

# RENTON HIGHLANDS LIBRARY

## DAYLIGHTING ANALYSIS

Department of Architecture  
 Portland State University  
 Sergio Palleroni, Prof.  
 Huafen Hu, Prof.  
 Ben Dienes, GTA  
 Vanessa Vanderhoof, Grad Student  
 Angela Cutright, Grad Student  
 In coordination with THA Architecture

### ABSTRACT

It is common knowledge that natural light is better for the built environment and occupying such environments. It also is important to note that society spends the better part of their lives in structures or buildings; these spaces have a hand in our daily experiences. Not only do people benefit from natural lighting, physically and mentally, but daylighting systems can also lower dependency on electricity, lowering the usability and lifetime costs of a structure. There is also a chance for creating too much daylight, bright surfaces and areas can hinder the occupants and some spaces do not need daylighting. It is here that we see how important it is to study daylighting, analyzing and testing its effects throughout the design process. Understanding the daylighting systems of a building may lead to the architect determining the orientation of a building on the site as well as location of program and openings within the building in connection to orientation and lighting privileges. The analysis and study of daylighting is key as early as the schematic design phase as the development of spaces and the lighting needs, in amount and quality, begin to take shape and can effect the overall design scheme.



Figure 1 - Models of exterior and interior of Renton Library project

### THE PROJECT

The Renton Highlands Library project is a small community library located in Renton, WA, in a residential and commercial area. Adjacent to the building is a future project, an approximate 6 story tall housing development. The overall scheme of the building is relatively simple; a single story building broken up into 3 parts with 2 flanking functional portions with a large reading room at the center. The reading room is the focus, a two story tall space with large floor to ceiling glazing on either end, partially shaded with exterior screens. Skylights have been incorporated to the ceiling to maximize daylighting into the space along with a thin wooden screen to help diffuse light and add aesthetic. The overall space is bright, consisting of mostly white surfaces.

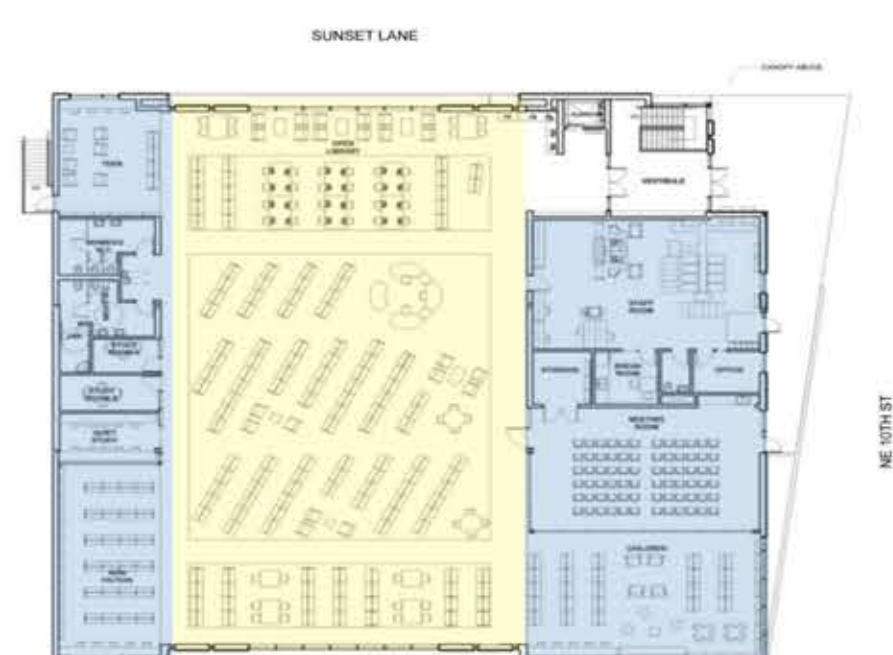


Figure 2 - Floor plan of Renton Library Project. Focus area is the yellow central zone.

### PROCESS

To test the daylighting for the Renton Library we used the firm's Revit model and plugged it into Rhino, using the DIVA plug-in to test the daylighting. We assigned materials and transmittance or reflectivity to all of the crucial surfaces in the main space and calculated the proper settings to simulate the site of the project.

We began the tests with the current design layout of the skylights, then ran several more iterations with different skylight arrangements, one with larger skylights and another with a different pattern. For each test, we ran simulations of each solstice and each equinox and three times of day when the space would be occupied.

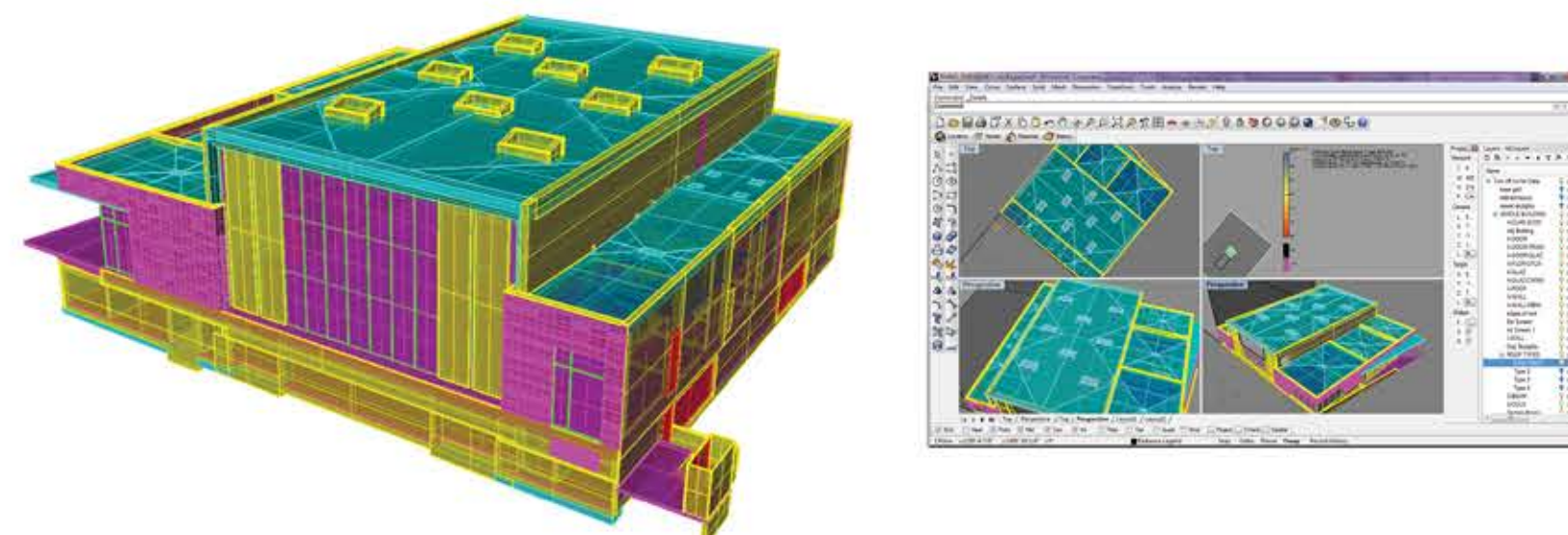


Figure 3 - Revit Models in Rhino with DIVA plug in.

### DATA

The majority of the results from the daylighting program came as no surprise to the designers for the most part. The ends of the building, which had floor to ceiling glazing, were bright, but were considerably helped out by the 50% transmittance exterior screen, lowering the daylighting levels to appropriate standards. The skylights created patterns of bright light throughout the floor of the main space, mimicking the shape and size of the skylights. The spots though were pushing the comfortability levels of the 50-200FC standards, running in the areas of 500FC in summer months. As well as the skylights created high areas of contrast; the areas around the skylights were not well lit as there was not much overflow from the skylights. Areas of high contrast can be an issue, especially when the main activity of the space includes reading.

The secondary studies of the skylights drew several conclusions. As we rearranged the skylights and played with the sizing, we kept running into the issue of high contrast and 'hot-spots' of light in the areas of the skylights.

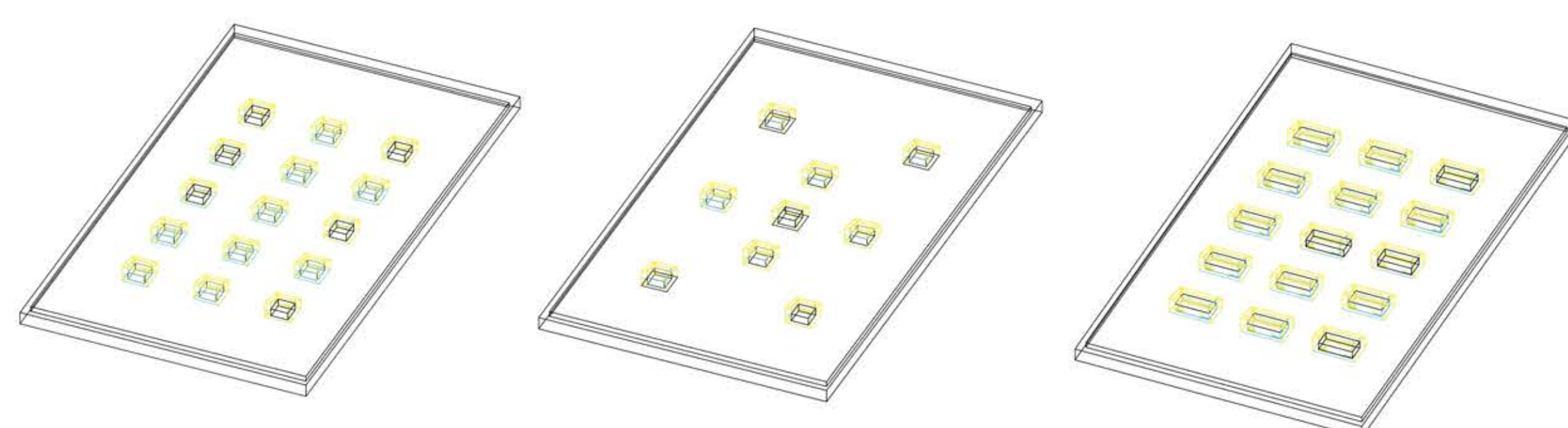


Figure 4 - Three different iterations of skylights. The hope was that the different organization might lead to more even daylighting in the space.

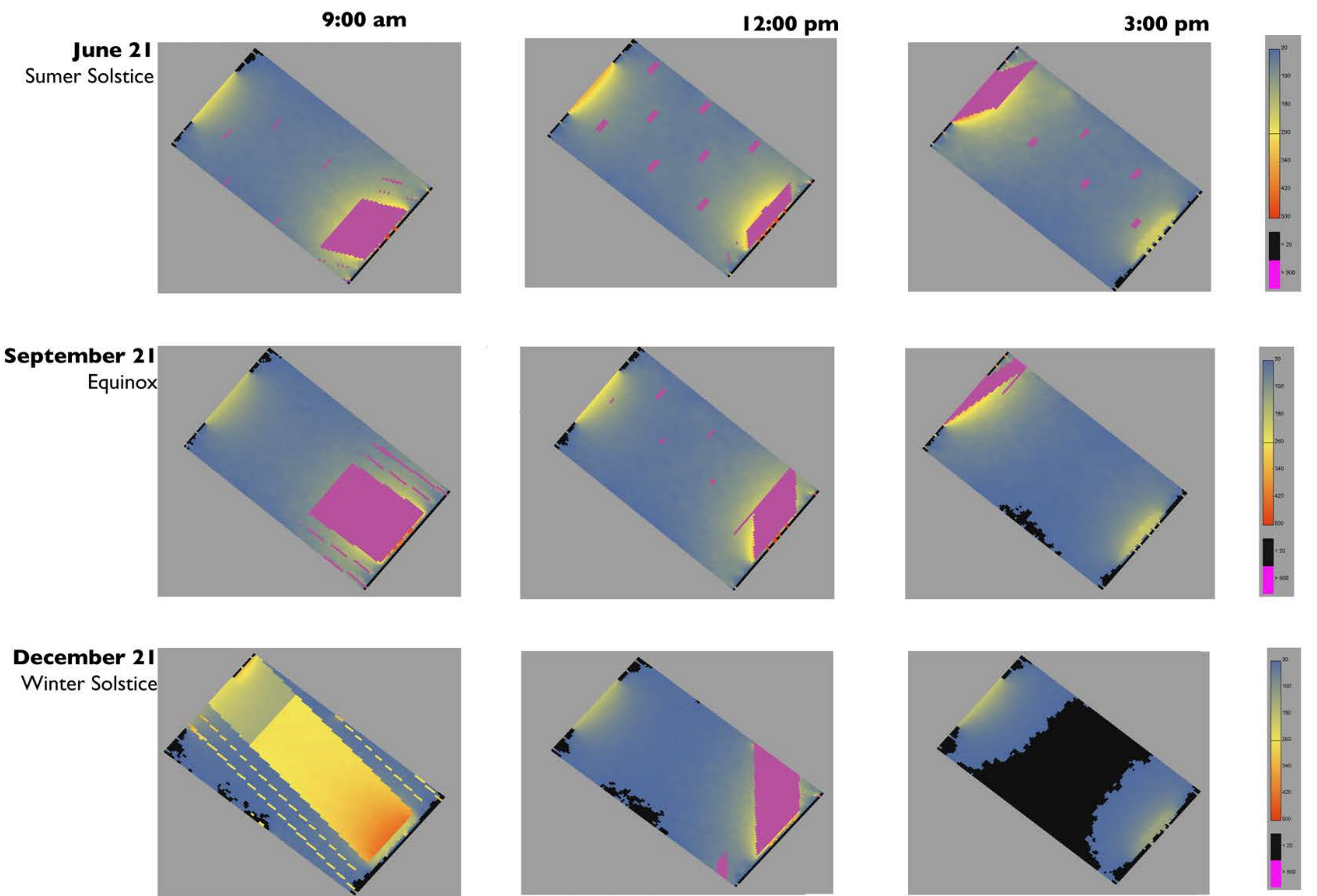


Figure 5 - Original skylight configuration daylighting tests. Measurements are all done in footcandles.

### CONCLUSION

The conclusions drawn from our tests pointed out that while skylights can be effective in bringing in daylight into spaces, other aspects must be considered to not create too much contrast between day lit areas and non-day-lit areas. The daylight from skylights needs to be altered in some sort of manner to help even out or disperse the daylight. These options include using more opaque window glazing to help diffuse the light as well as changing the opening shape of the skylight to give more surfaces for the light to bounce off of.

It is also important to note that had the DIVA analysis occurred sooner in the design process, more action could have occurred to alter the design in accordance with the findings.

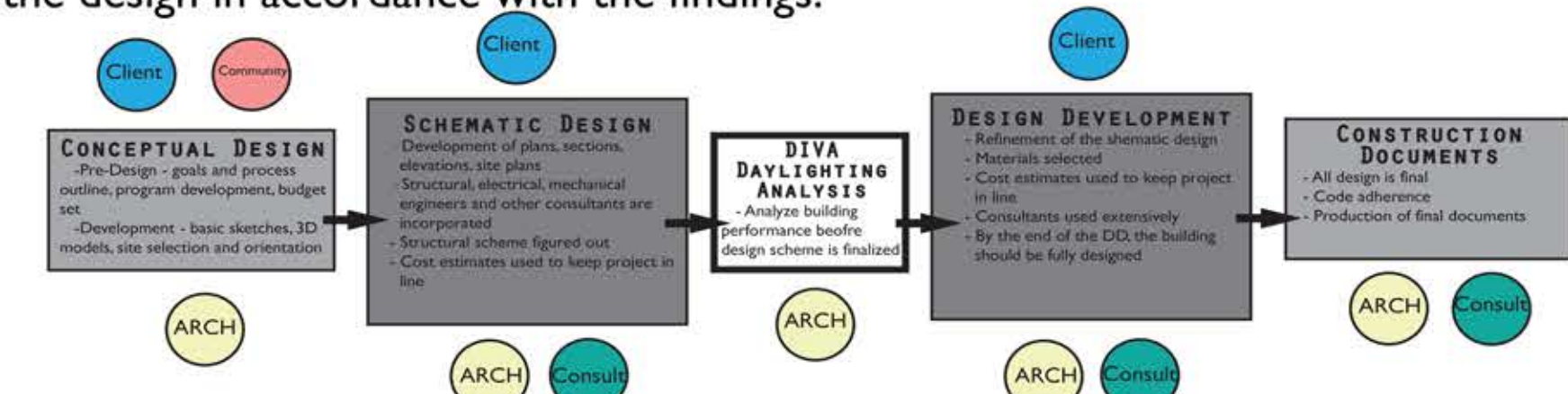


Figure 6 - Methodology diagram of the architectural design process. DIVA analysis would be useful if used before the design development phase to allow proper changes.