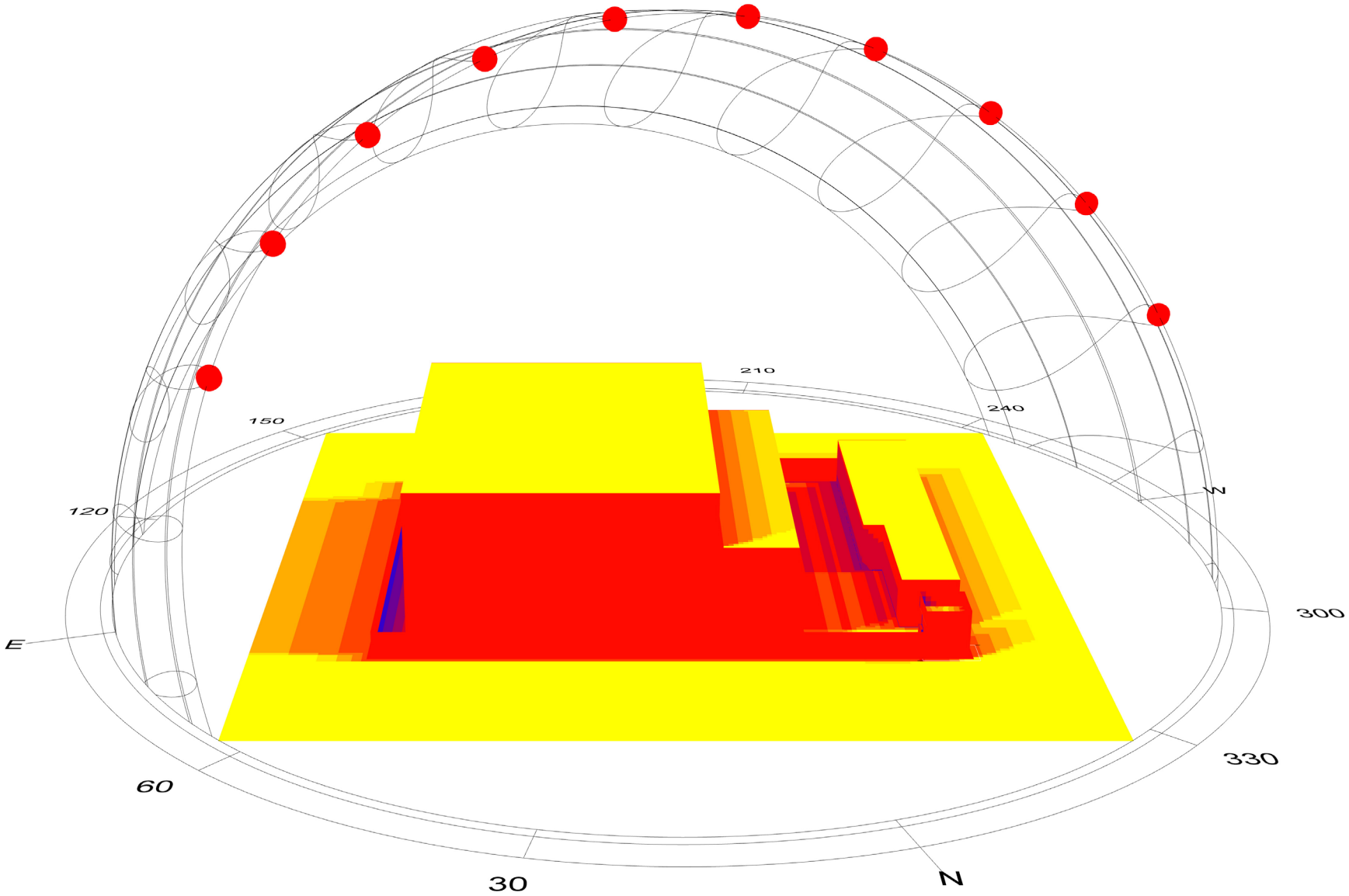


LEED V4 EQ Credit: Daylight

Compliance Documentation Last updated: 8th May 2019

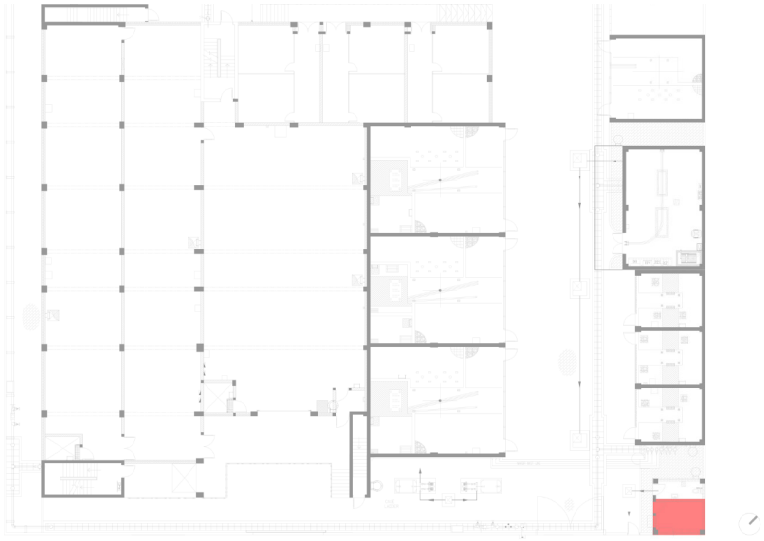
Introduction

Having daylight in space not only cuts back on the energy use for illumination but at the same time provides qualitative benefits such as; less absenteeism, contextual awareness, and aids the building occupants in maintaining their circadian rhythm. While daylight is good, excessive daylight creates condition of visual discomfort for the building occupants. Recognizing that fact, LEED expects the designs to demonstrate how they mitigate glare and achieve minimum daylight levels at the same time.

This project shows compliance via **option-2** in the EQ : Daylight credit. This route expects point in time illuminance analysis for 9 am and 3 pm on an equinox day. Brightest days within 15 days of both the equinoxes are found to be March 21st and September 26th. Following values were used to run point in time analysis for 9 am and 3 pm on an equinox day.

9 am Direct Normal Radiation	September 26th	715 wh/m2	
	March 21st	826 wh/m2	Average = 770.5 wh/m2
9 am Diffuse Horizontal Radiation	September 26th	155 wh/m2	Average = 133.5 wh/m2
	March 21st	112 wh/m2	
3 pm Direct Normal Radiation	September 26th	649 wh/m2	
	March 21st	821 wh/m2	Average = 735 wh/m2
3 pm Diffuse Horizontal Radiation	September 26th	137 wh/m2	Average = 121.5 wh/m2
	March 21st	106 wh/m2	

Key Plan



Security Room

Simulation Parameters

Visible Light Transmittance (VLT)

Glazing : 69%

Reflectance

Ceiling : 70%
Floor : 20%
Walls : 69%
Exterior context : 79%
Ground : 78%

Test Plane

Height : 0.76 meters above floor
Grid size : 0.1 x 0.1 meters

The reflectance values for the interior walls, the exterior context, and the finished ground, and finished ceiling are derived based on the RGB values of the color applied on the interior walls of the room, the exterior paint applied on the other buildings on the campus, and the color of the pavers, and the paint on the ceiling.

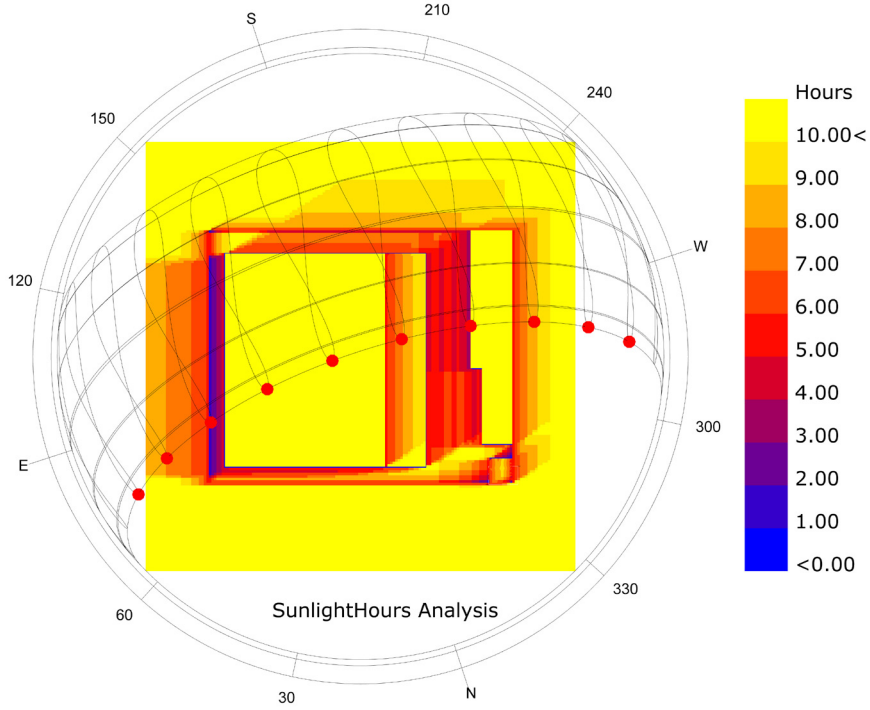
Interior finish		Exterior finish		Ground Finish		Ceiling Finish	
Red	182	Red	217	Red	214	Red	190
Green	177	Green	200	Green	195	Green	177
Blue	174	Blue	170	Blue	180	Blue	171

Following formula was used to derive reflectance values from the RGB values colors. Where, q is the average reflectance and s is specularity. In this case, specularity was considered to be 0.

$$q = (0.265R + 0.670G + 0.065B) * (1 - s) + s$$

The issue of potential glare is addressed by proposing manually adjustable interior opaque roll-able blinds. In the simulation it is assumed that the blinds will be lowered whenever the disability glare or intolerable glare is experienced.

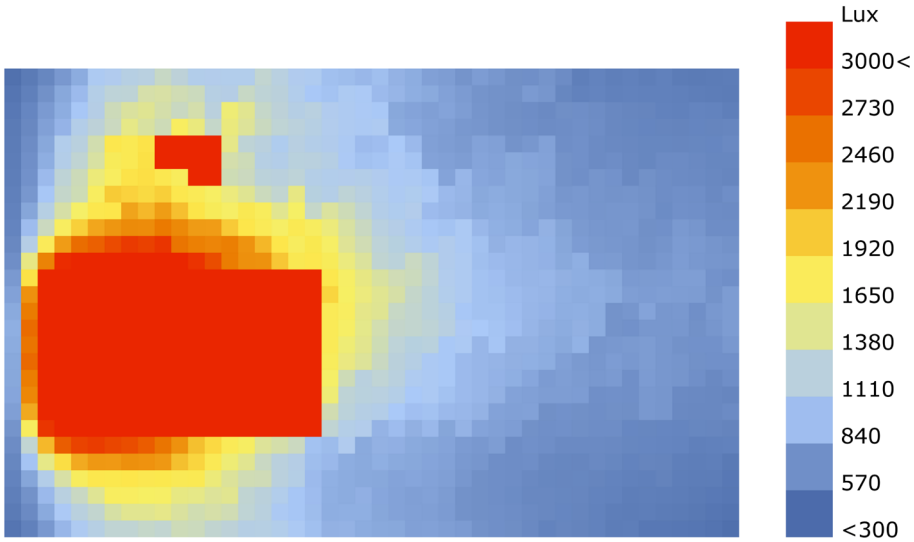
Geometry & Shadow Study



The two images above show shadow pattern at 4 pm on the summer solstice in the geometry development environment and Radiance. This check is performed to ensure geometry transfer and correct north orientation before performing any simulation.

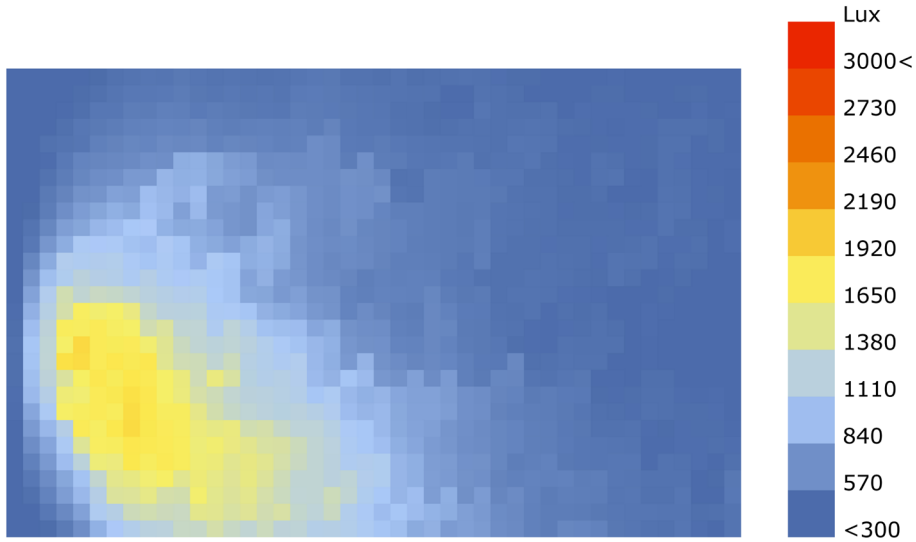
The image on the left show the shadow range for all the hours on the equinox. It is evident from the image that the neighboring buildings and the compound wall offer enough shade to the security room.

Illuminance at 9 am on Equinox



Illuminance

Illuminance at 3 pm on Equinox



Illuminance

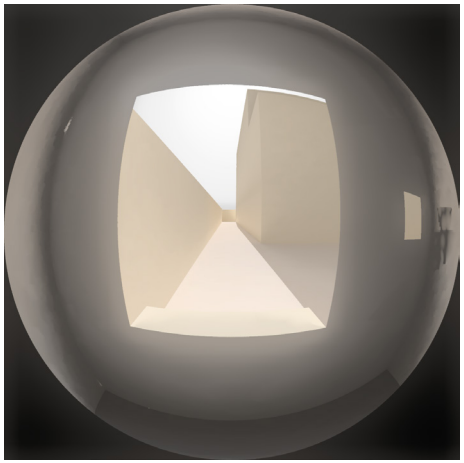
85% Area meets LEED criteria

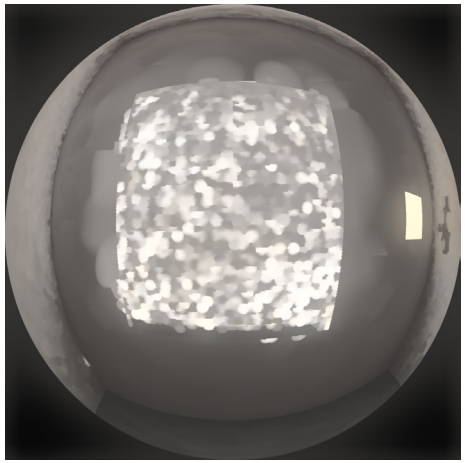
91% Area meets LEED criteria

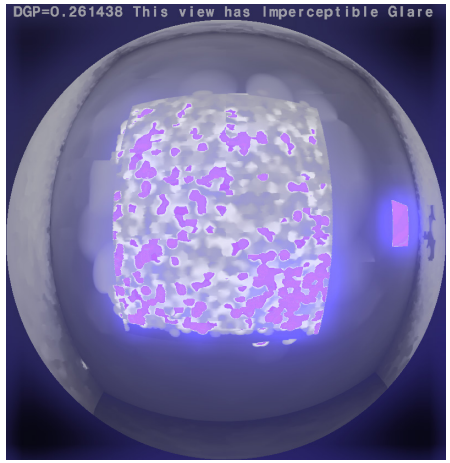
Glare Studies

9 am on 21st September

The first image show the view from the window. In this view, the probability of an occupant experiencing glare is **71%**. The other two images show the same view with the shades lowered. As anticipated, having the shade lowered reduces the probability of an occupant experiencing glare to **26%**.

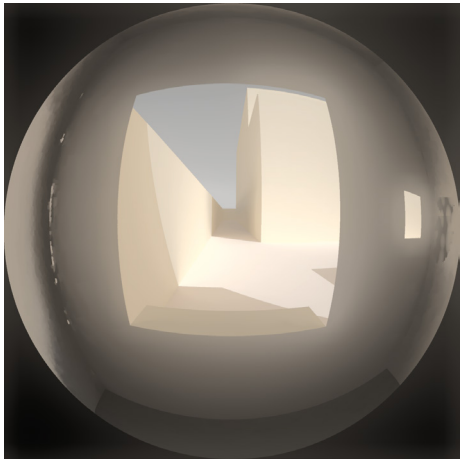


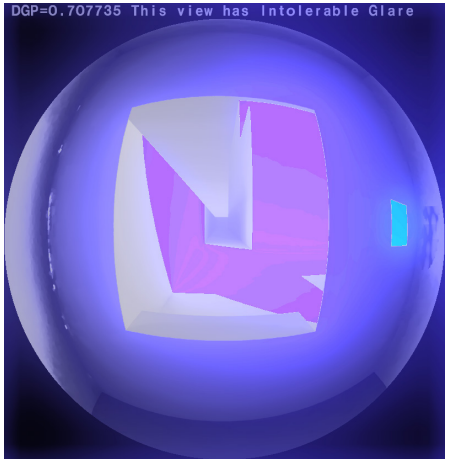


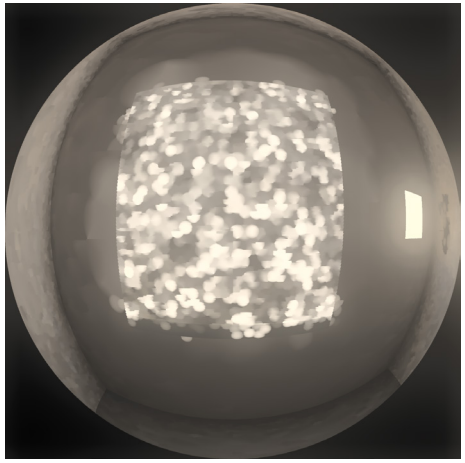


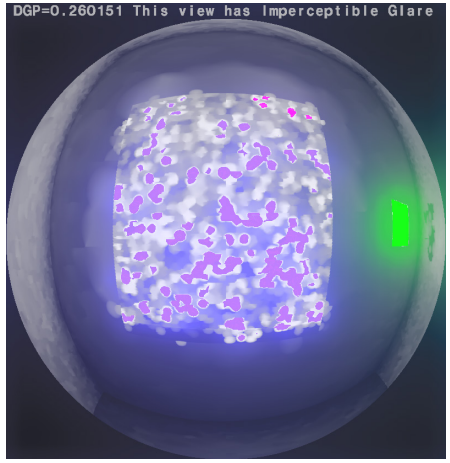
3 pm on 21st September

The first image show the view from the window. In this view, the probability of an occupant experiencing glare is **71%**. The other two images show the same view with the shades lowered. As anticipated, having the shade lowered reduces the probability of an occupant experiencing glare to **26%**.









Result & Summary

76% Area meets LEED criteria at both 9am and 3pm on Equinox

It is evident from looking at the sun path that the boundary wall near to the security cabin the existing substation building block a lot of suns. This helps in controlling excessive direct sunlight into the space. With about 13% of glazed area on the window and door hosting wall, at least **76%** percent of the floor area satisfies the option-2 requirements of receiving illuminance levels between 300 lux and 3000 lux at both 9am and 3pm on an equinox day. And hence, **1 point** is claimed under this credit.

Daylight glare probabilities for 9 am and 3 pm on an equinox day were evaluated. During both the times, the glare was found to of disturbing level. In all such cases, it is assumed that the interior blinds will be lowered by the occupant. Additional glare studies were performed to measure the effect of the blinds on the daylight glare probability. It was observed that lowering the blind can address glare and can bring down the daylight glare probability to imperceptible levels.