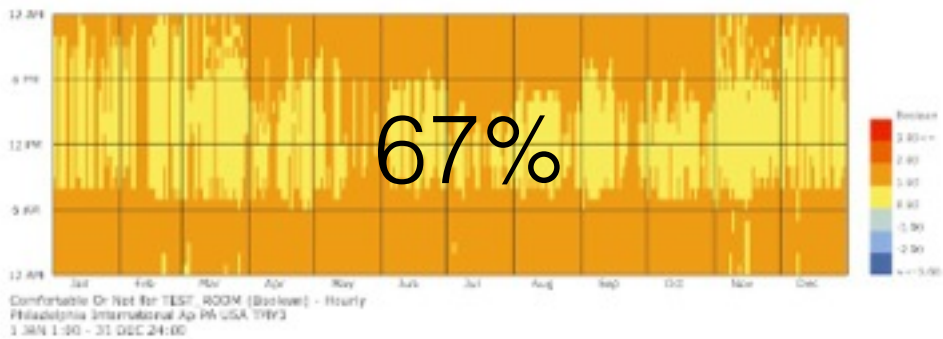
The three kinds of shading depth range from 0.1 m to 0.3 m.



Without Shading

With Optimized Shading

Adaptive
Comfort



PMV
Comfort

