Energy Simulation

Philadelphia Apartment
Generic Geometry

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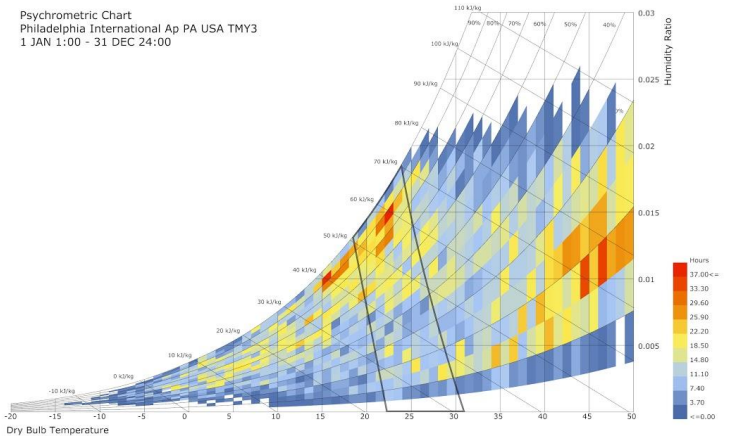
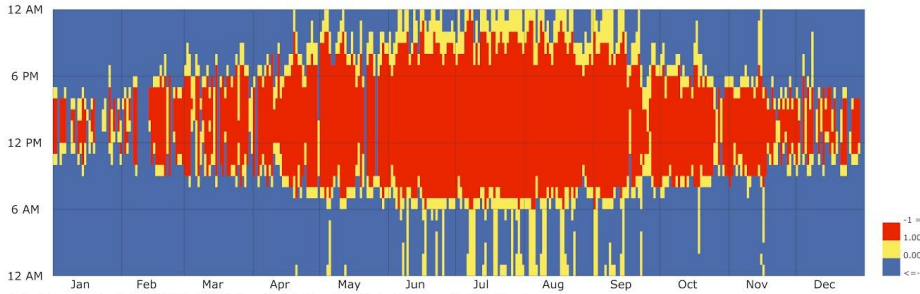
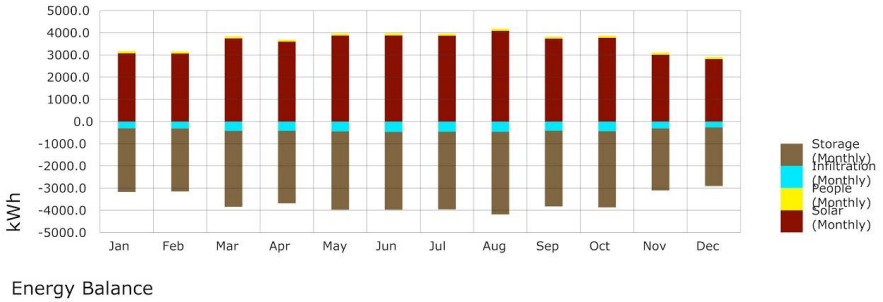
ARCH 753 - BPS
Fall 2016 - PennDesign

Step 1 = 12.74%

Orientation - 90º
Shading - None
Wall R - 5.50
Window R - 1.00
Window SHGC - 0.70
Roof R - 9.20
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab





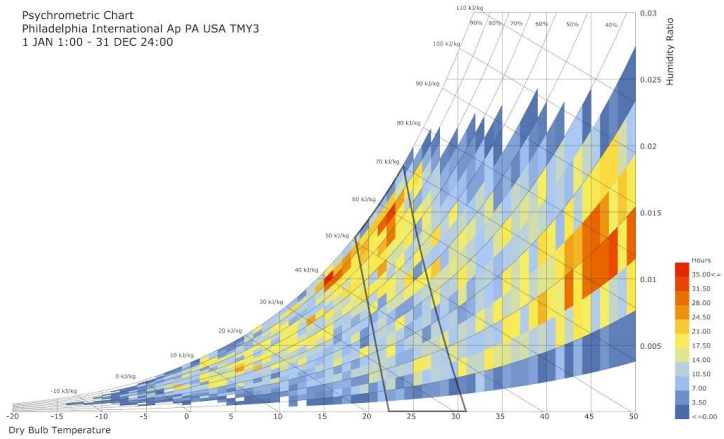


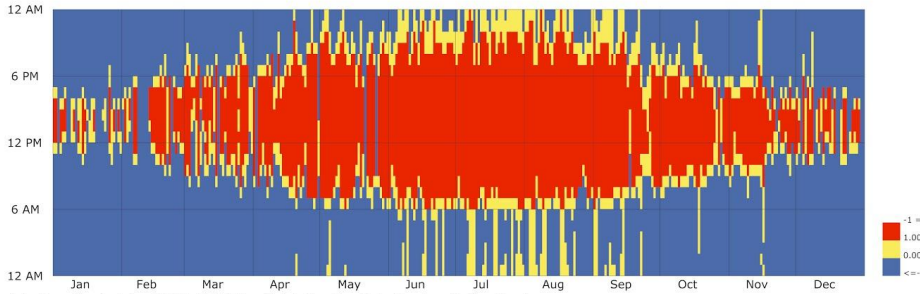
Energy Balance

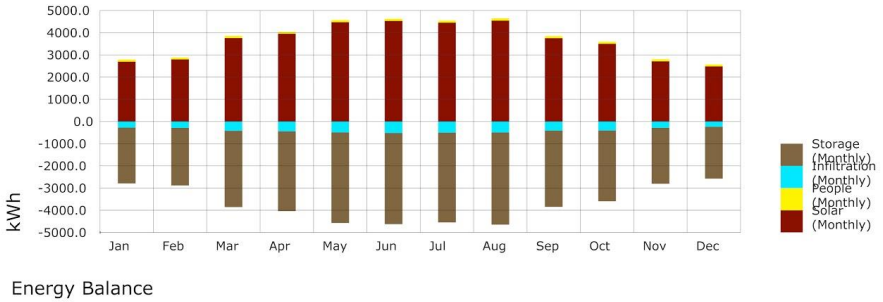
Comfortable (%): 12.74
hot (%): 34.04
cold (%): 53.22

Step 2 = 12.95% (+0.21)

Orientation - 45º
Shading - None
Wall R - 5.50
Window R - 1.00
Window SHGC - 0.70
Roof R - 9.20
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab



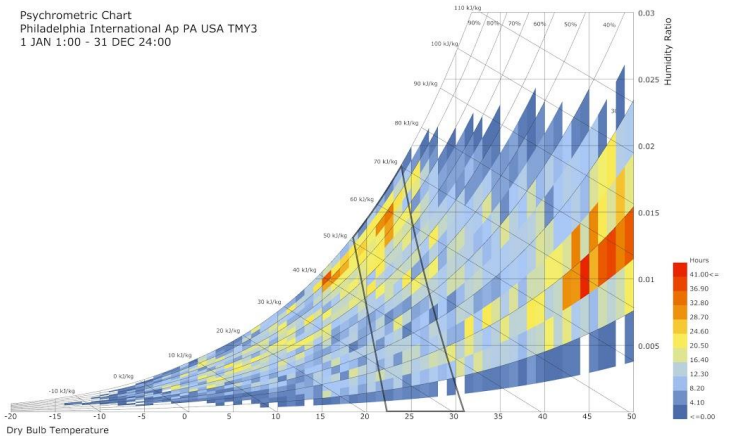


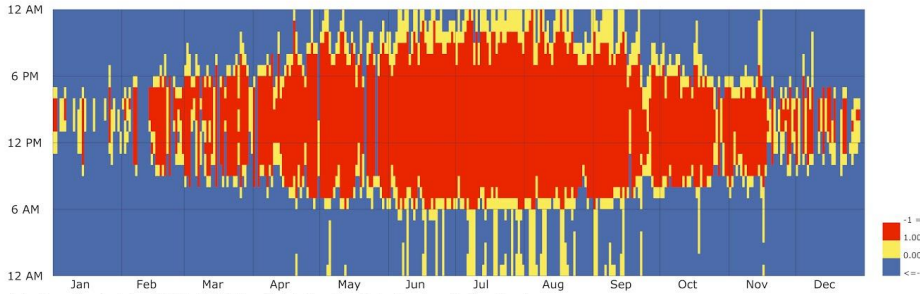


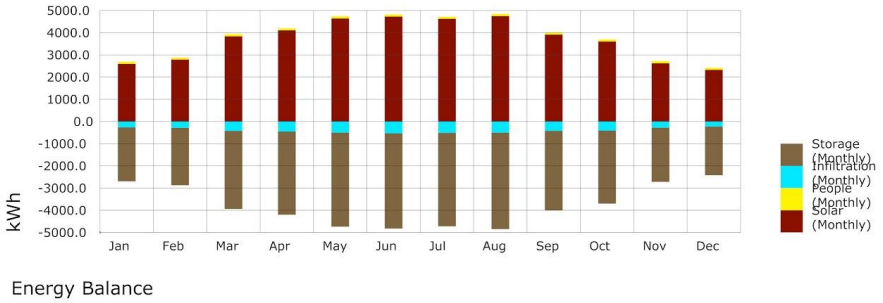
Comfortable (%): 12.95
hot (%): 33.85
cold (%): 53.21

Step 3 = 12.97% (+0.02)

Orientation - 0º
Shading - None
Wall R - 5.50
Window R - 1.00
Window SHGC - 0.70
Roof R - 9.20
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab





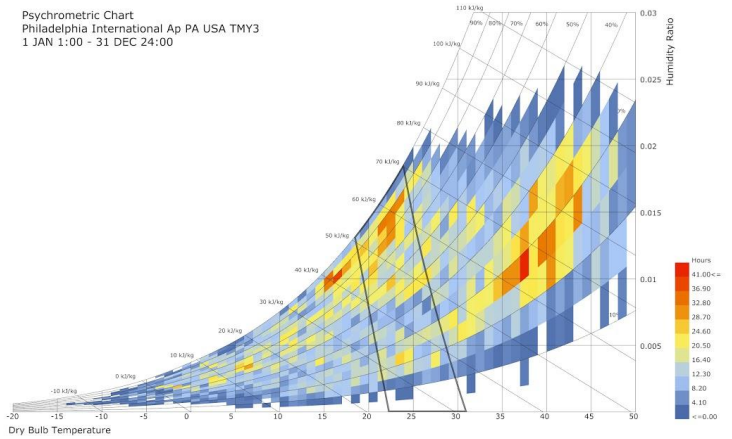


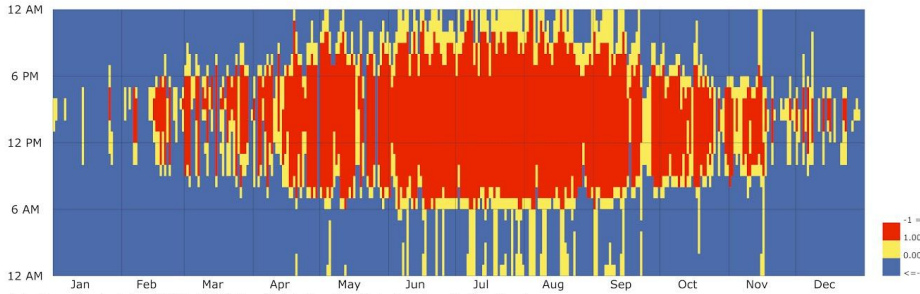
Comfortable (%): 12.97
hot (%): 33.96
cold (%): 53.07

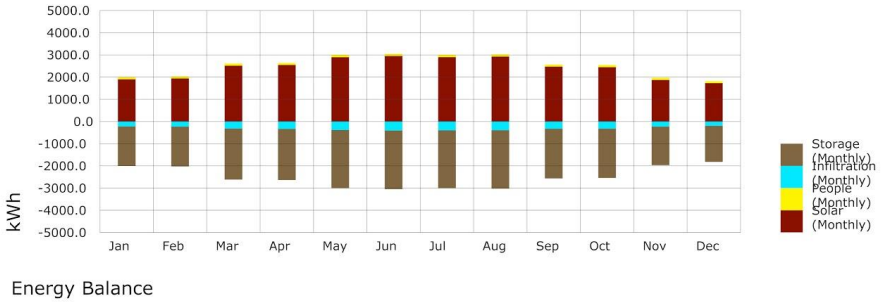
Step 4 = 14.38% (+1.41)

Orientation - 0º
*Shading - 0.50 depth (x3)**
Wall R - 5.50
Window R - 1.00
Window SHGC - 0.70
Roof R - 9.20
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab

* Adding shade dramatically increases comfortable hours and balances the energy gains and losses.





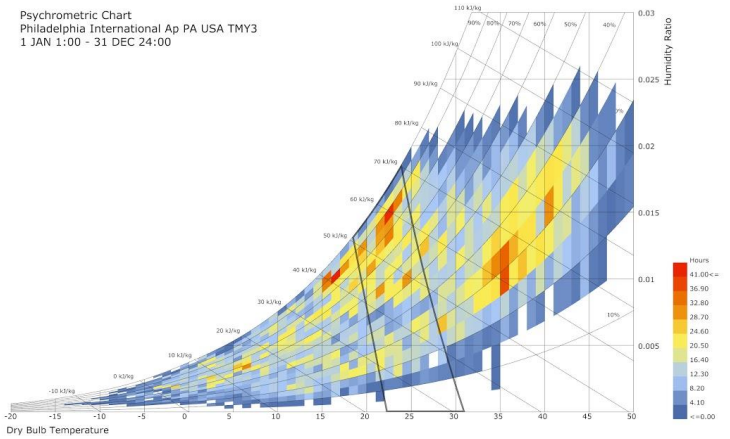


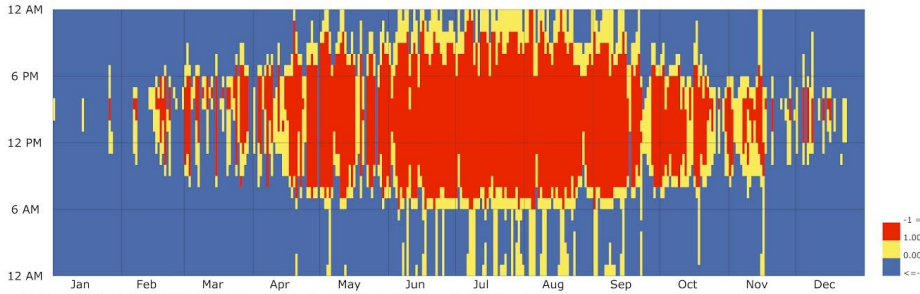
Energy Balance

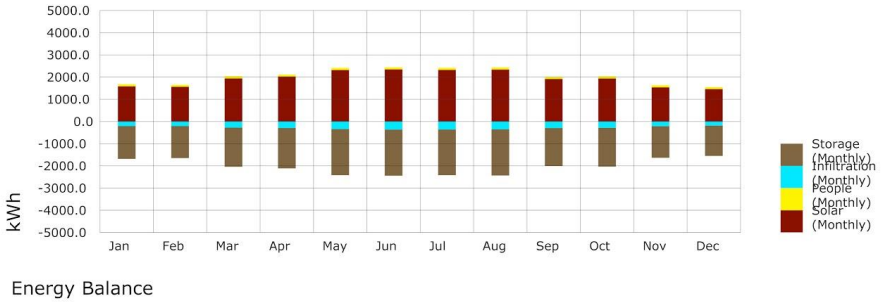
Comfortable (%): 14.38
hot (%): 28.81
cold (%): 56.8

Step 5 = 15.24% (+0.86)

Orientation - 0º
Shading - 0.80 depth (x3)
Wall R - 5.50
Window R - 1.00
Window SHGC - 0.70
Roof R - 9.20
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab





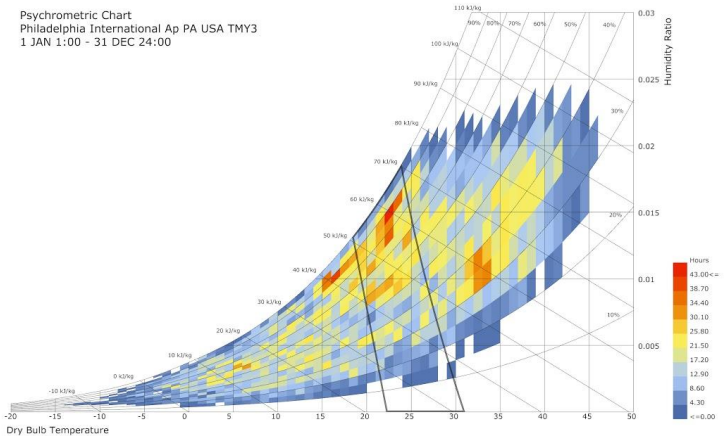


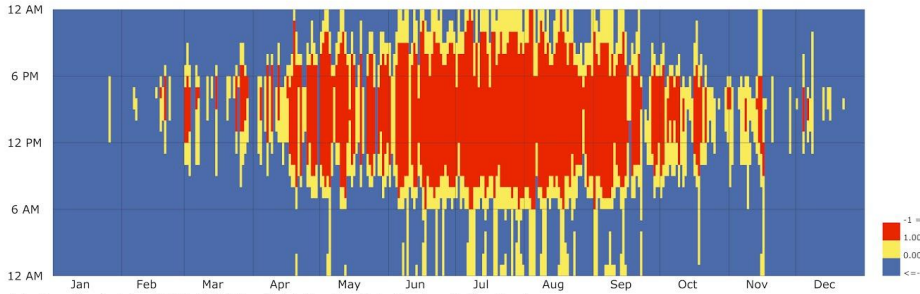
Energy Balance

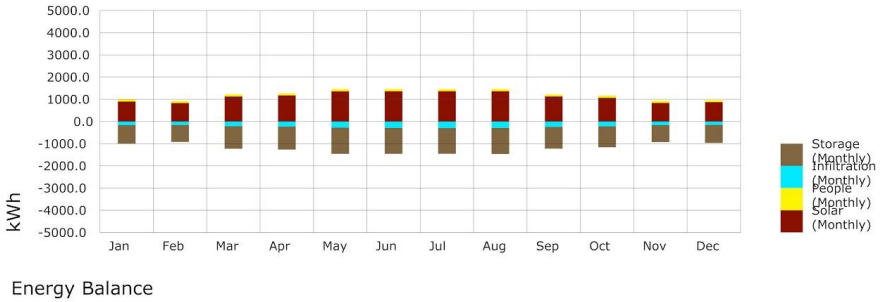
Comfortable (%): 15.24
hot (%): 26.16
cold (%): 58.6

Step 6 = 16.02% (+0.78)

Orientation - 0º
Shading - 0.80 depth (x6)
Wall R - 5.50
Window R - 1.00
Window SHGC - 0.70
Roof R - 9.20
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab





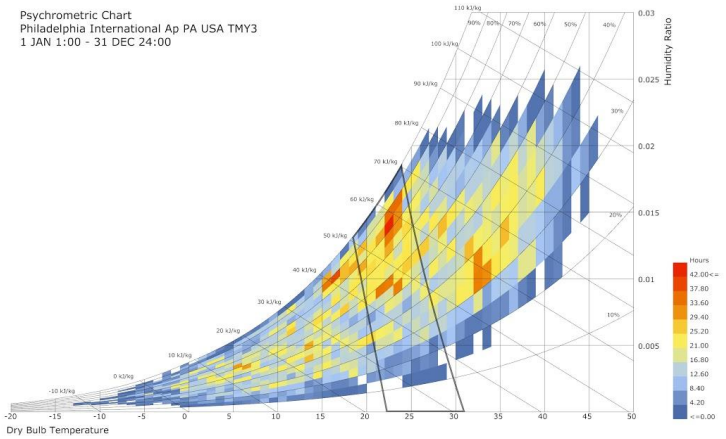


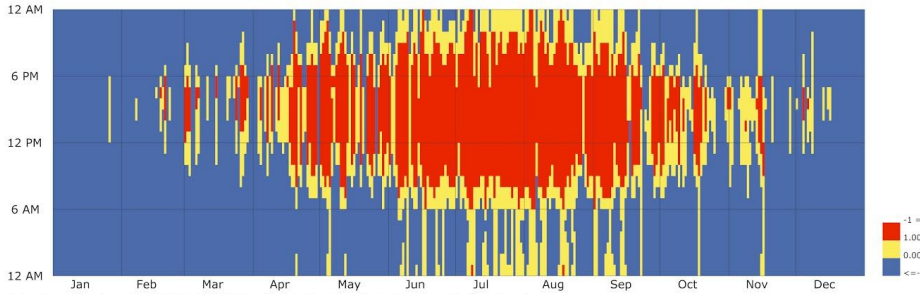
Comfortable (%): 16.02
hot (%): 20.87
cold (%): 63.12

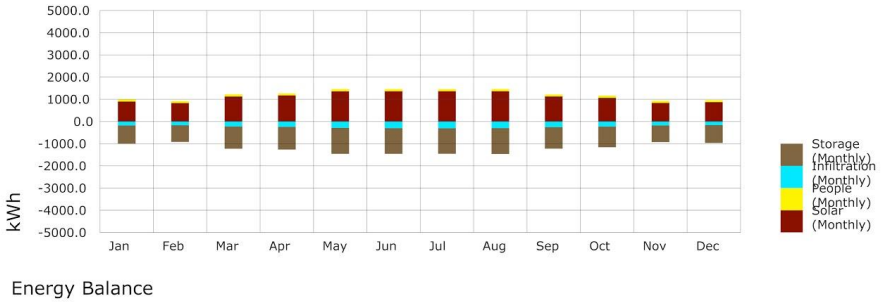
Step 7 = 16.87% (+0.85)

Orientation - 0º
Shading - 0.80 depth (x6)
*Wall R - 34.40**
Window R - 1.00
Window SHGC - 0.70
Roof R - 9.20
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab

*Even though the Wall Thermal Resistance Coefficient increased almost sixfold, comfortable hours did not increase as much, and gains/losses remain mostly unchanged.







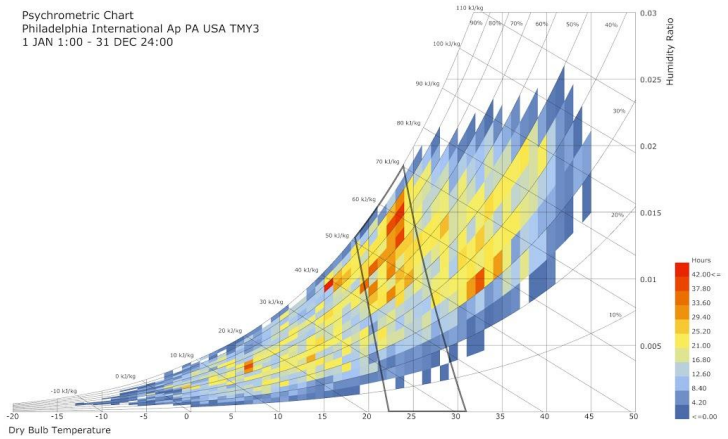
Energy Balance

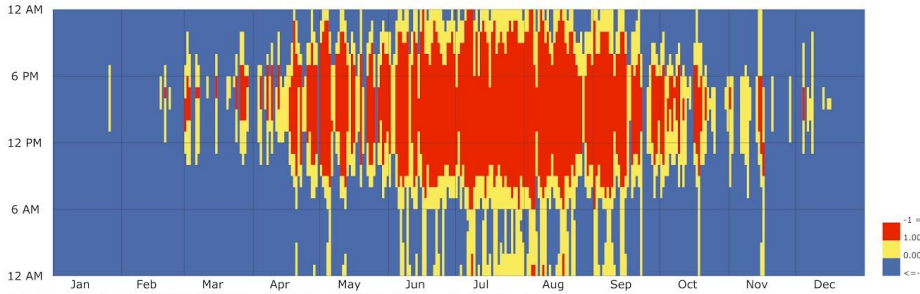
Comfortable (%): 16.87
hot (%): 20.82
cold (%): 62.31

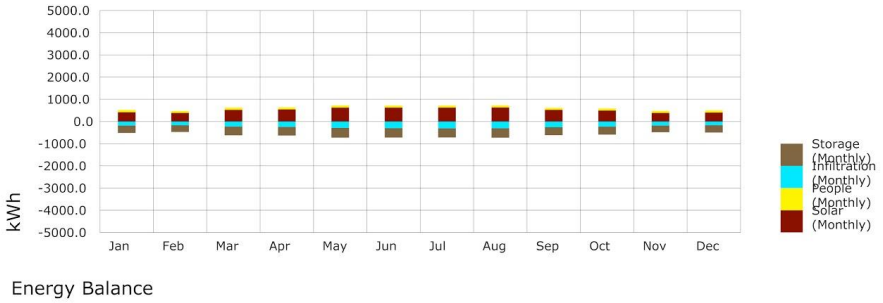
Step 8 = 17.65% (+0.78)

Orientation - 0º
Shading - 0.80 depth (x6)
Wall R - 34.40
*Window R - 0.17**
*Window SHGC - 0.39**
Roof R - 9.20
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab

*Compared to the walls, windows do reduce gains an losses greatly, and comfortable hours are slightly increased.







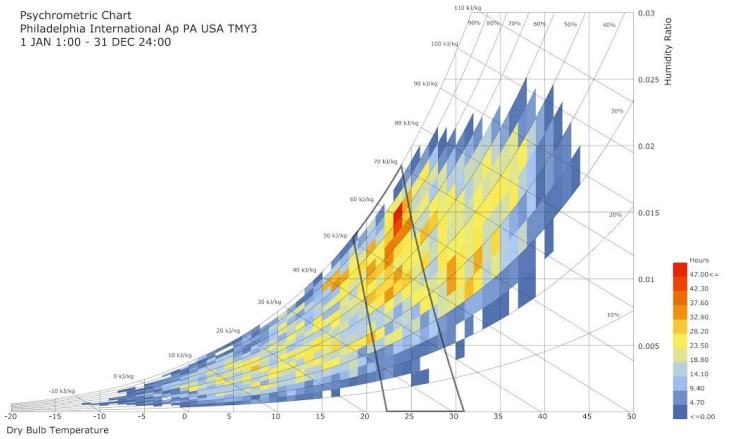
Energy Balance

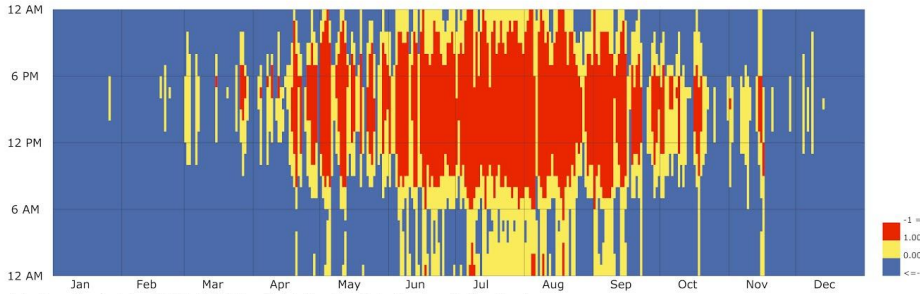
Comfortable (%): 17.65
hot (%): 20.21
cold (%): 62.15

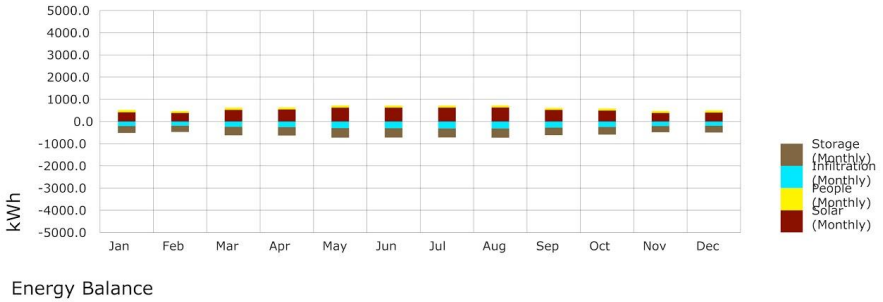
Step 9 = 19.47% (+1.82)

Orientation - 0º
Shading - 0.80 depth (x6)
Wall R - 34.40
Window R - 0.17
Window SHGC - 0.39
*Roof R - 34.40**
Air Change Rate - 2.00
Thermal Massing - Regular concrete slab

*Increasing the Roof Thermal Resistance Coefficient dramatically improves thermal comfortable hours. Gains/losses remain stable.



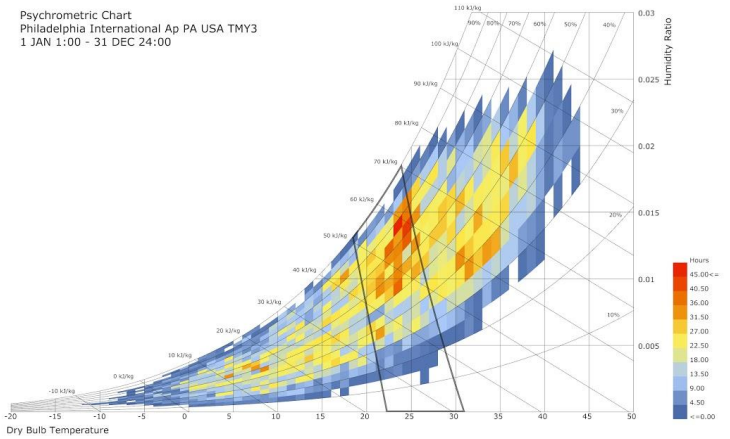


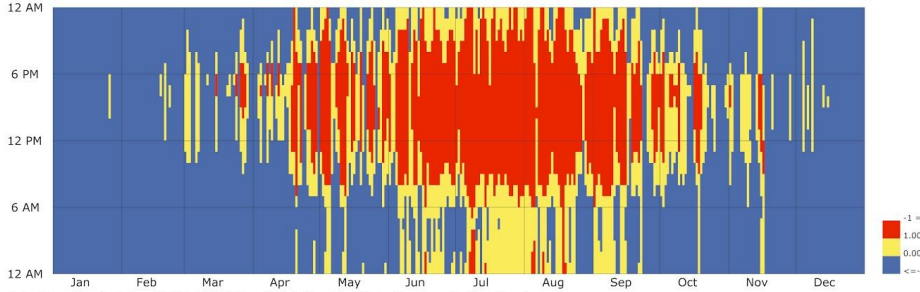


Comfortable (%): 19.47
hot (%): 19.11
cold (%): 61.42

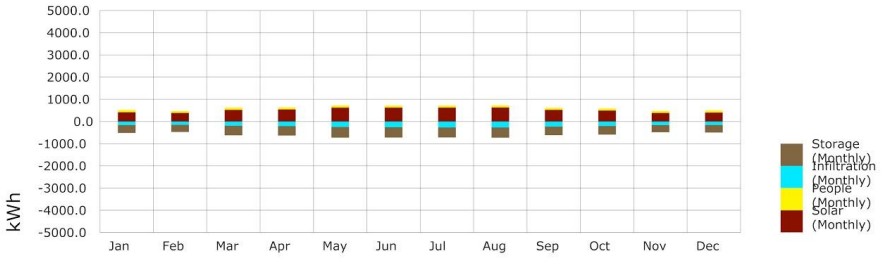
Step 10 = 20.01% (+0.54)

Orientation - 0º
Shading - 0.80 depth (x6)
Wall R - 34.40
Window R - 0.17
Window SHGC - 0.39
Roof R - 34.40
Air Change Rate - 1.30
Thermal Massing - Regular concrete slab





Adaptive Comfort for ZONE_0_T (-1 = Cold, 0 = Comfortable, 1 = Hot) - Hourly
Philadelphia International Ap PA USA TMY3
1 JAN 1:00 - 31 DEC 24:00

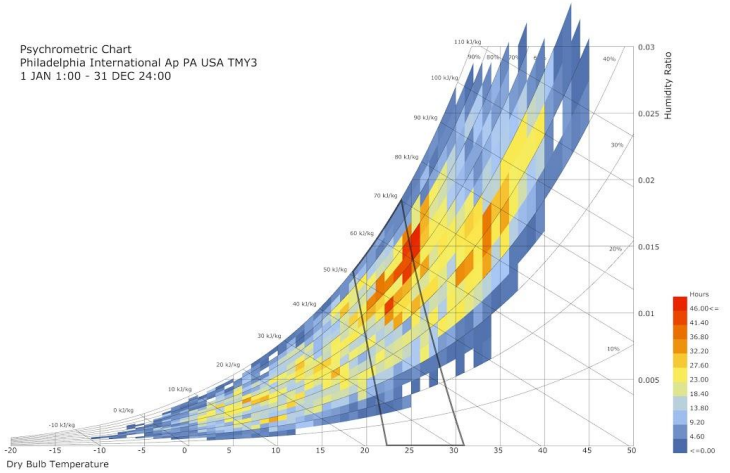


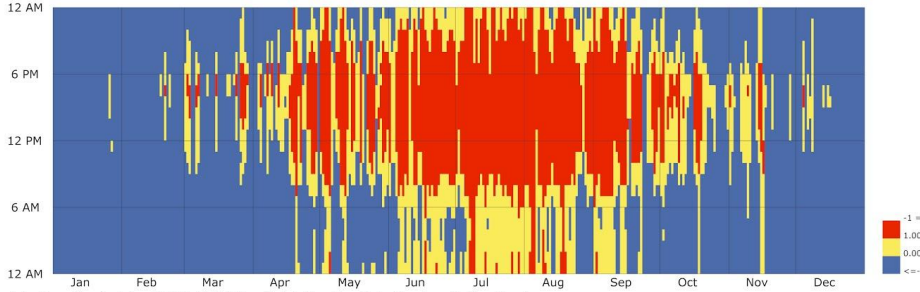
Energy Balance

Comfortable (%): 20.01
hot (%): 20.65
cold (%): 59.34

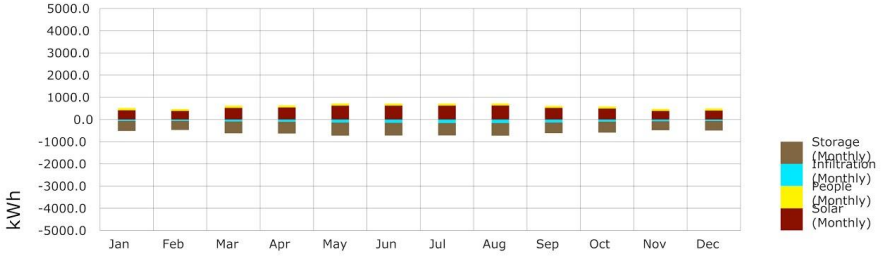
Step 11 = 20.15% (+0.14)

Orientation - 0º
Shading - 0.80 depth (x6)
Wall R - 34.40
Window R - 0.17
Window SHGC - 0.39
Roof R - 34.40
Air Change Rate - 0.40
Thermal Massing - Regular concrete slab





Adaptive Comfort for ZONE_0_T (-1 = Cold, 0 = Comfortable, 1 = Hot) - Hourly
Philadelphia International Ap PA USA TMY3
1 JAN 1:00 - 31 DEC 24:00

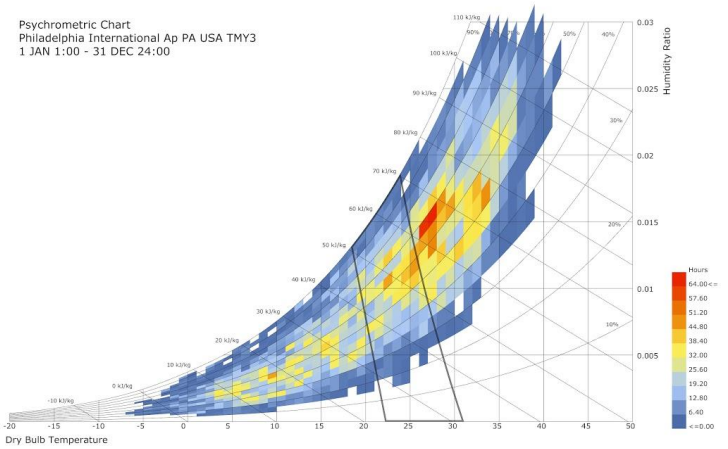


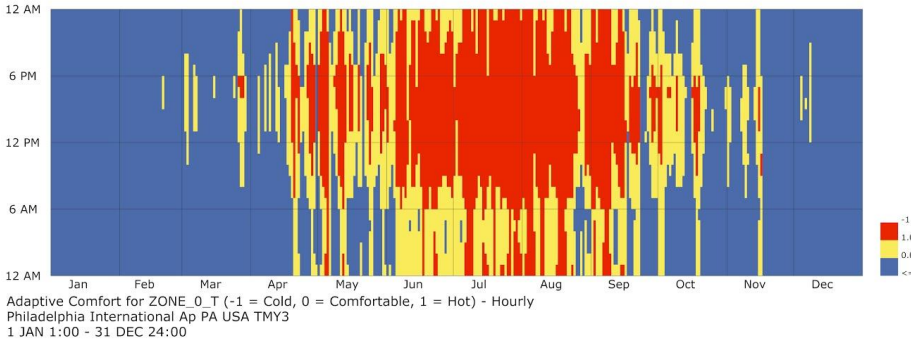
Energy Balance

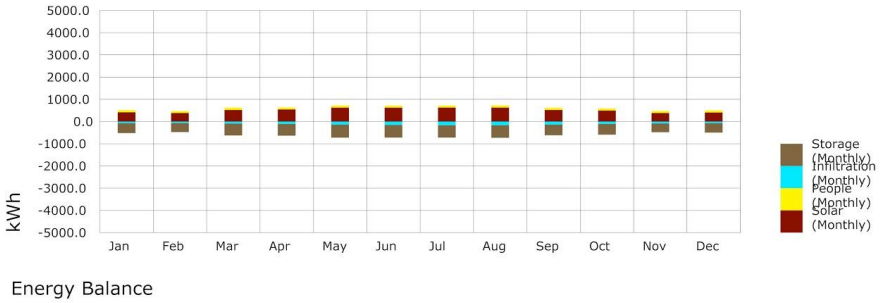
Comfortable (%): 20.15
hot (%): 22.93
cold (%): 56.92

Step 12 = 21.14% (+0.99)

Orientation - 0º
Shading - 0.80 depth (x6)
Wall R - 34.40
Window R - 0.17
Window SHGC - 0.39
Roof R - 34.40
Air Change Rate - 0.40
Thermal Massing - Regular concrete slab + 4” Concrete







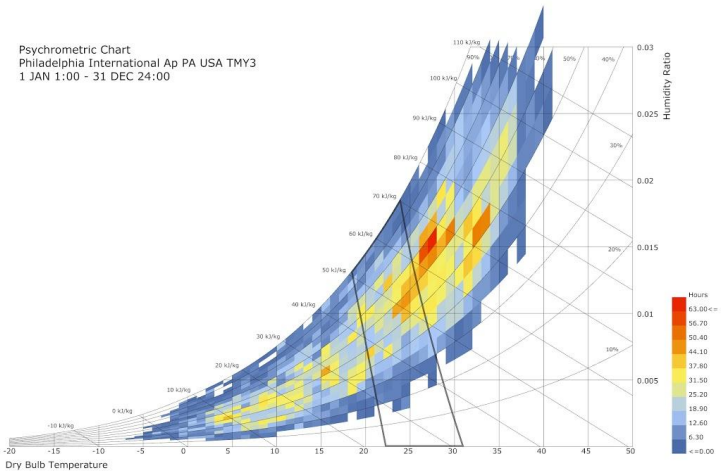
Energy Balance

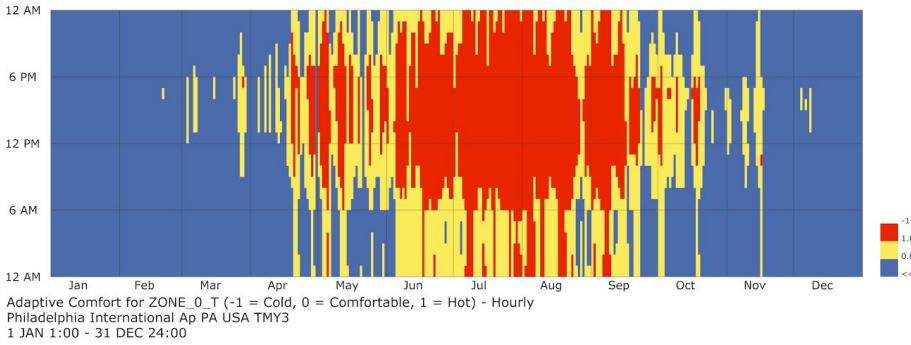
Comfortable (%): 21.14
hot (%): 23.14
cold (%): 55.72

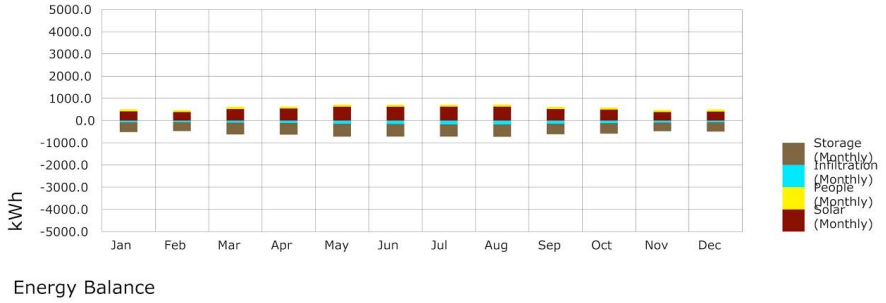
Step 13 = 21.37% (+0.23)

Orientation - 0º
Shading - 0.80 depth (x6)
Wall R - 34.40
Window R - 0.17
Window SHGC - 0.39
Roof R - 34.40
Air Change Rate - 0.40
*Thermal Massing - Regular concrete slab + 8” Concrete**

*Adding the first extra 4” of concrete seems to have a more effective ratio of mass to comfort achieved than adding double that amount.







Energy Balance

Comfortable (%): 21.37
hot (%): 22.82
cold (%): 55.81