Thermal Comfort in a Simple Room

Building Performance Simulation

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Assignment 7

Trial and Error

The purpose is to find the most percentage of comfortable hours in a simple room trying to change different parameters like window scale, construction, air change and material and rotation of the room. The approach was to start to play one by one with these factors and see what changes will happen.

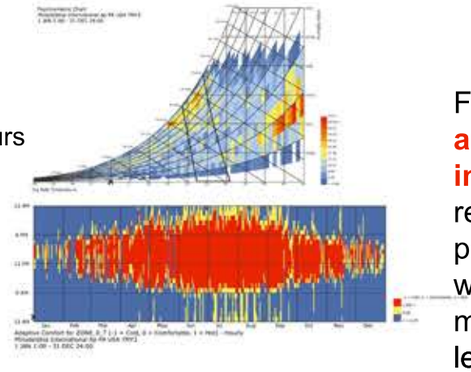
First Step: changing window scale and wall to winodw ratio, **west and east windows were omitted**. The expectation was that omitting window would reduce solar gain and percent of hot hours would be reduced, also air exchange and infilteration would probably be reduced so cold hours would also be less. The final result is reaching 15 % comfortable.

Window is changed into just south window and the ratio reduced from 0.7 to 0.5 and then to 0.2. And the percentage became First percentage of comfortable hours increased to about 16-17 % and then increasd a littile bit firther. The obvious reason was when winodw ratio is becoming lower, solar gain will be reduced to a great deal and percentage of hot hours would be low.

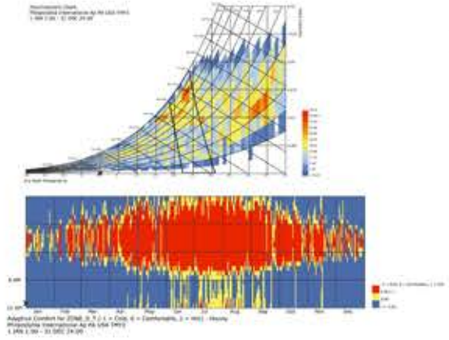
In the next step, I tried to **change R values for wall and window** and the result is shown for each change. The expectation is that as R values increases the temoerature loss would be less and air would be more trapped into the room. Expectedly, comfortable hours would be increased. Although for window it did not follow that trend. The problem was that percent of cold hours would increase when windows are have more R value.

Percentage of Comfortable Hours
in
Base Model

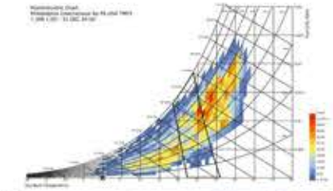
Comfortable (%): 12.82
hot (%): 33.88
cold (%): 53.3



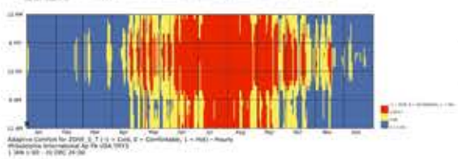
Comfortable (%): 15.9
hot (%): 33.09
cold (%): 51.0



Comfortable (%): 16.77
hot (%): 31.88
cold (%): 51.35



Comfortable (%): 17.11
hot (%): 27.82
cold (%): 55.07



High R for roof added

Comfortable (%): 21.36
hot (%): 28.2
cold (%): 50.45

High R for Exterior Walls

Comfortable (%): 23.44
hot (%): 32.35
cold (%): 44.21

High R value for Window

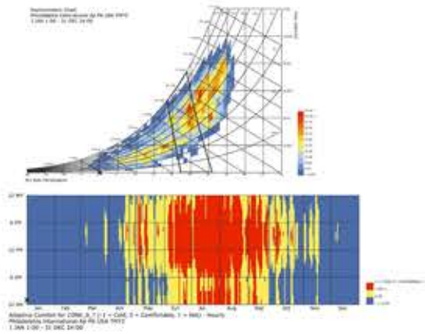
Comfortable (%): 21.78
hot (%): 30.71
cold (%): 47.51

For the next step, **thermal mass is changed and the concrete thickness increased to 8 inch**. The percentage of comfortable hours reached about 23.5 which is pretty good compared to base model. The expectation is when ticker materials are used, the walls are more insulated and air infilteration would be less.

Comfortable (%): 23.57
hot (%): 30.42
cold (%): 46.0

As mentioned before, increasing R value for window would be resulted into lower percentage of comfortable hours, so here **R value for window reduced** to increase solar gain and consequesntly thermal comfort.

Comfortable (%): 24.51
hot (%): 22.67
cold (%): 52.82

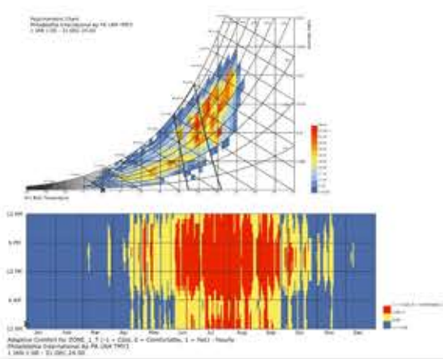


As for the next parameter, I **added blinds to the model** to control the solar gain so internal space would not be too hot and at the same time heat can come it and warm up the space. It seems that adding blinds would not be helpful with the specified condition. It would both increase the percent of hot and cold hours because it will make the room more isolated.

Comfortable (%): 17.57
hot (%): 27.03
cold (%): 55.4

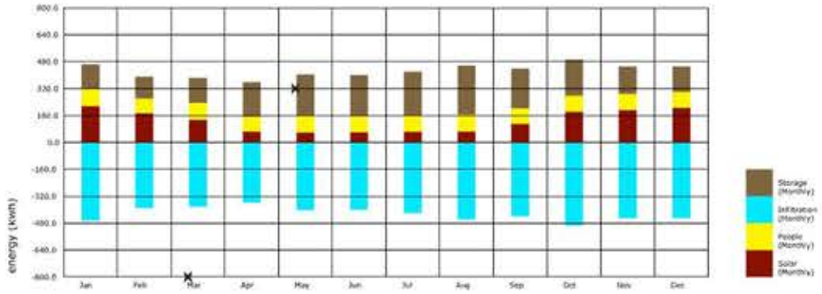
With regards to previous analysis, reducing blinds would be more helpful for increasing thermal comfort. As a result, here **blind's depth reduced to 0.3 meter and their amount reduced to 4**. The result is showing progress so the change was helpful. This way, the percentage of cold hours would remain the same while the percentage of hot hours would be reduced.

Comfortable (%): 25.3
hot (%): 21.8
cold (%): 52.9



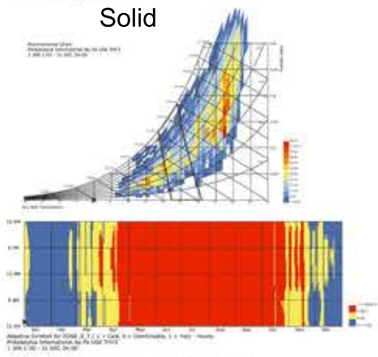
Finding the Highest Percentage

To find the highest percentage energy balance diagram was used to get the sense of problamatic oarameters. So as for the final model which had 25% of comfortable hours. It seems that the only thing which is causing the loss of energy is infilteration, so we should try to make the amount of infilteration lower. Because cold hours were way more problamatic than hot hours the focus is to reduce the percentage of cold hours.



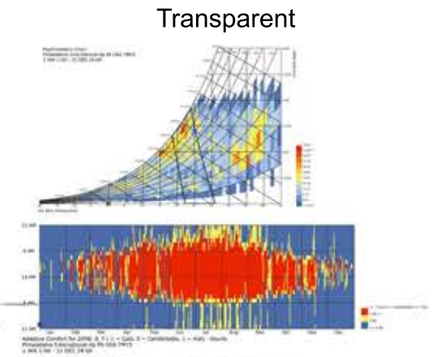
The other experiment that was tried was to make the room both **isolated and the reverse** of it as possible to see which results we may be faced and what would be the lowest percentage possible for both cold and hot hours. So the result is showing percentage of comfortable hours in solid room and transparent room.

Solid



Comfortable (%): 19.87
hot (%): 55.75
cold (%): 24.37

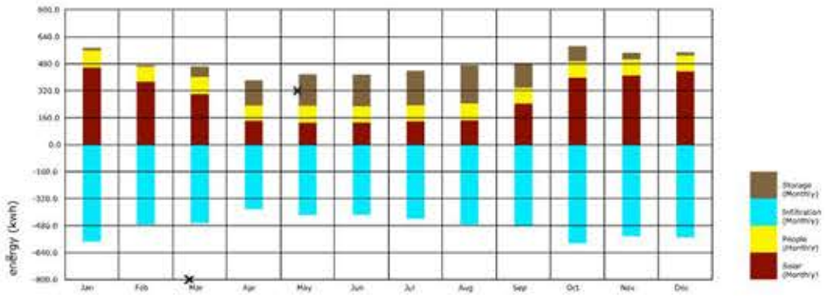
Transparent



Comfortable (%): 13.29
hot (%): 28.76
cold (%): 57.96

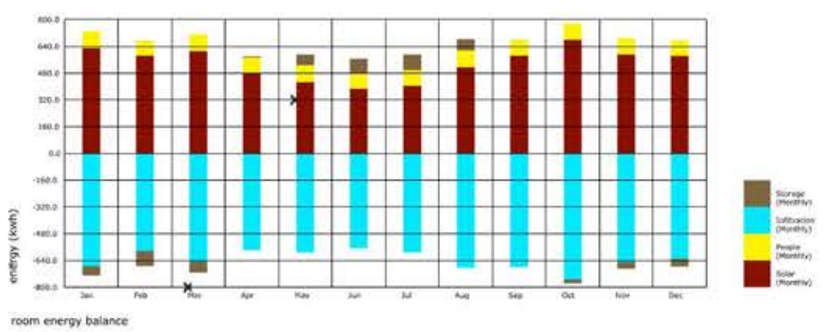
In this case, the **R value for window became the lowest possible**. As a result solar gain increased and percentage of cold hours reduced accodingly.

Comfortable (%): 25.89
hot (%): 25.19
cold (%): 48.92



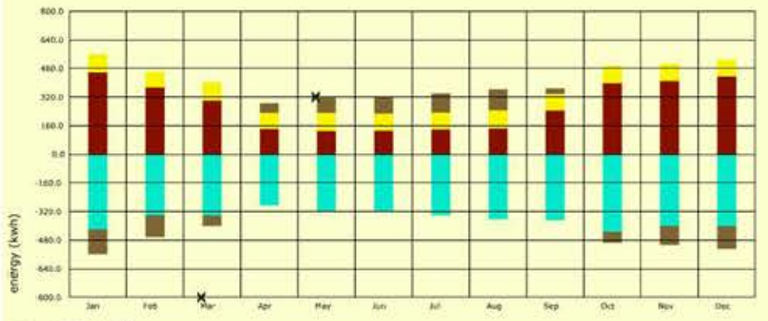
Playing with different parameters would allow us to see how these parameters are related to each other. So again I **omitted the blinds** after lowering the R value to get even more solar radiation to warm us the place. Although solar gain was more infilteration also became much more problamatic, so the result was not good. One conclution here is when we have same percentage of hot and cold hours stillthe comfortable hours percentage is not satisfying.

Comfortable (%): 23.05
hot (%): 38.73
cold (%): 38.22

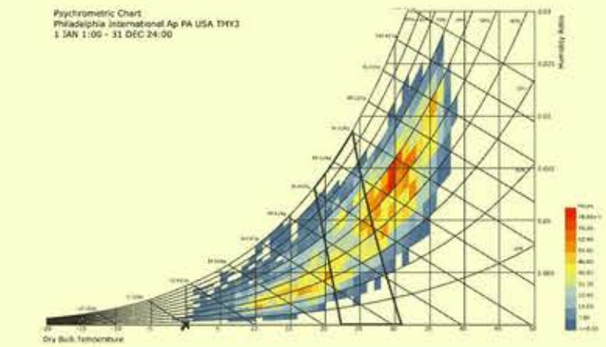


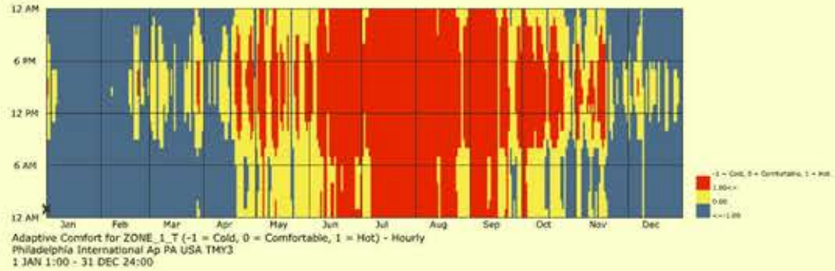
Finally, I **readded the blinds** to get the same percentage as the previous model and also as the only problem for cold hours was infilteration I **changed the air change hours from 2 to 1**. The result became pretty much satisfying. Almost 26 % of comfortable hours was achieved in which percentage of hot hours are rather similar to percentage of cold hours. Consequently, this can be a good pro-

comfortable.



room energy balance





Comfortable (%): 26.11
hot (%): 35.55
cold (%): 38.34