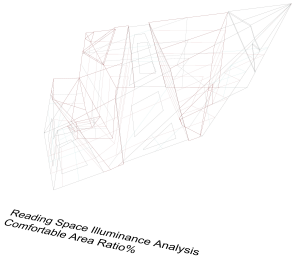
Parkside Library Glazing Optimums Report

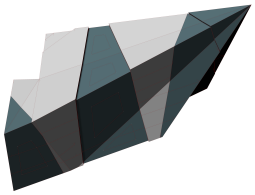
Weizhen Jia
632-003

I. Design Problem

The problem I am going to use Ladybug/Honeybee is a new library at East Parkside in Philadelphia. It is multi-functional and the core program is the Public library. It is an individual building that has 5 floors, containing stacks and reading space. At the two ends, there are glazing surface with multiple height space. In the middle, there is an atrium can also providing skylights and views out. Because of the functionality, the reading space requires the daylight within an certain amount. So that people could have a comfortable reading light condition and views out. However, how large the glazing area is properly? What's the best ratio of glass and wall? That is the key in the library nature light design.

Model as shown on the right.
(Blue part is the surface placing glazing)





II. Analytical Approach

For the glazing ratio problem, I need to realize that there are two conditions I don't want to happen:

> **1. Too dark** (no natural light): If I have a very small number of glazing ratio, there is very limited nature light can come through. It might providing sufficient light for the area that closing to the window. However, for the middle part of each floor, there will be a dark zone which have no nature light at all.
> **2. Too** bright (glaring): If I have too large glazing area, it can bring light to the deep side of the floor. But we know the reading needs no glaring, which is extremely harmful to eyes. There fore, too much light is also unwanted.

By analysis and solving the problem more precisely, I set up a minimum and maximum amount of luminance, which is 200lux~2000lux. Within that domain, I call it comfort zone. It is suitable for placing reading area. The more comfort area we have, the more reading area I can put. Here is how I evaluate the result:

> **Comfortable Area Ratio(%)=Comfort Area / Total Floor Area**

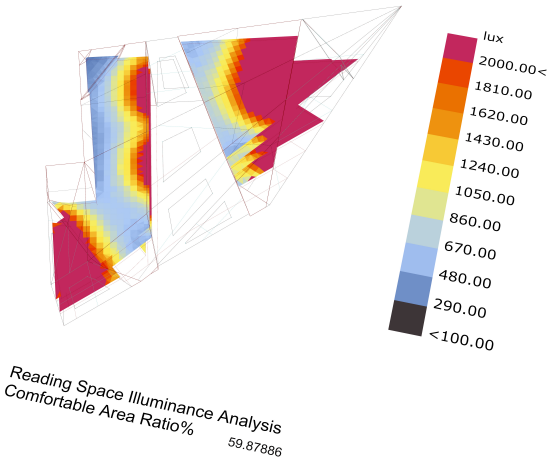
The large ratio I get, the result is better.

III. Data Visualization

By setting up the Ladybug/Honeybee definition, I have 3 perimeters which are "Glazing Ratio", "Dates of The Year" and "Time of The Day".

Glazing Ratio: 50%~90%
Dates of The Year: June 21th, Sep 21th, Dec 21th
Time of The Day: 9AM~5PM

For example:



In the graphic above, it is one visualized results at June 21th, 9AM, glazing ratio is 50%.

IV. Data Table

After calculating all the possibility, there are 135 results

June 21th

	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm
50%	59.9	62.8	66.5	71.1	74.6	72.7	69.8	70.0	71.2
60%	53.8	60.2	64.9	68.4	73.9	71.5	68.0	69.0	73.4
70%	46.4	52.6	56.5	63.4	69.9	68.0	63.9	66.2	73.1
80%	37.0	44.5	49.4	57.5	63.3	63.7	58.9	61.9	71.1
90%	30.3	36.9	44.0	52.9	56.3	58.2	53.6	57.4	68.1

Sep 21th

	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm
50%	46.6	63.9	55.6	65.4	64.3	59.8	61.6	57.5	45.2
60%	52.1	62.4	60.8	65.8	64.0	61.5	63.1	63.1	50.9
70%	56.9	58.1	65.1	65.7	62.5	62.2	63.7	65.5	56.5
80%	61.4	53.5	64.8	64.1	58.1	59.5	61.4	64.6	62.7
90%	64.3	48.4	65.0	61.4	53.6	56.4	57.4	64.1	66.7

Dec 21th

	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	AVE	
50%	37.1	64.9	69.5	48.3	61.3	56.2	51.3	43.4	0.00	57.6	
60%	42.0	69.6	71.8	53.6	65.5	62.4	57.7	47.4	0.00	59.9	←
70%	46.8	69.3	70.1	58.7	66.7	63.2	64.2	52.2	0.00	59.5	
80%	50.9	65.9	65.9	64.3	65.4	62.2	67.2	57.5	0.00	57.7	
90%	56.4	62.0	60.5	65.7	61.4	59.8	67.2	61.8	0.00	55.2	

For each row, i get a average comfort ratio through out the whole year. The number represents that for the certain ratio of glazing, it has the best comfortable zone ratio.

V. Design Explorer

Design Explorer links: http://tt-acm.github.io/DesignExplorer/?GFOLDER=0BynsWj59BPhwOWhTRlJyd2oydWc

VI. Conclusion

By calculate the 135 result, I have the optimum glazing ratio, which is 60%. And the average comfortable area is 59.9% of total area in the whole year. For the glazing design problem I described, and set 200lux~2000lux as the critical numbers for the evaluation, **60% is the best ratio**. Less could be dark and more could be glaring.