FINAL REPORT

CLASS: ARCH632003 PerformanceBased Computational Design
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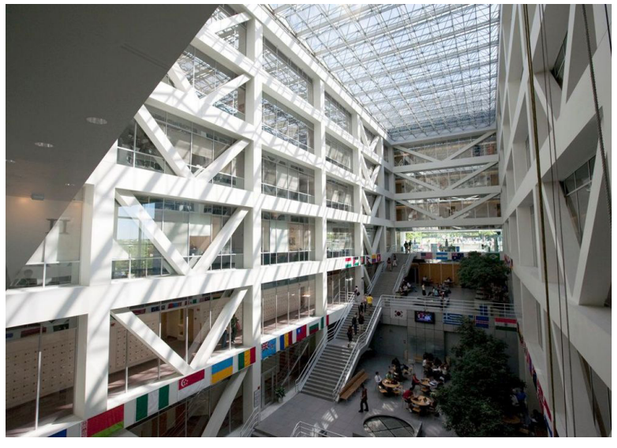
Part 1: Design Problem



Relationship between shape of atrium and buiding preformance

In architecture, an atrium is a large open air or skylight covered space surrounded by a building. It can provide light and ventilation to the interior and can give people a feeling of space and light. Designer enjoy the opportunity to create new types of spaces in buildings, and developers see atrium as prestigious amenities that can increase commercial value and appeal. (Wikipedia)

What is the best shape of a lighting atrium in a building in terms of thermal comfort, CFD analysis and daylight factor?

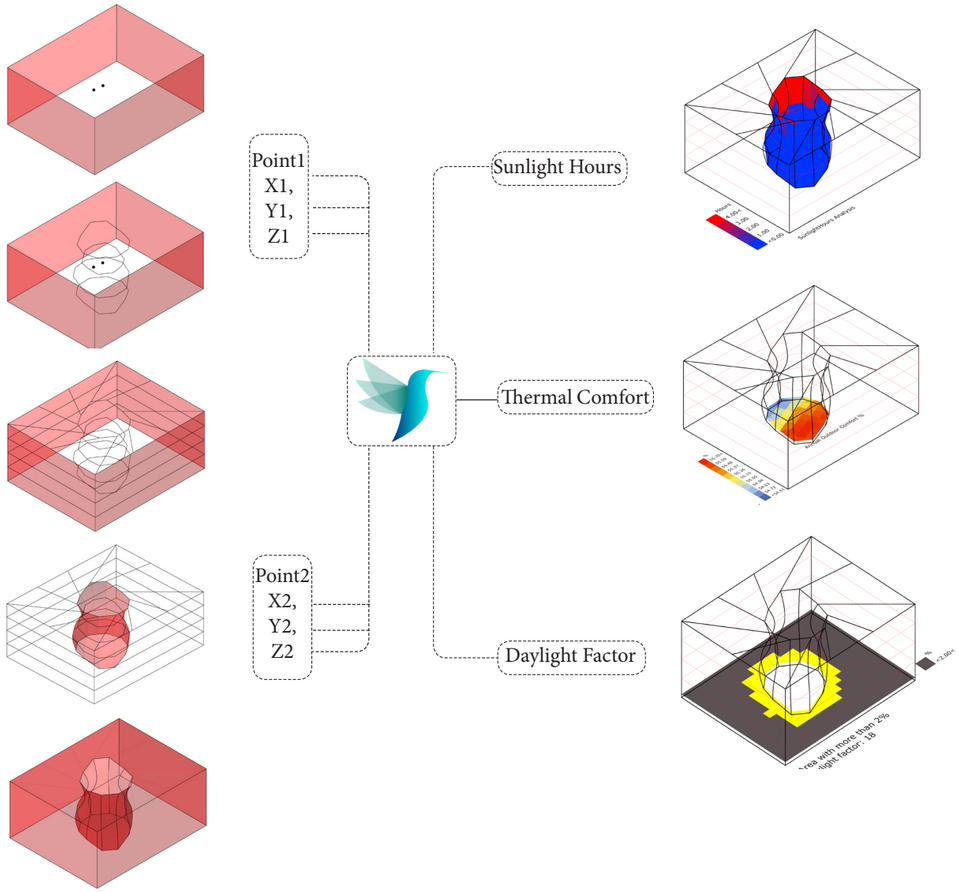
Lighting atrium is an important element in building. What we try to do is defining the shape and analyzing relevant factors, which are helpful to make decision. Considering the different preferences or demands, we can find the best choice by comparing the factors.

By using Grasshopper, Ladybug, Honeybee, Butterfly, Colibri, large quantities of scienarioes have been recorded, which is meaningful to desingers as well as customers to build the best shape.

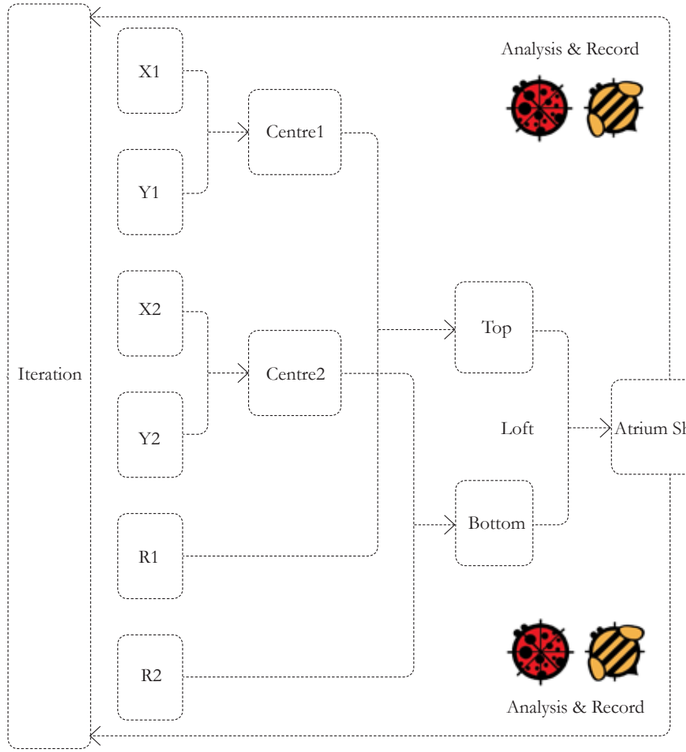
Tools we use:

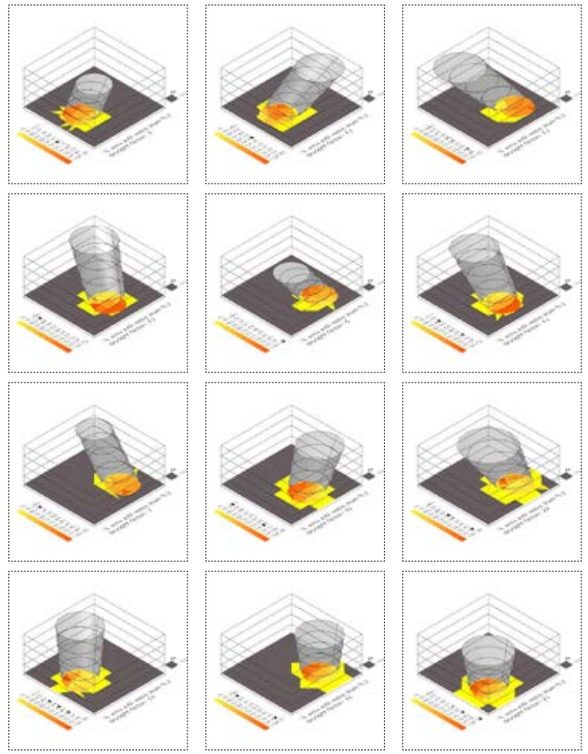
Part 2: Analytical Approach

1. At first stage, we start with 2 points, which have 6 parameters in total to generate the shape of atrium.

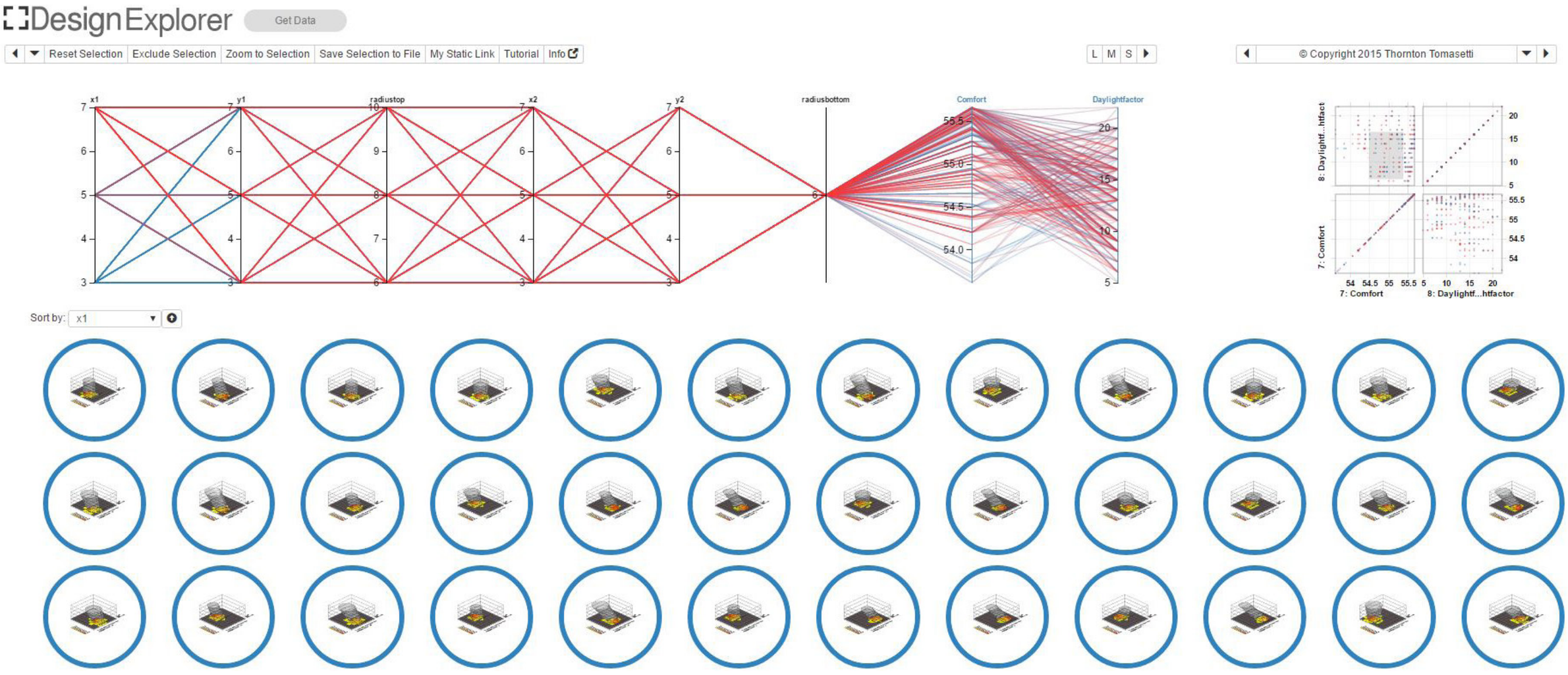


2. At second stage, we changed our parameters, and control the top and bottom shape of atrium, using Colibri to collect data. Then we done the analysis on how the shape can impact thermal comfort and daylight factor.





3.We use Design Explorer to analysis our data, trying to find the relationship between shape of atrium and thermal comfort within the atrium and dalight factor in the building.

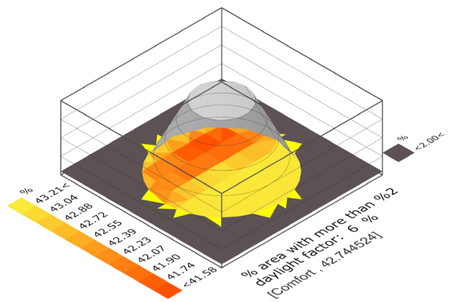


Part 3: Prototype Analysis

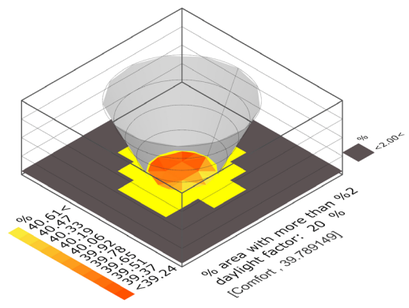
From the last stage, we realized that there is no “best shape” of atrium, the best choice of atrium is different, depening on different design demand. So we tried to do prototype analysis in four different places.

MINNEAPOLIS

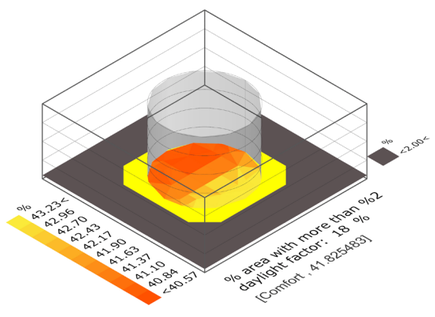
Daylight factor: 6%
Comfort:42.7



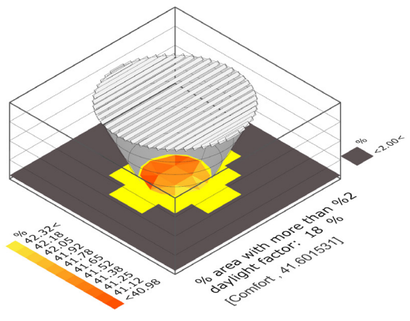
Daylight factor: 20%
Comfort:39.8



Daylight factor: 18%
Comfort:41.8

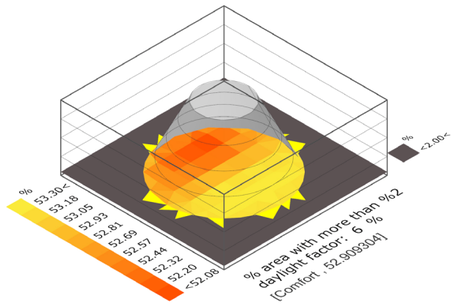


Daylight factor: 18%
Comfort:41.6

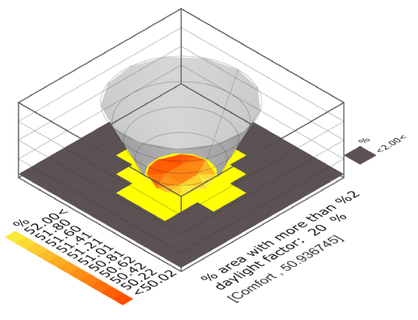


NEW ORLEANS

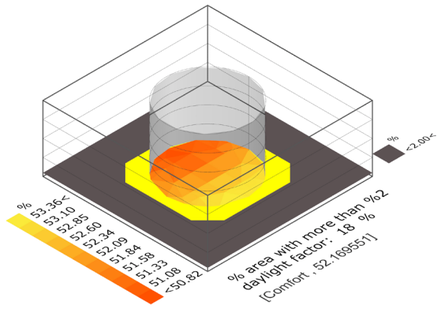
Daylight factor: 6%
Comfort:52.9



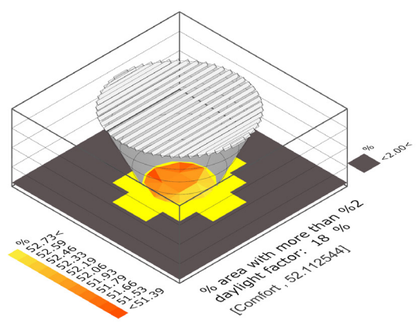
Daylight factor: 20%
Comfort:50.9



Daylight factor: 18%
Comfort:52.2

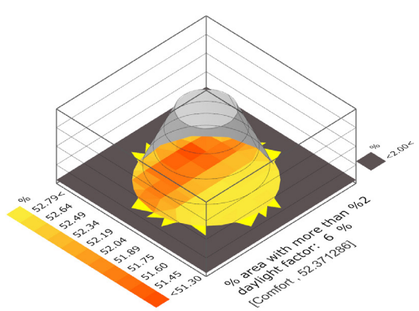


Daylight factor: 18%
Comfort:52.1

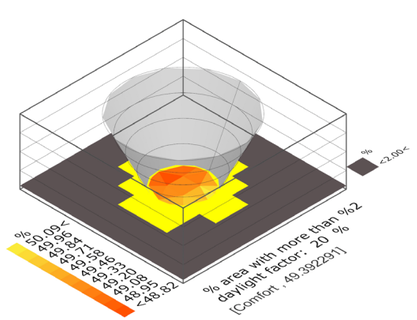


PHILADELPHIA

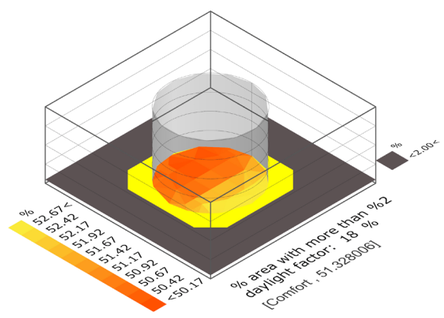
Daylight factor: 6%
Comfort:52.4



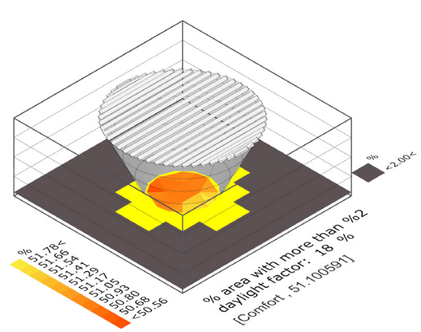
Daylight factor: 20%
Comfort:49.4



Daylight factor: 18%
Comfort:51.3

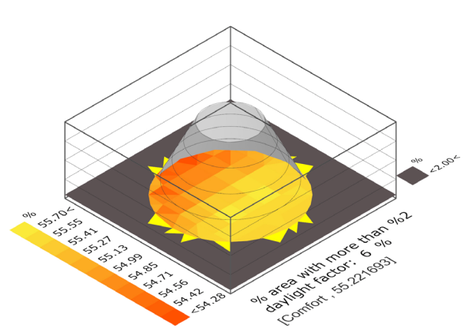


Daylight factor: 18%
Comfort:51.1

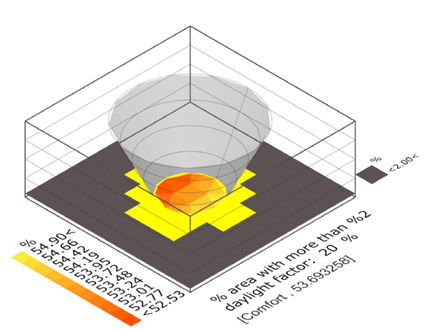


PHOENIX

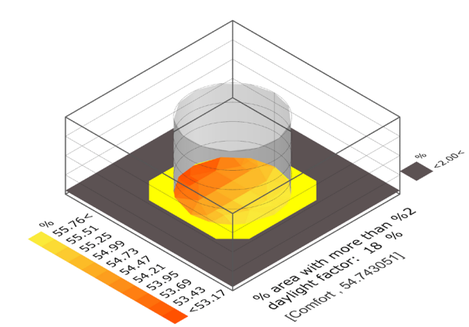
Daylight factor: 6%
Comfort:55.2



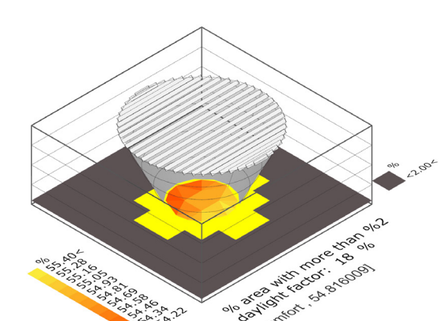
Daylight factor: 20%
Comfort:53.7



Daylight factor: 18%
Comfort:54.7



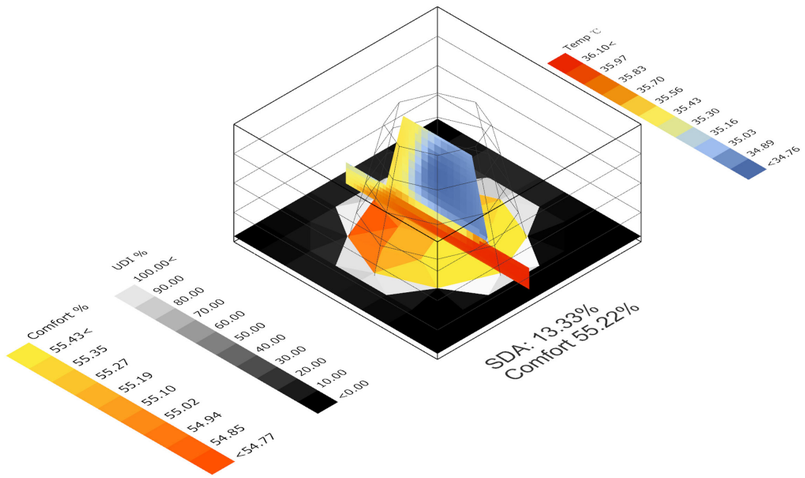
Daylight factor: 18%
Comfort:54.8



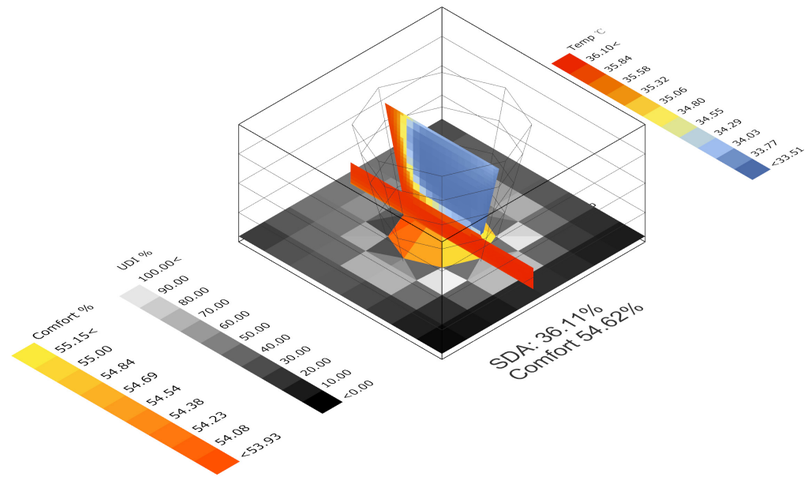
Finally, we use the four prototype in Phoenix to do deeply analysis. We simulated thermal comfort, visual comfort, and natural ventilation in the four types of atrium. In this way, designer can get different prototypes and their performance data, then they can choose which type to use in their design based on different factor.

PHOENIX

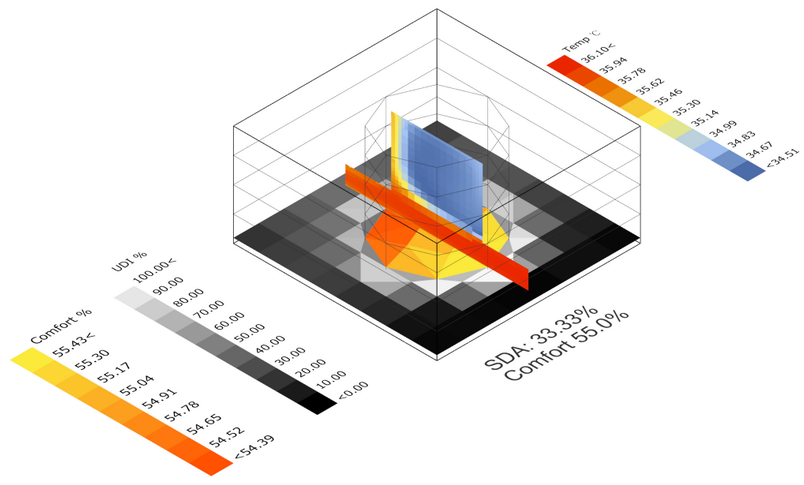
SDA: 13.33%
Comfort:55.22%



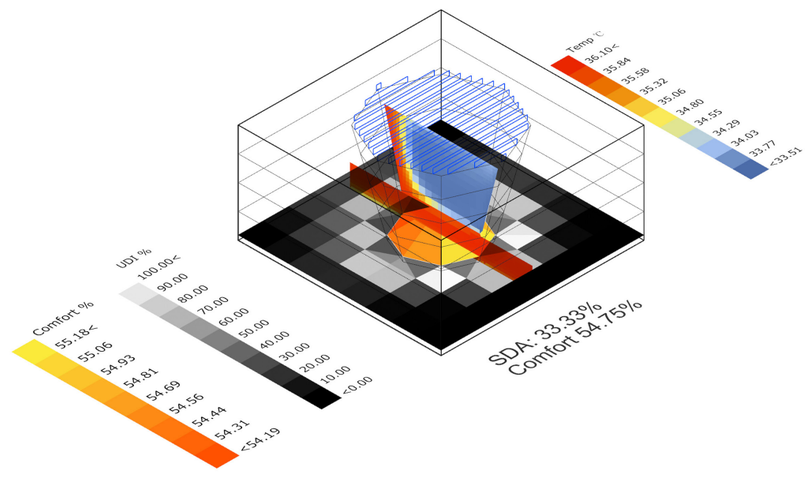
SDA: 36.11%
Comfort:54.62%



SDA: 33.33%
Comfort:55.0%



SDA: 33.33%
Comfort:54.75%



Calculate the temperature on each surface of atrium

Measure the air speed and wind direction

Get natural ventilation visual data

Get Comfort and Daylight factor visual data

Designer choose from prototypes based on porformance

We also make our efforts to create a frinedly interface by HUMAN UI, as to provide an easy access to architects who can make a wise decision between different design conditions.
This is the interface we are trying to achieve in our design. Although some part is not fixed yet, we will keep trying.