May 2nd, 11:00 AM - 1:00 PM

Daylighting Optimization Study: Rock Creek High School Commons Skylight Optimization

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Daylighting Optimization Study

Rock Creek High School Commons Skylight Optimization

**ABSTRACT**

The aim of this study is to optimize the shape of the skylight in order to enhance daylighting. Rhinoceros, Grasshopper, and Galapagos are the softwares utilized to test different shapes on top and bottom of the shaft of the skylight, and the findings show preference to those with beneficial impacts on Spatial daylight autonomy (sDA) of greater than 35% and Annual Solar Exposure (ASE) of less than 10%. Selecting metrics within the above parameters result in optimal skylight geometry with highest daylighting output. The initial purpose of the experiment was to optimize the design of the skylight shaft with the goal of providing the best distribution of daylight while minimizing potential for glare; however, it appears that this shaping may have negligible effects on how the skylight performs as long as the sDA is greater than 35%.

**Conclusion**

The results of the study confirmed the use of these various programs helped in making informed design decisions. In this study, Rhinoceros is used as the primary modeling environment. Ora simulates and analyzes the daylighting and Grasshopper is utilized to edit an algorithm that automates geometric parameters and simulation inputs according to preferable analysis results. Galapagos produced a multitude of configurations for skylight design and daylighting options. Applying these parameters to the design narrows the scope of options, and provide the user direction, viability and possibility. The results from the research and simulations aid in the process of creating volumetric design and an engaging daylighting typology that is aesthetically appealing. The softwares enable the room to easily attain an adequate sDA value, but made it difficult to achieve an acceptable ASE value since the ASE values would have been higher than 10%. The initial purpose of the experiment was to optimize the design of the skylight shaft with the goal of providing the best distribution of daylight while minimizing potential for glare; however, it appears that this shaping may have negligible effects on how the skylight performs as long as sDA is greater than 35%. Based on the findings, it was concluded to use other means such as tinted glass to reduce the percentage of ASE.

**Methodology Timeline**

- **Development**
- **Modeling**
- **Research**
- **Simulation**
- **Presentation**

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**Timeline**

- **Simulation Count**
  - 10
  - 20
  - 30
  - 40
  - 50
  - 60
  - 70
  - 80
  - 90
  - 100

**Software Tutorial**

- Grasshopper
- Ora

**Curtain Wall (West)**

- March 20
- Tutorial
- Met with Bora
- Presented sections of the proposed
- Altitude at 12:00 pm
- 2/23/18
- Galapagos simulations and data

**Curtain Wall (East)**

- June 21
- Tutorial
- Met with Nicholas and Rosemary
- Presented sections of the proposed
- Altitude at 12:00 pm
- 2/26/18

**Altitude at 12:00 pm**

- Summer Solstice: 21°
- Fall Equinox: 45°
- Winter Solstice: 93°
- Spring Equinox: 81°

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**Simulations**

- Top Opening Value
- Bottom Opening Value
- Resulting ASE %
- Simulation Count
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100

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**Exposure to Direct Sun**

- June 21
- Winter Solstice
- Fall Equinox
- Summer Solstice

**Exposure to Direct Sun**

- Holiday
- Tutorial
- Met with Bora
- Presented sections of the proposed
- Altitude at 12:00 pm

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**Occupancy:**

- Model Context
- Existing Commons
- • Objective: maximize sDA
- A percentage of regularly occupied floor area that receives 300 lux or shows preference to those with beneficial impacts on sDA and ASE.
- target: > 55%

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**Research and Design**

- Research paper
- Met with Bora
- Presented sections of the proposed
- Altitude at 12:00 pm