

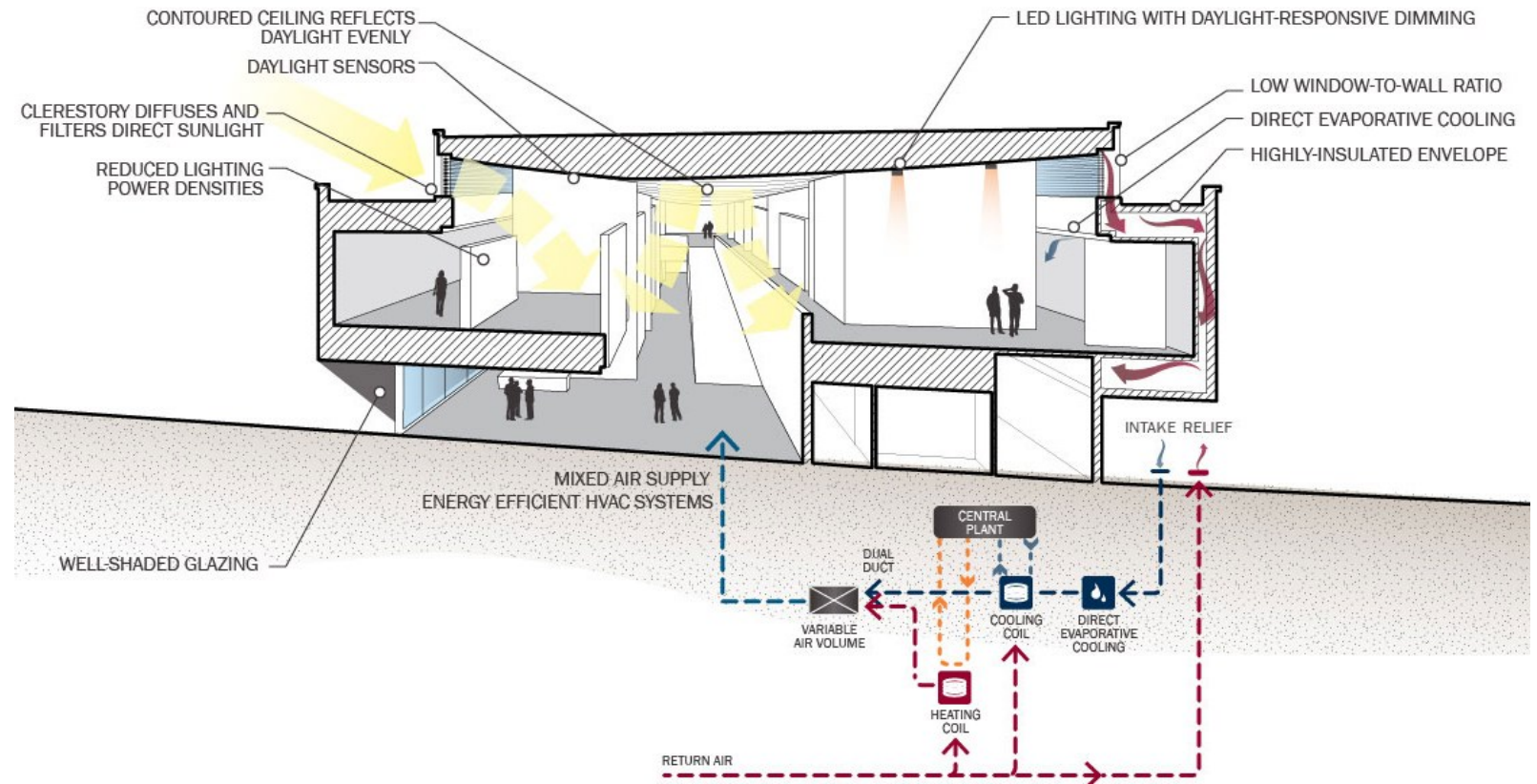
# What's Trending in Daylighting?

Seif Eses – Atelier Ten

September 1<sup>st</sup>, 2026

## Environmental Design

We guide the design towards innovative solutions for enhancing thermal and visual comfort, energy performance, water management, and other sustainability goals.



# Daylight at A10

## What does daylighting at A10 mean?

- To build an intuition for daylighting performance in building design.
- To optimize project design for use of daylight and solar resources.
- To design fenestration systems that are integrated in architectural design that enhance occupant experience.
- To create comfortable visual environments.
- To utilize daylight for delight, function, and evocation.
- To improve project energy performance.



# Most Common Questions of 2025/26

 r/AtelierTen

Is my projector bright enough for a projected image to be visible in a daylight space?

↑ 249    ↓ 57

 r/AtelierTen

What are the species of plantings that would work in our space given the available solar exposure?

↑ 400    ↓ 23

 Share

 r/AtelierTen

Is my projected image visible from the exterior of the building?

↑ 200    ↓ 10

 r/AtelierTen

How will this new development impact the plantings on our site?

↑ 500    ↓ 57

 Share

 r/AtelierTen

Will our neighbors be impacted by our building's bright lighting at n

↑ 100    ↓ 5

 r/AtelierTen

How can we improve sunlight access for s?

 Share

 r/AtelierTen

Are my current façade design and blind specifications enough to ensure my projected image's visibility?

↑ 300    ↓ 30

es of plantings we specified in our space get enough sunlight to survive?

↑ 500    ↓ 57

 Share

# Projected Light Visibility

**Most Common – LED Screen Visibility**

# LED Screen Visibility – NW Facing Classroom

Introduction



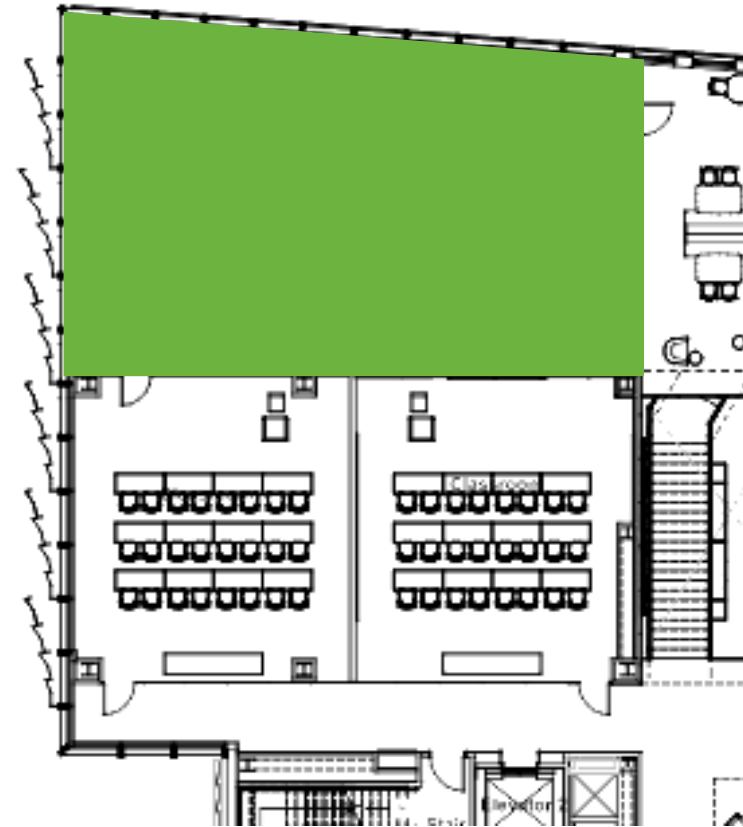
Is our facade shading system effective at improving LED screen visibility and visual comfort in this classroom?

## Study Overview

Atelier Ten studied direct sun exposure on the display screen in the northwest classroom to inform exterior shade screen perforation sizes.

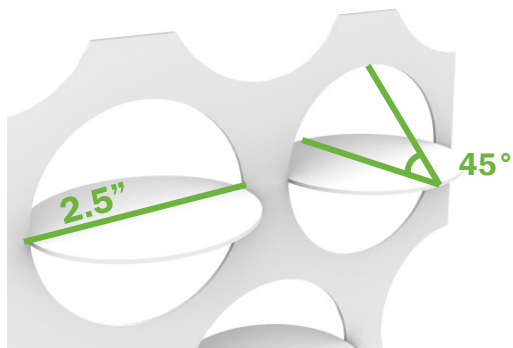
## Analysis Methodology

- Profile angle evaluation
- Luminance renderings with glow surface



# West Façade Perforated Shade Screen

## Current Design – 2.5” Openings

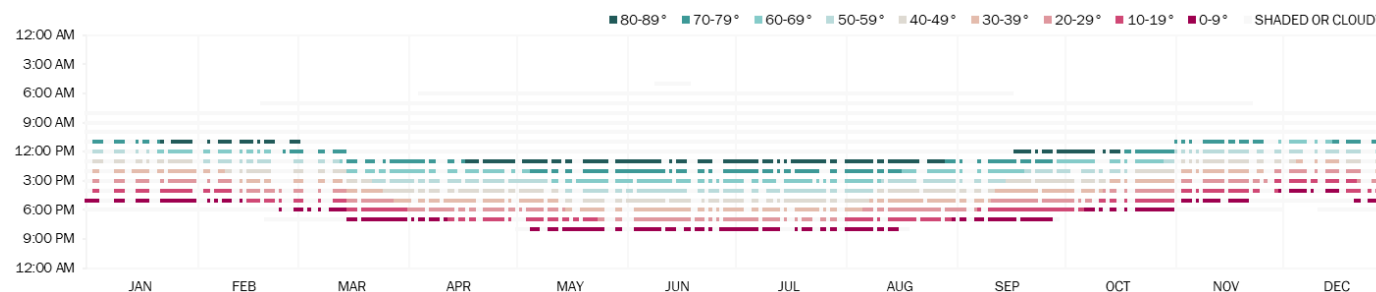


## Alternate Design – 1.5” Openings



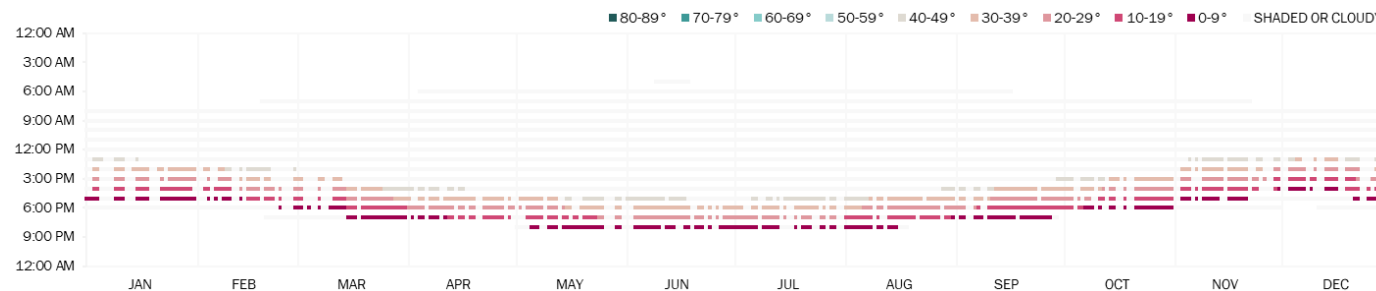
## West Façade – Unshaded

~1,900 hours of exposure



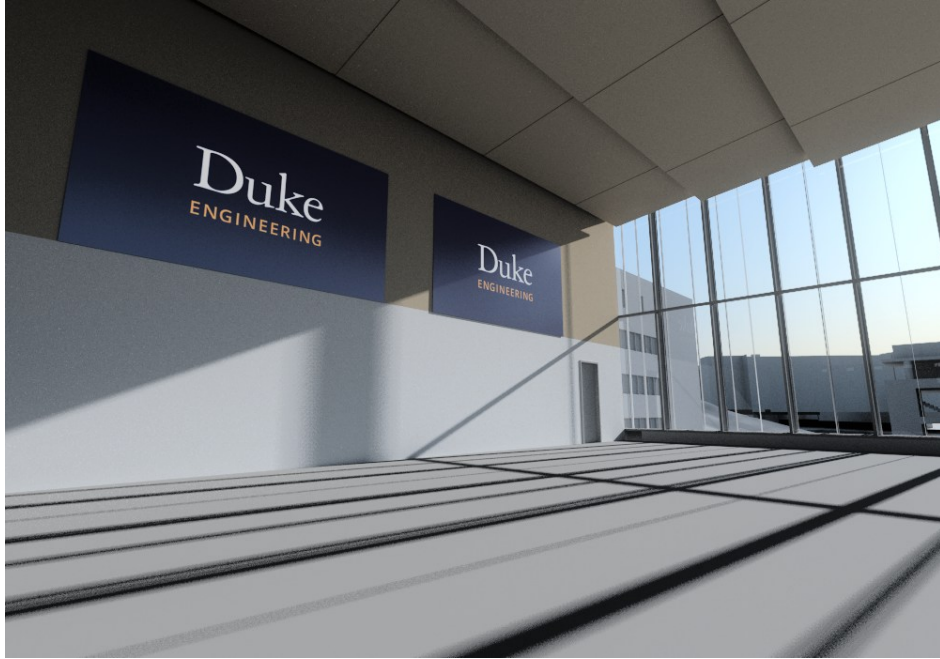
## West Façade – w/Screen

~1,000 hours of exposure – **45% Reduction**



# Northwest Classroom - Unshaded

Luminance Rendering @ March 21<sup>st</sup>, 4pm



Human Eye Perception

Screen Visibility ● ○ ○ ○ ○



False Color Rendering



Visual Comfort ● ○ ○ ○ ○

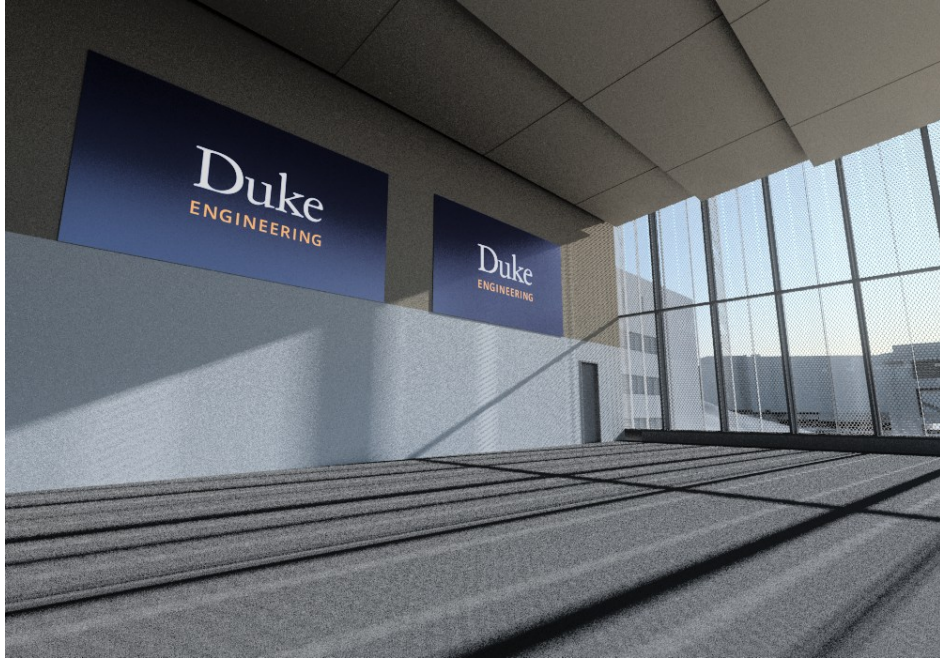
Unshaded, the northwest classroom receives direct solar exposure which creates visual contrast, increases visual discomfort risk, and decreases the visibility of screen brightness. Screen visibility is poor because of the direct sun exposure.



Image used for screen display

# Northwest Classroom – Shade Screen w/ 2.5” Diameter Perforations

Luminance Rendering @ March 21<sup>st</sup>, 4pm



Human Eye Perception

Screen Visibility ● ● ● ○ ○

When incorporating perforated exterior shade screens, sunlight is able to enter the classroom with reduced luminance contrast, and screen visibility improves.



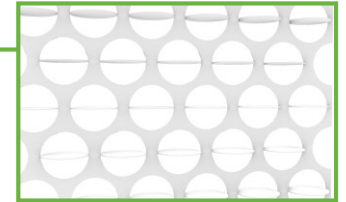
False Color Rendering



Visual Comfort ● ● ● ○ ○



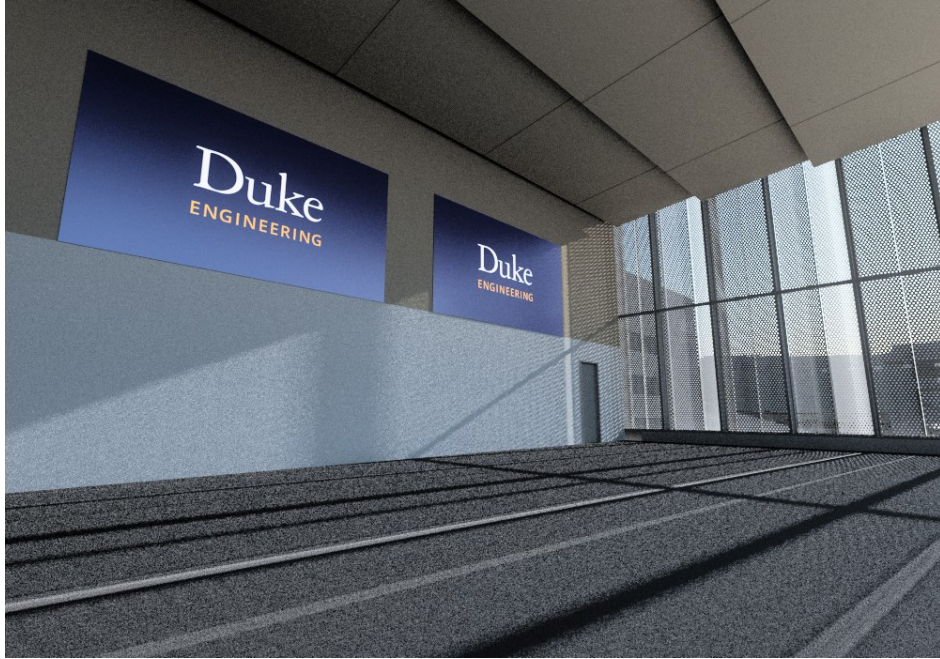
Image used for screen display



**2.5" Diameter Perforations**  
**46% Opaque**  
**54% Open**

# Northwest Classroom – Shade Screen w/ 1.5” Diameter Perforations

Luminance Rendering @ March 21<sup>st</sup>, 4pm



Human Eye Perception

Screen Visibility ● ● ● ● ○



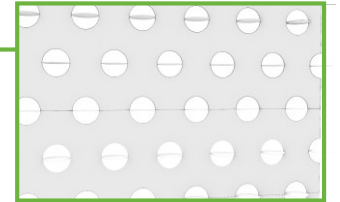
False Color Rendering



Visual Comfort ● ● ● ● ○



Image used for screen display



**1.5" Diameter Perforations**  
**85% Opaque**  
**15% Open**

Reducing the diameter of exterior shade screen perforations reduces sunlight exposure, yielding the highest screen visibility and lowest luminance contrast of all scenarios tested. The view out of the classroom is maintained and daylight availability is not heavily compromised.

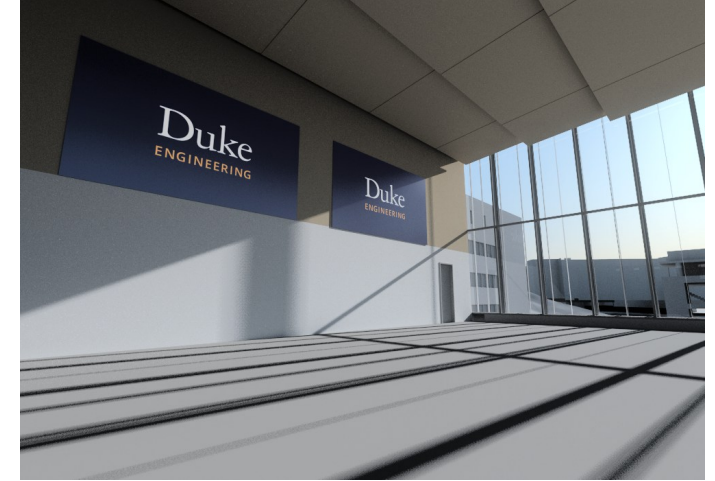
# LED Screen Visibility – NW Facing Classroom

## Recommendation

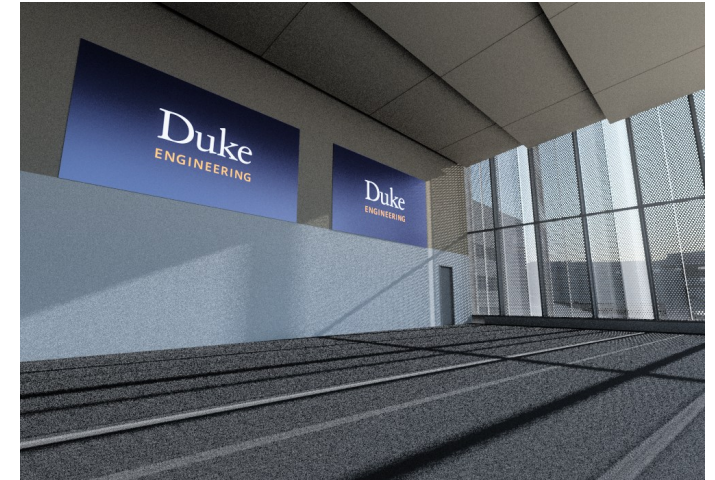
54% openness is successful, however, reducing the openness to 15%, or 1.5" diameter of perforated openings, is recommended to:

1. Improve screen visibility
2. Mitigate unwanted summer solar gain
3. Maintain view and daylight availability for occupants

Unshaded



1.5" Diameter  
Perforations



**Recently Trending – Projected Image Visibility**

# Projected Image Visibility – SE Facing Classroom

## Introduction



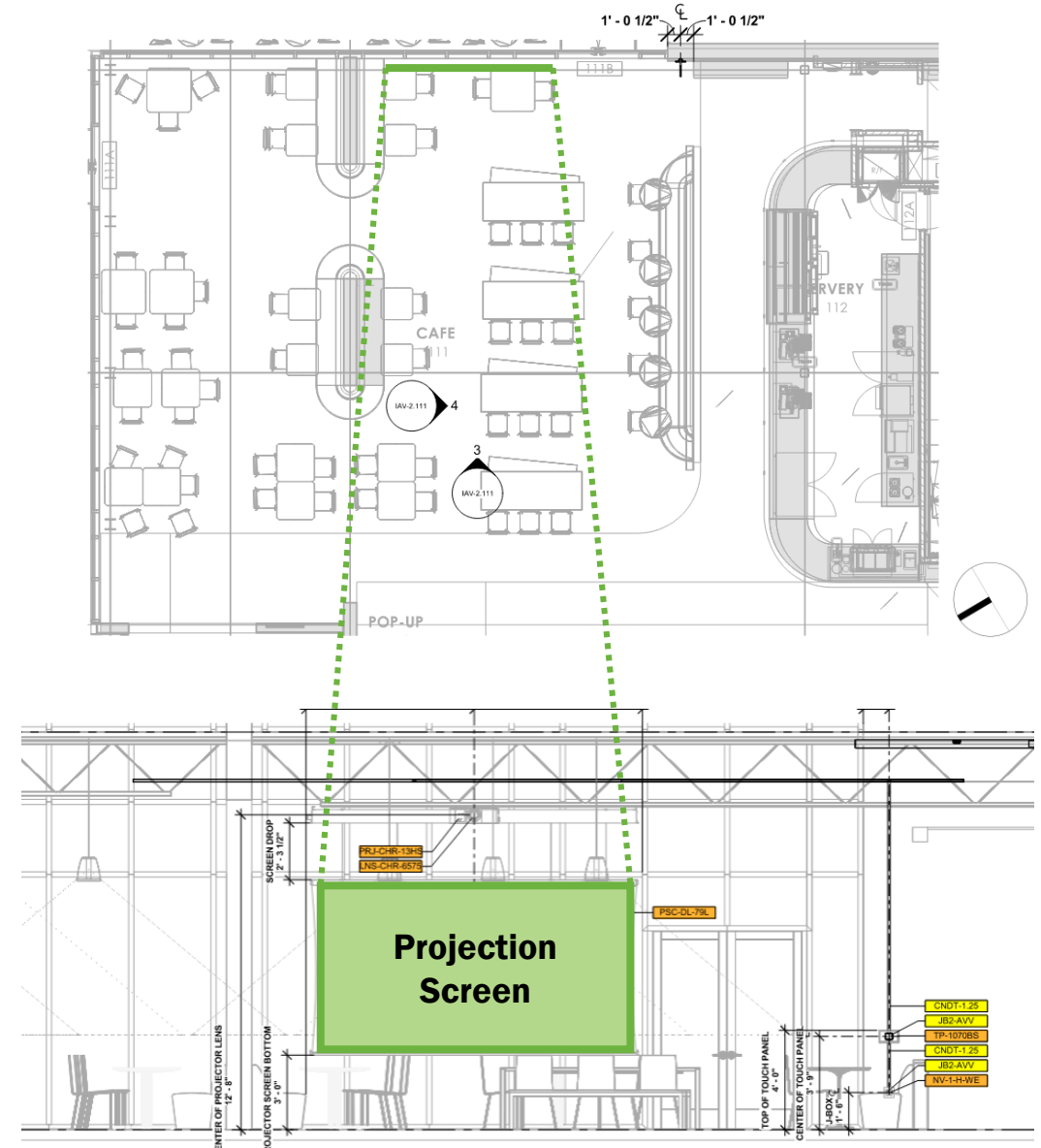
Are our blinds sufficient for maintaining visibility for projected images in our cafe?

## Study Overview

The goal of this study was to identify an openness factor and color for the interior blinds that alleviates visibility concerns for the projection screen in the ground floor café.

## Analysis Methodology

- Estimate the brightness of the projected image
- Luminance renderings with glow surface



# Projected Image Visibility – SE Facing Classroom

## Introduction



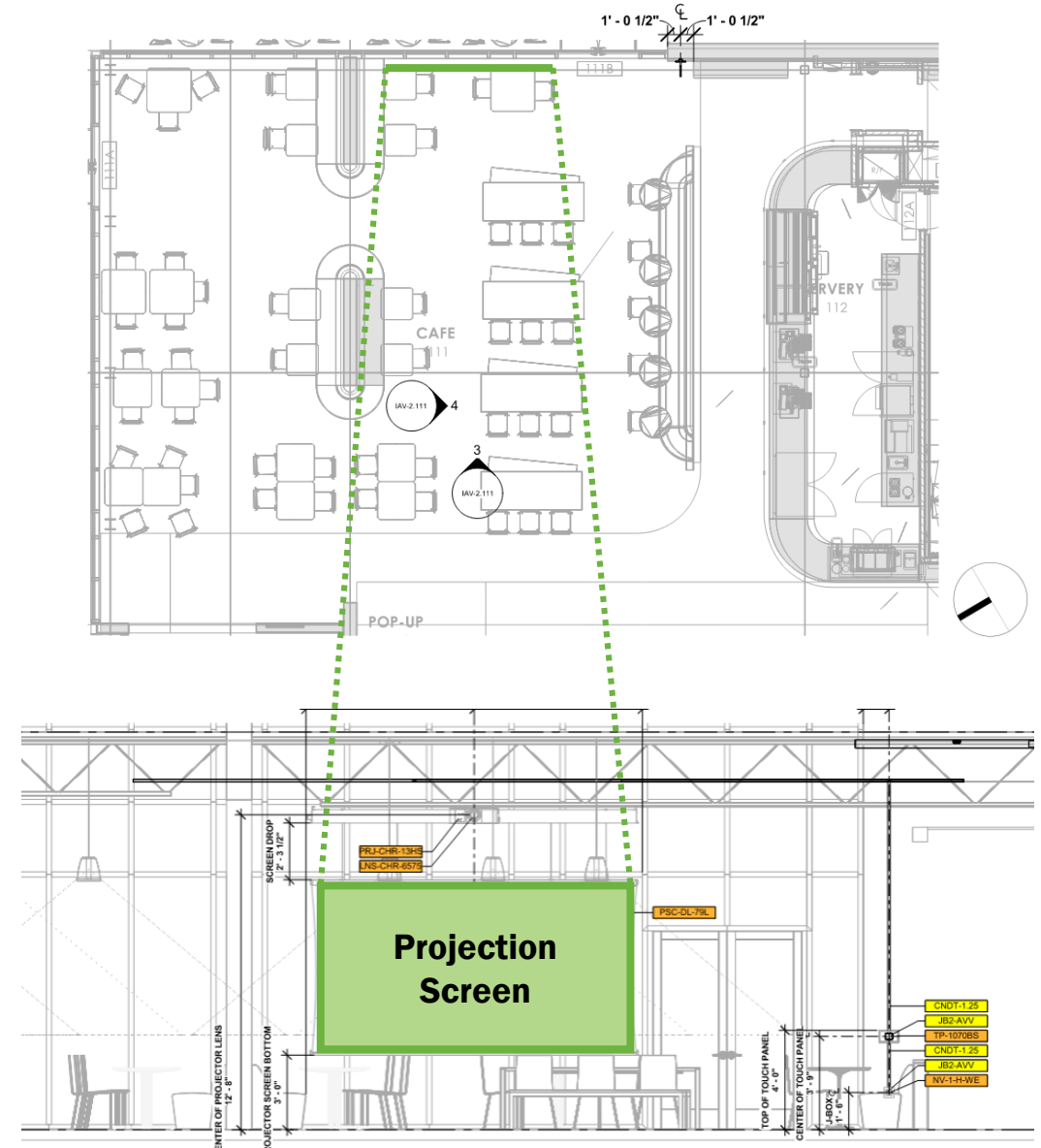
Are our blinds sufficient for maintaining visibility for projected images in our cafe?

## Study Overview

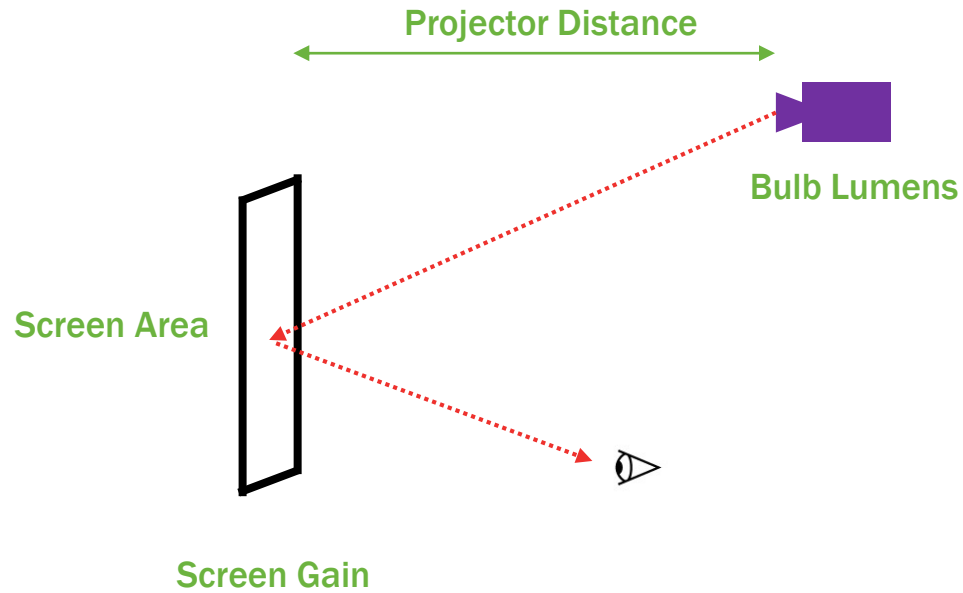
The goal of this study was to identify an openness factor and color for the interior blinds that alleviates visibility concerns for the projection screen in the ground floor café.

## Analysis Methodology

- Estimate the brightness of the projected image
- Luminance renderings with glow surface

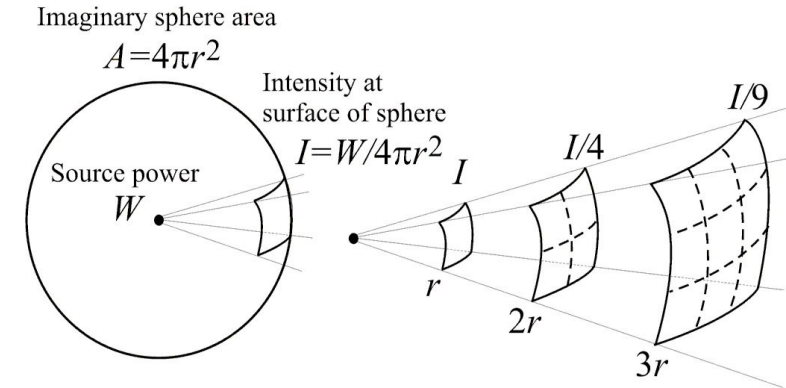


# Projector Brightness



Factors that affect screen luminance

Typical publicly available calculators do not incorporate projector distance or positioning



Inverse Square Law

**Screen Gain Calculator**

Enter any 3 values to calculate the missing variable

Projector Lumens  
4000 Lumens ( ▾ )

Screen Gain  
1 (unitless)

Screen Area  
5.26 m<sup>2</sup> ▾

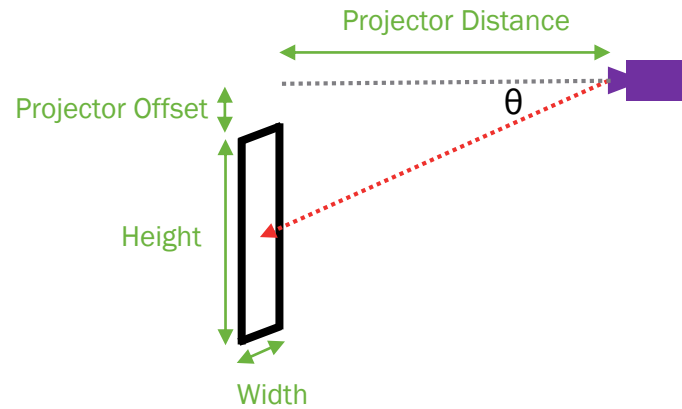
Screen Brightness (Luminance)  
242.0607 cd/m<sup>2</sup> (nil ▾)

**Calculate** **Reset**

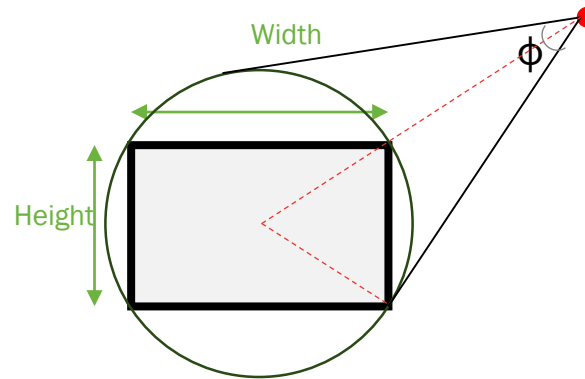
◀ ⬇ 🖨 📄 👍 👎

Typical Online Calculator

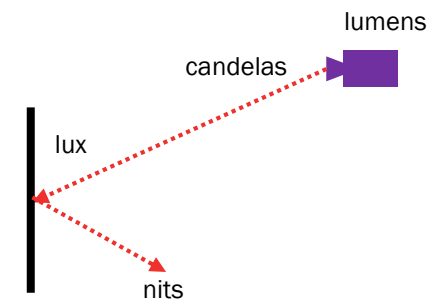
# Factors that Affect Screen Luminance



Vertical Displacement Angle

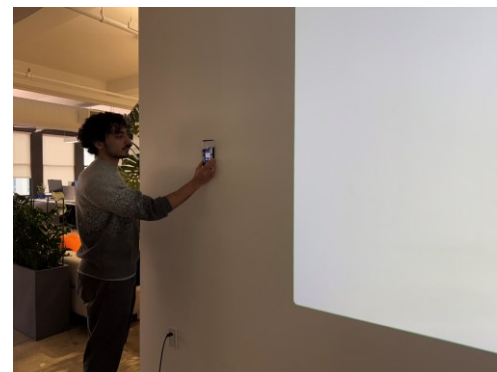
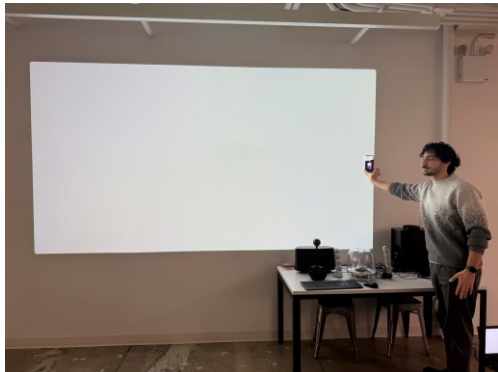
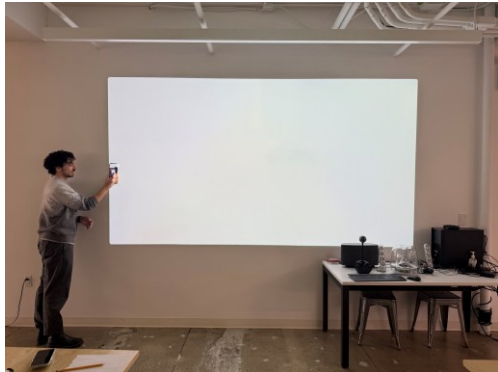


Apex Angle (Cone Projection)



Calculation Sequence: Projector Lumens, candelas  
output, screen lux, screen nits

# Illuminance Evaluation

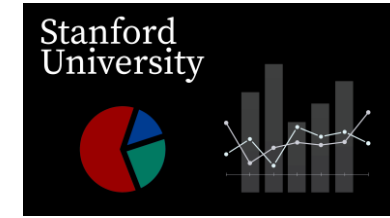


# Luminance Evaluation



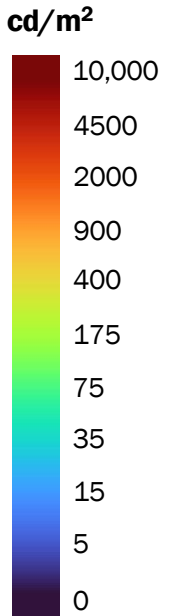
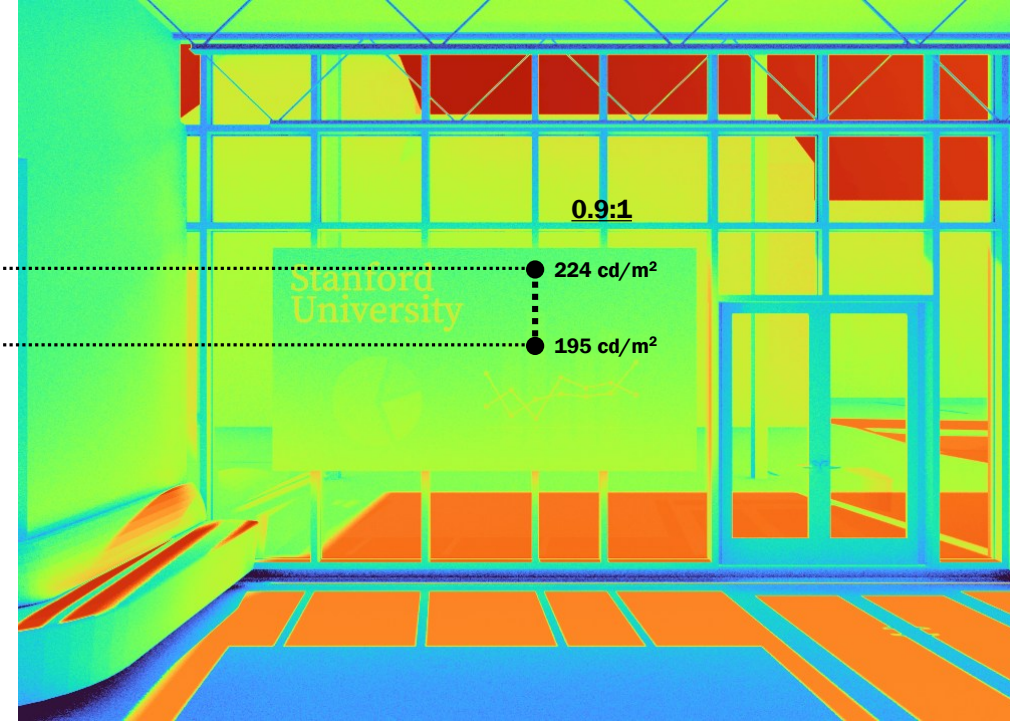
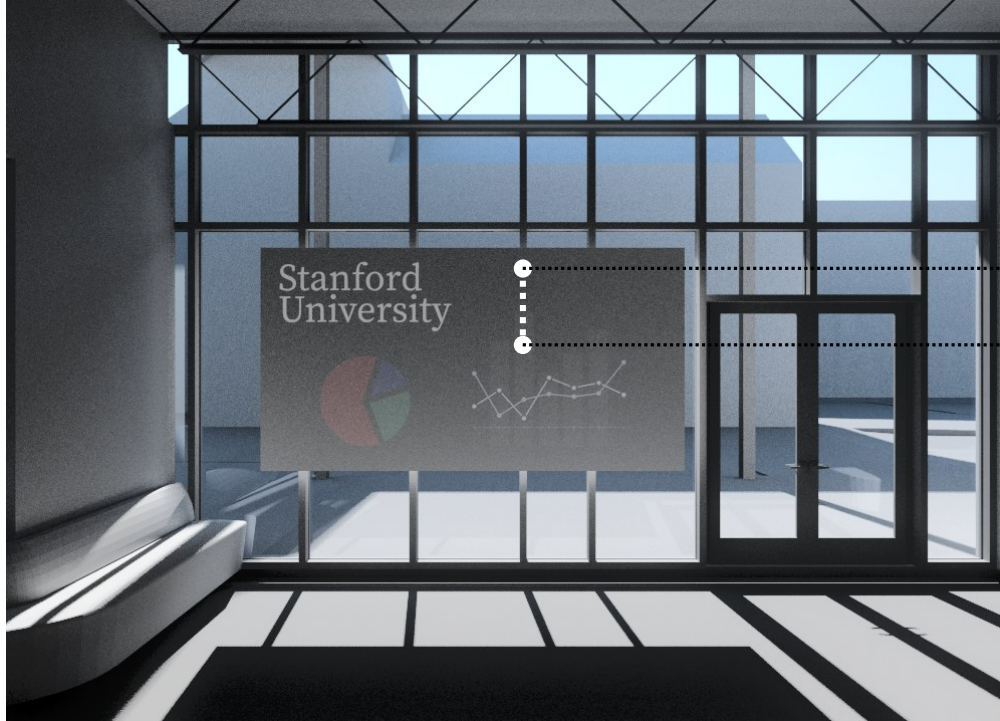
# Projection Visibility

No Blinds – March @ 9AM



*Projected Image*

Projection Visibility ● ○ ○ ○ ○

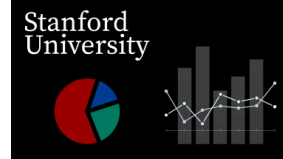


During the **morning hours of the shoulder season**, direct sun enters deep into the café from behind the projection screen. **Without blinds, this results in extremely poor projection image visibility.**

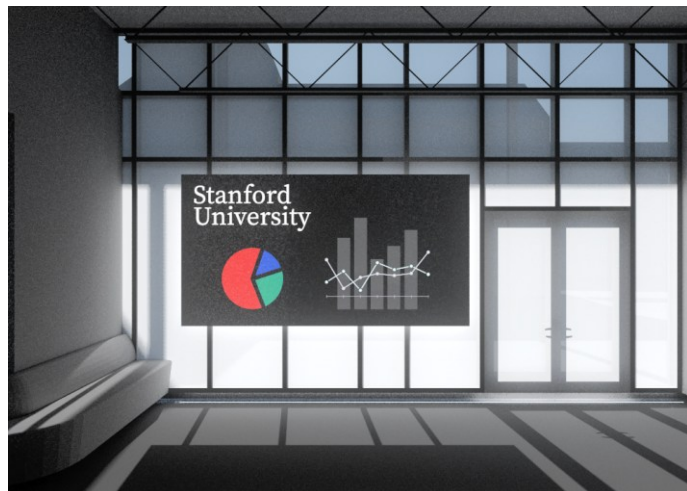
# Projection Visibility – Openness Comparison

Silver Birch Blinds – March @ 9AM

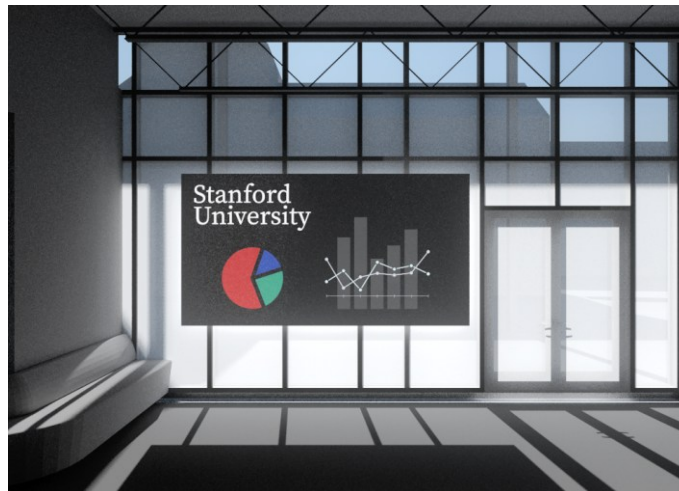
Silver Birch  
55% Diffuse Reflection



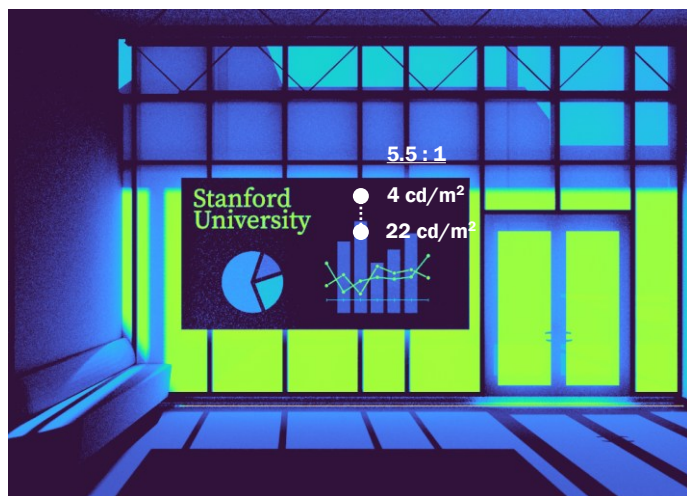
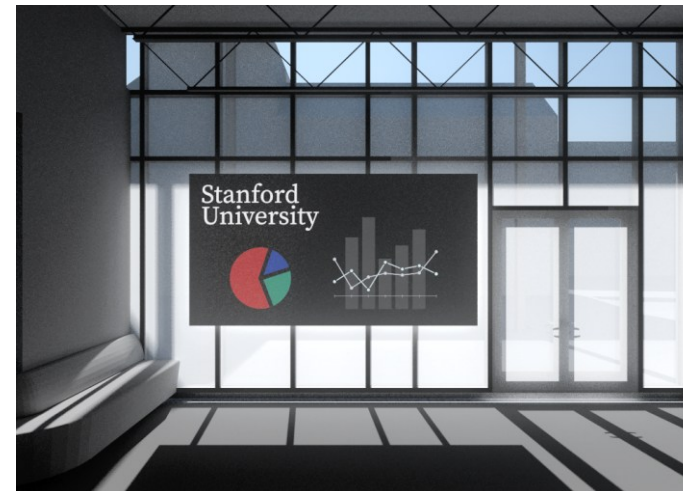
Silver Birch – 1% Openness



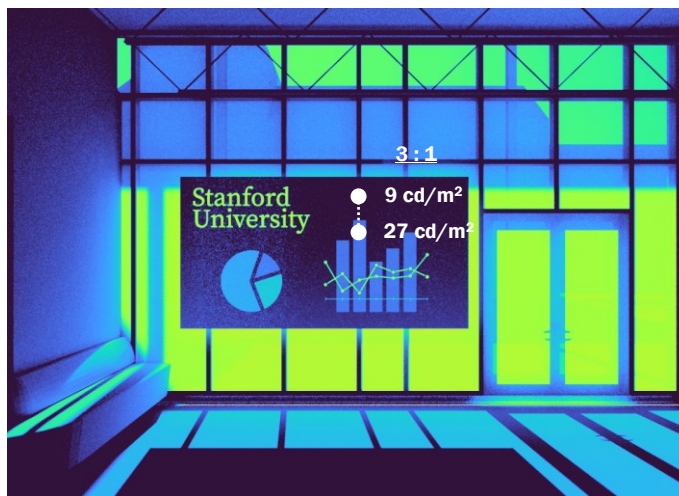
Silver Birch – 3% Openness



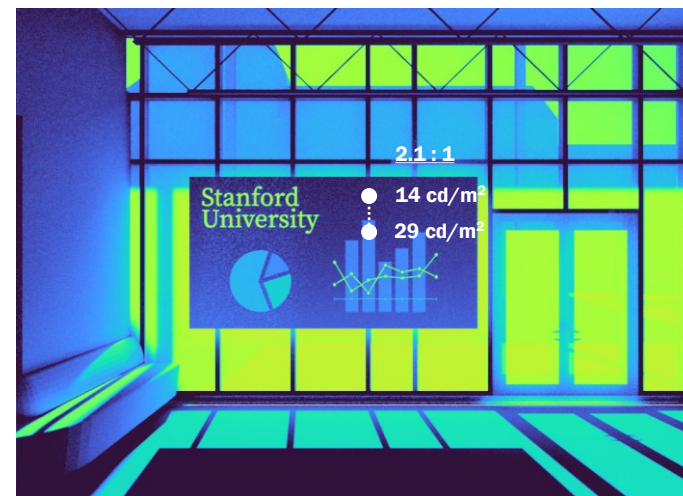
Silver Birch – 5% Openness



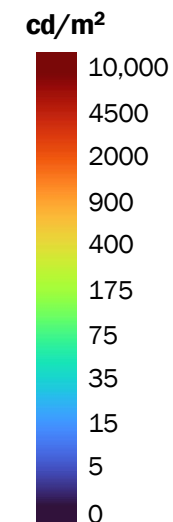
Projection Visibility ● ● ● ● ●



Projection Visibility ● ● ● ● ○



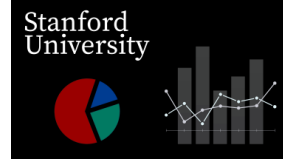
Projection Visibility ● ● ● ○ ○



# Projection Visibility – Openness Comparison

Shadow Grey Blinds – March @ 9AM

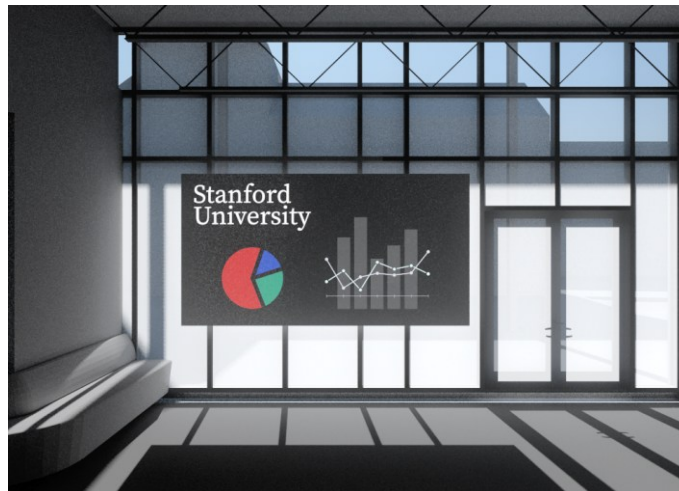
Shadow Grey  
10% Diffuse Reflection



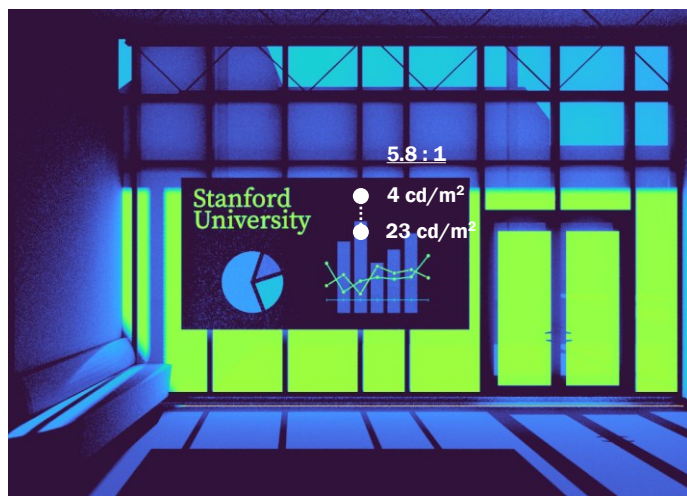
Shadow Grey – 1% Openness



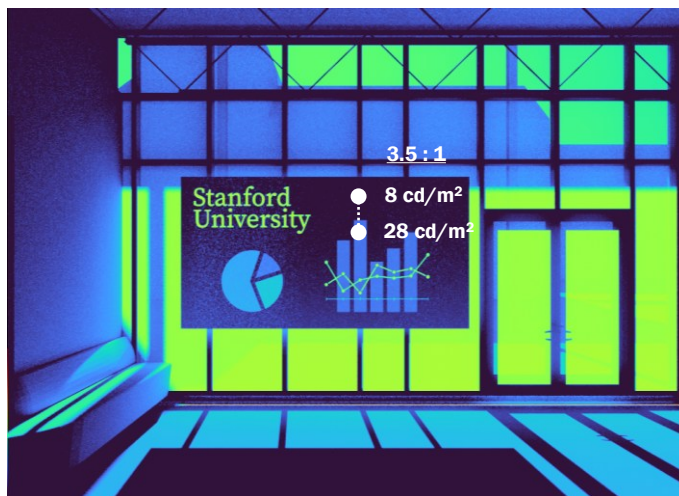
Shadow Grey – 3% Openness



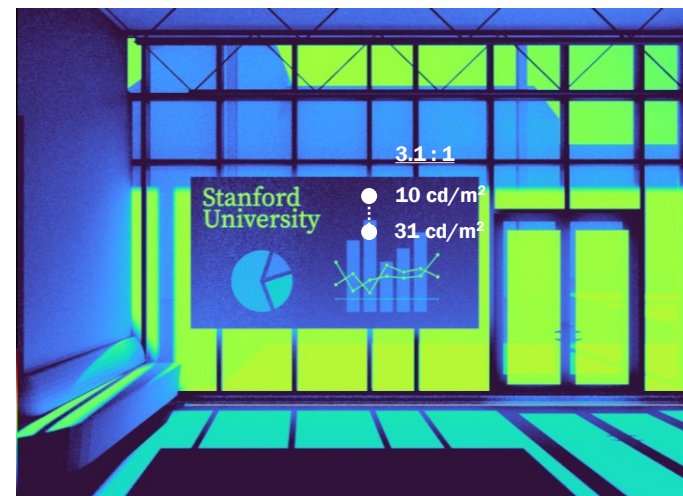
Shadow Grey – 5% Openness



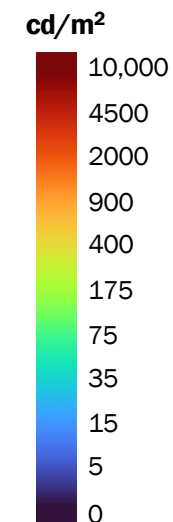
Projection Visibility ● ● ● ● ●



Projection Visibility ● ● ● ● ○



Projection Visibility ● ● ● ○ ○



# Summary

Projection Visibility – March @ 9AM

## Blind Openness

Reducing the openness increases contrast between screen and surroundings, improving visibility.

Atelier Ten recommends a max openness of 3%.

## Blind Color

Choosing a less reflective blind (darker) increases contrast between screen and surroundings, improving visibility. It also improves visibility of the exterior through the blind.

Atelier Ten recommends a darker shade cloth ~10% diffuse reflectivity.

**Silver Birch – 1% Openness**



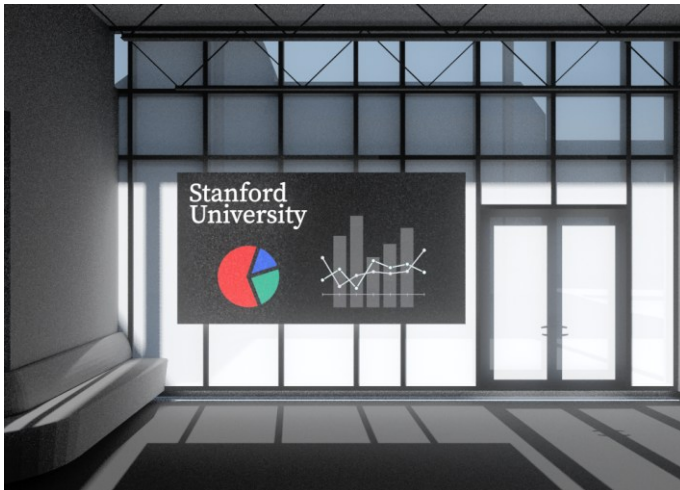
**Silver Birch – 3% Openness**



**Silver Birch – 5% Openness**



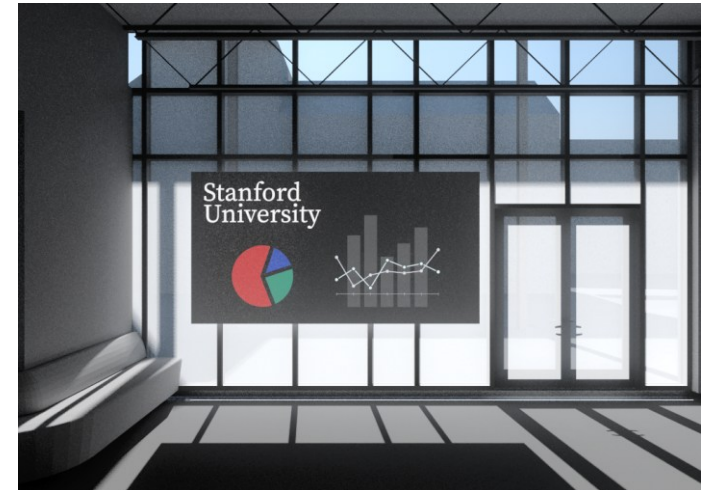
**Shadow Grey – 1% Openness**



**Shadow Grey – 3% Openness**



**Shadow Grey – 5% Openness**



**Niche – Screen Visibility from Exterior**

# Projected Image Visibility – SE Facing Classroom

## Introduction



Will the images on our screens be visible from the exterior of the building during the daytime?

## Study Overview

The goal of this study was to help understand the visibility of the media screens during the daytime, as well as the necessary screen brightness to improve visibility.

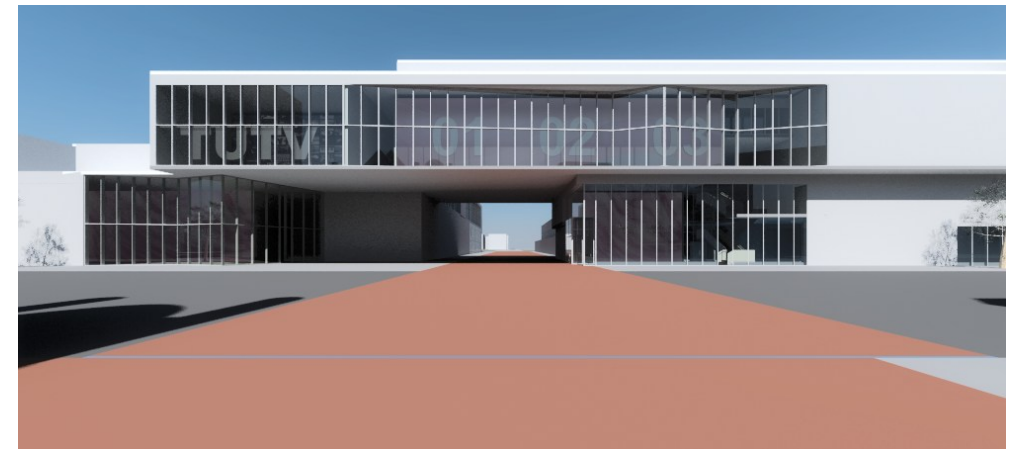
## Analysis Methodology

- Luminance renderings with glow surface
- High level energy modeling evaluation

## Conceptual Rendering (Source: SOM)



## Luminance Rendering



# Glazing Specification

Façade Transparency

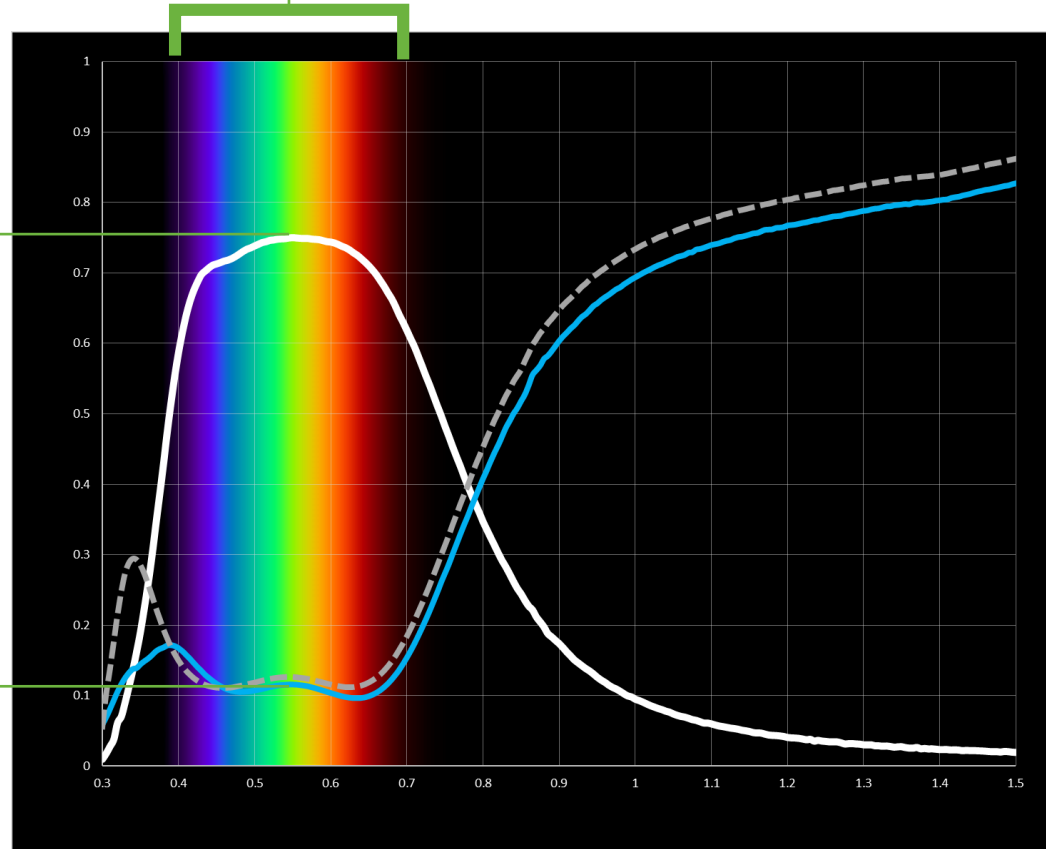
## VLT

Transmission  
(want to **maximize!**)

## Rf<sub>vis</sub>

Reflection  
(want to **minimize!**)

Visible Light Spectrum



**Visibility Equation:**

$$(\text{VLT} \times \text{brightness of inside scene}) > (\text{Rf}_{\text{vis}} \times \text{brightness of outside scene})$$

$VLT \times \text{luminance of light} > Rf_{vis} \times \text{luminance of hillside}$

$Rf_{vis} \times \text{luminance of hillside} > VLT \times \text{luminance of ceiling}$

$VLT \times \text{luminance of column} > Rf_{vis} \times \text{luminance of hillside}$

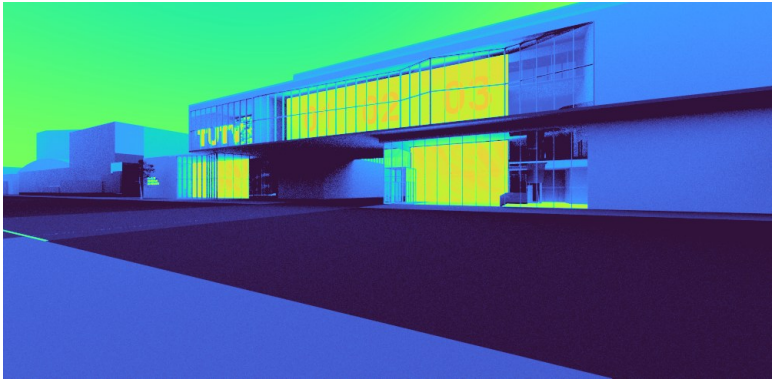
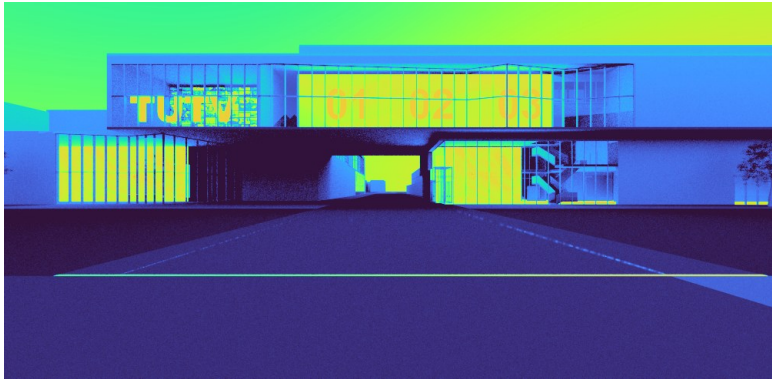
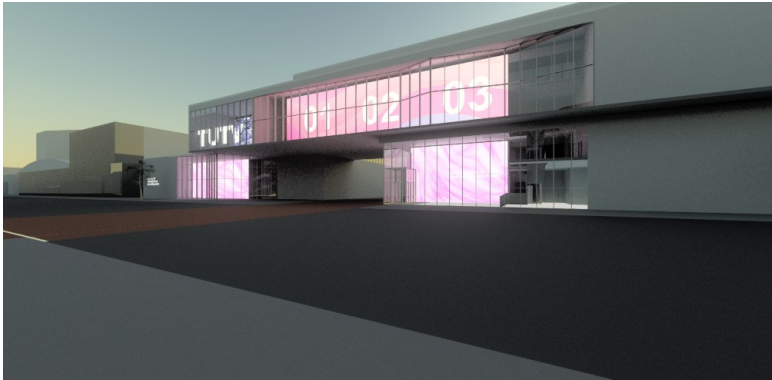
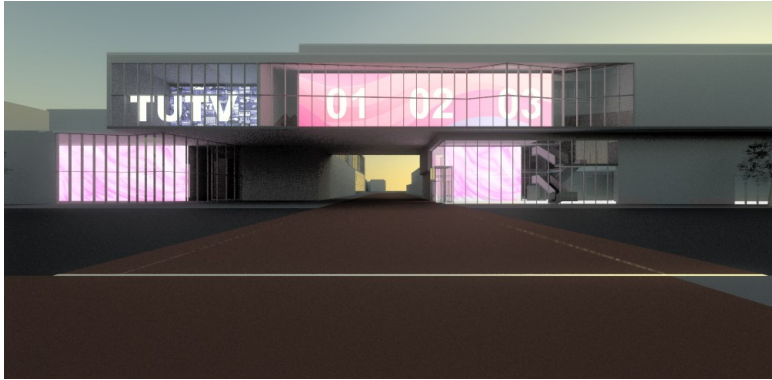
$Rf_{vis} \times \text{luminance of jacket} > VLT \times \text{luminance of inside wall}$

$Rf_{vis} \times \text{brightness foil tray} > VLT \times \text{luminance of inside wall}$

$VLT \times \text{luminance of table} > Rf_{vis} \times \text{luminance of suit jacket}$

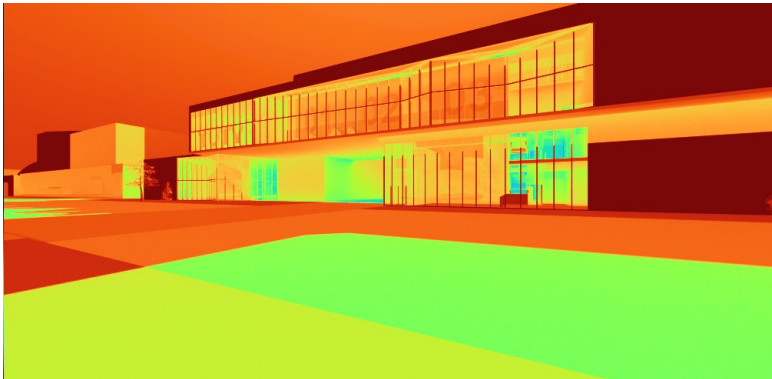
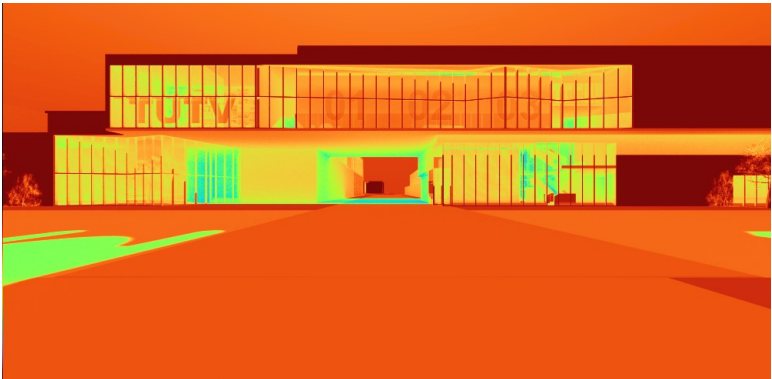
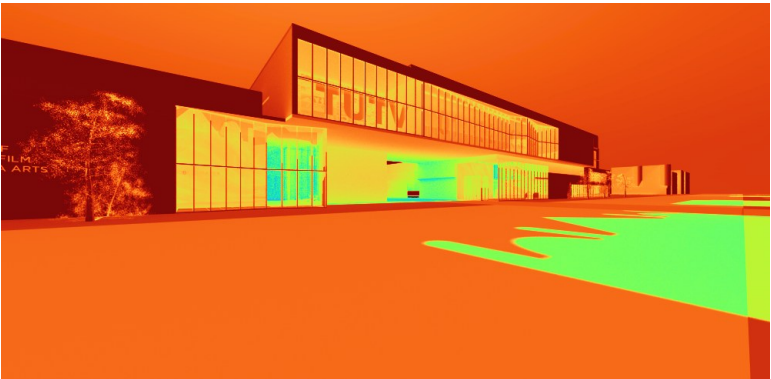
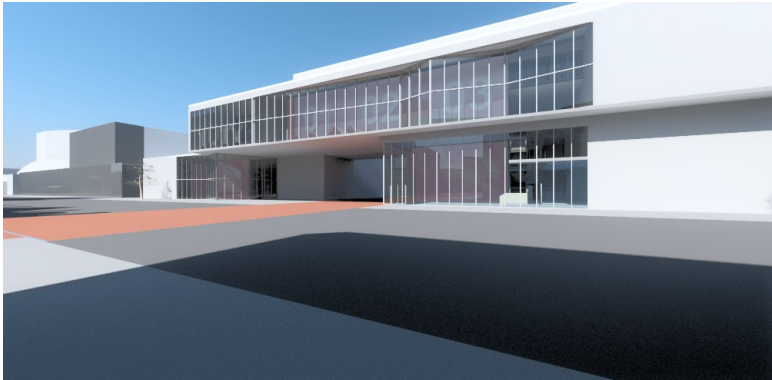
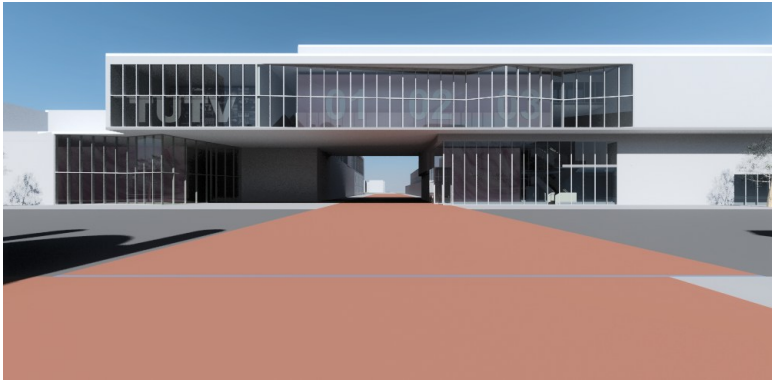
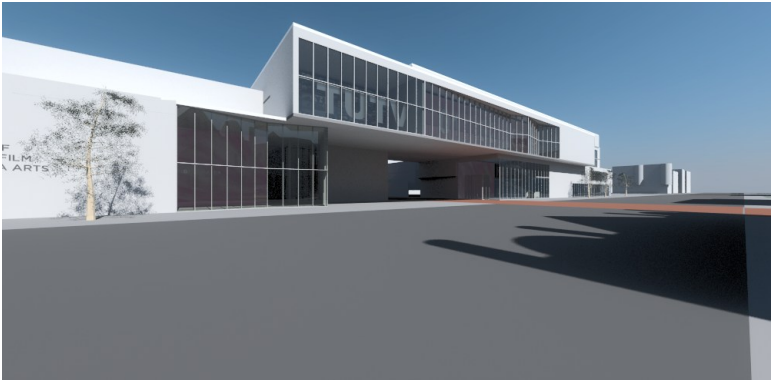
# June 21, Dusk

Screen Brightness: 1,000 nits



Screen Visibility ● ● ● ● ●

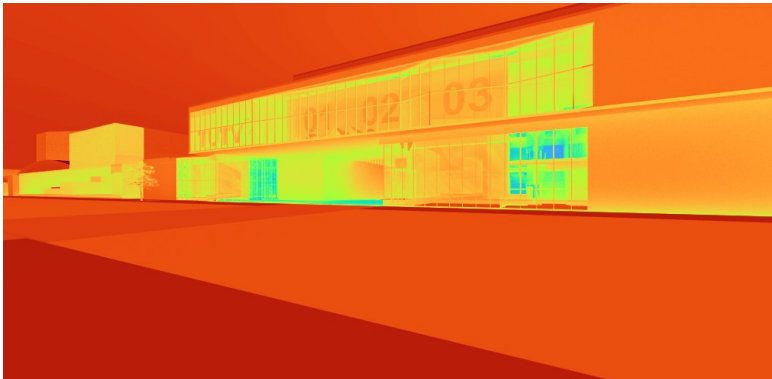
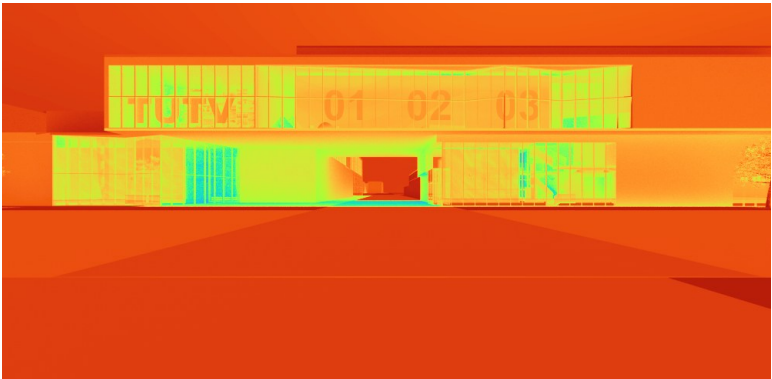
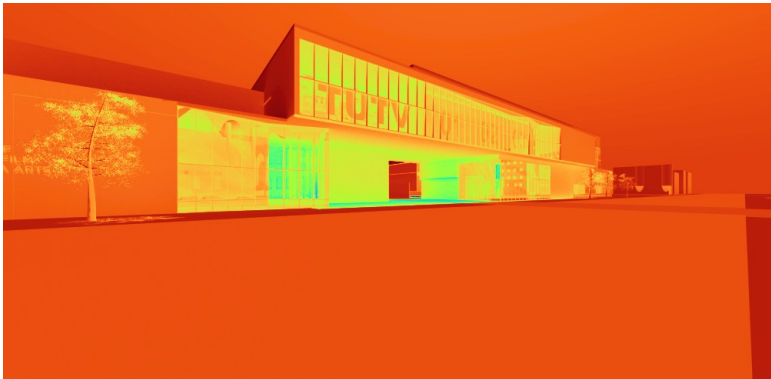
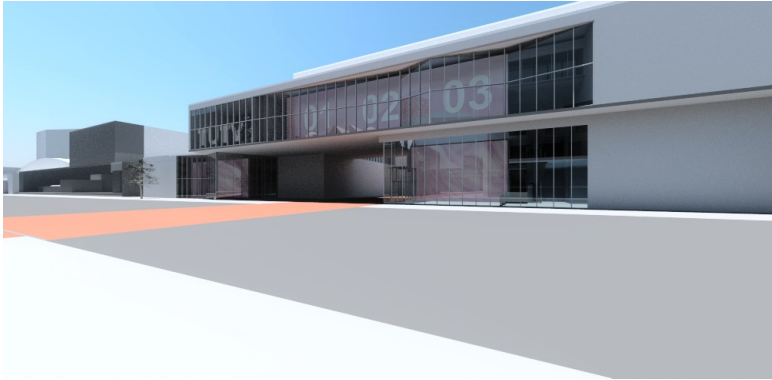
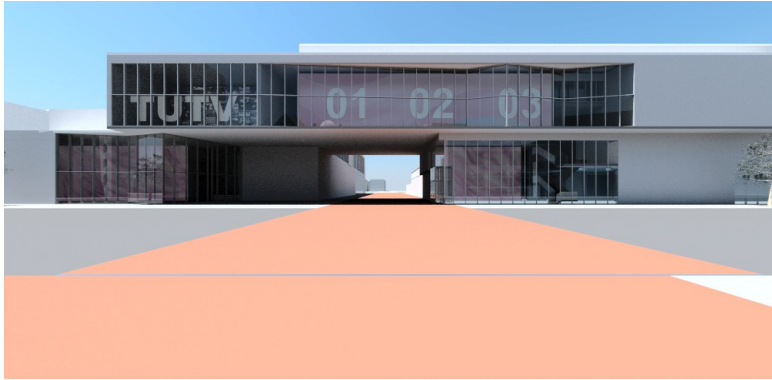
June 21, 9 AM  
Screen Brightness: 1,000 nits



Screen Visibility ● ○ ○ ○ ○

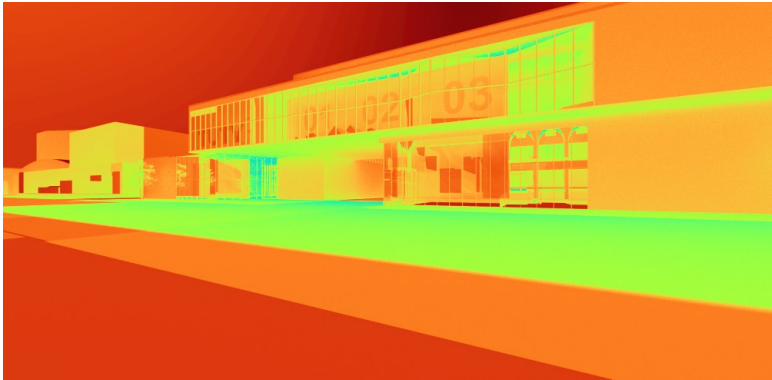
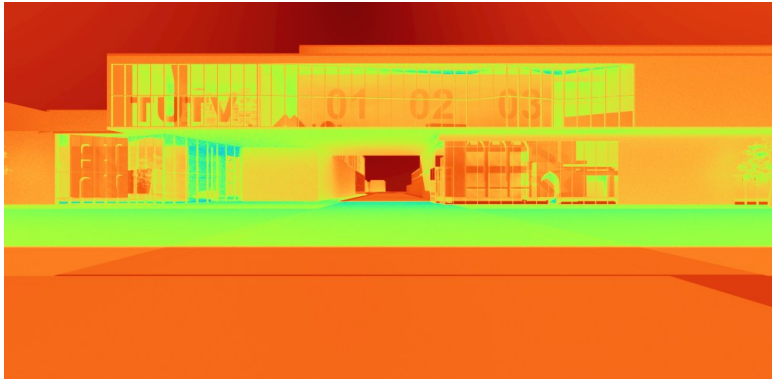
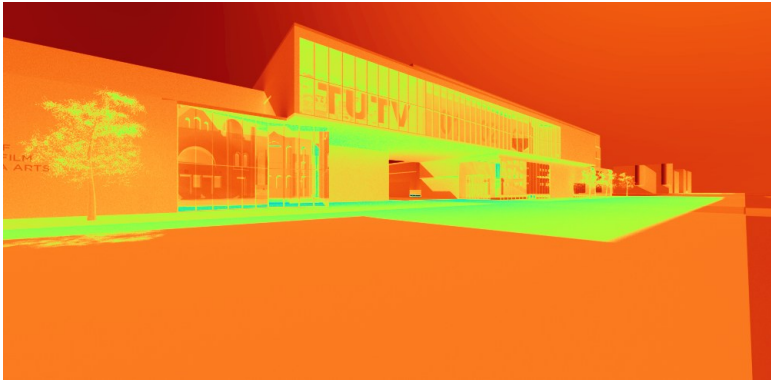
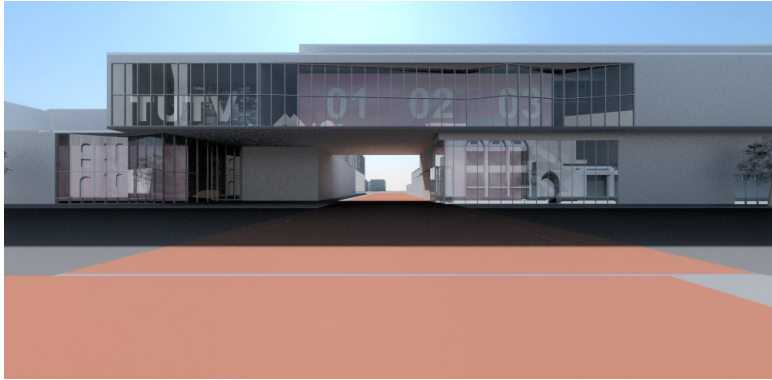
June 21, 12 PM

Screen Brightness: 1,000 nits



Screen Visibility ● ● ● ○ ○

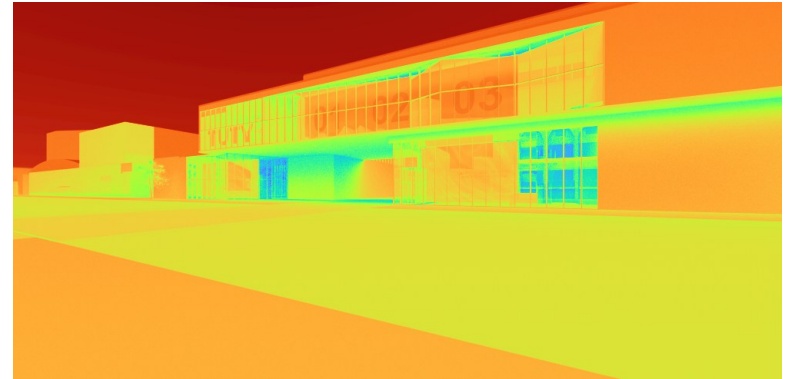
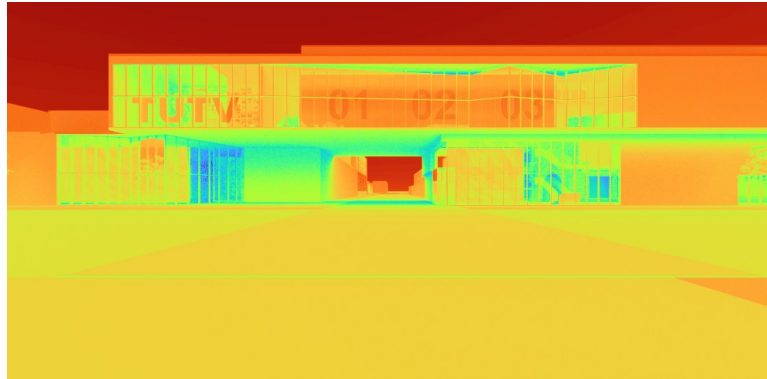
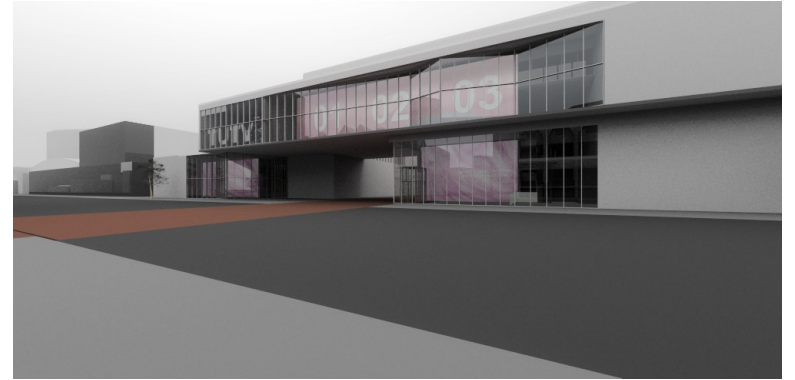
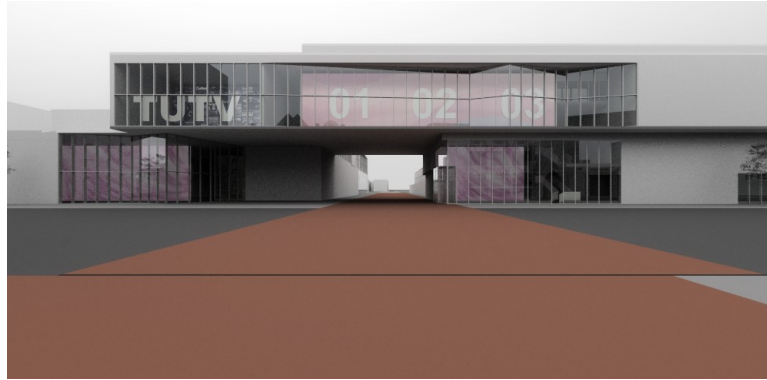
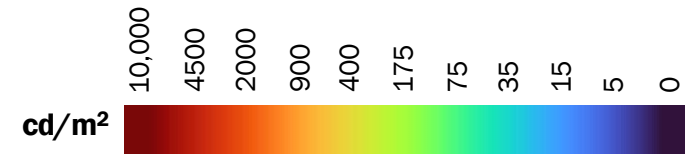
June 21, 4 PM  
Screen Brightness: 1,000 nits



Screen Visibility ● ● ○ ○ ○

# Overcast – June 21 (all day condition)

Screen Brightness: 1,000 nits

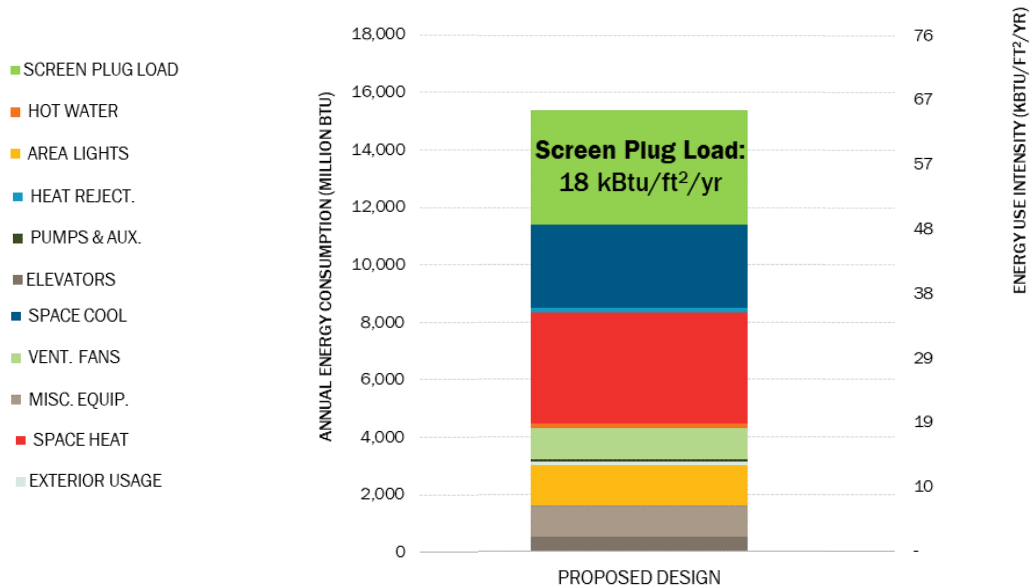


Screen Visibility ● ● ● ○ ○

# Screen Summary

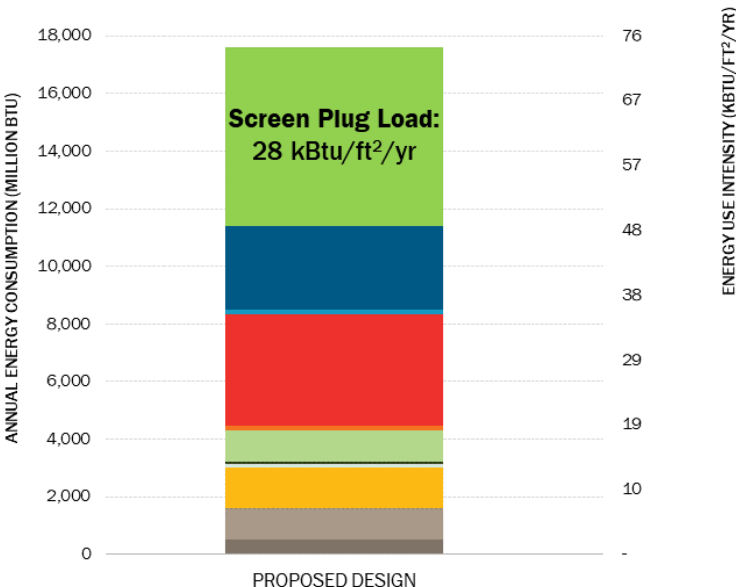
1,000 Nits

Screen Visibility ● ● ● ○ ○



2,000 Nits

Screen Visibility ● ● ● ● ○



# Building Impacts on Vegetation

# A10's Current Approach

## 1. Identifying the Design Problem

- A10, the architect, and the landscape designer identify solar access concerns for plantings.

## 2. Framing our Study

- A10 works with the landscape designer alongside research to understand the solar requirements of the plant species in the project.
- There are different occupants in the space, what may be good for trees might be uncomfortable for humans.

## 3. Informed Analysis

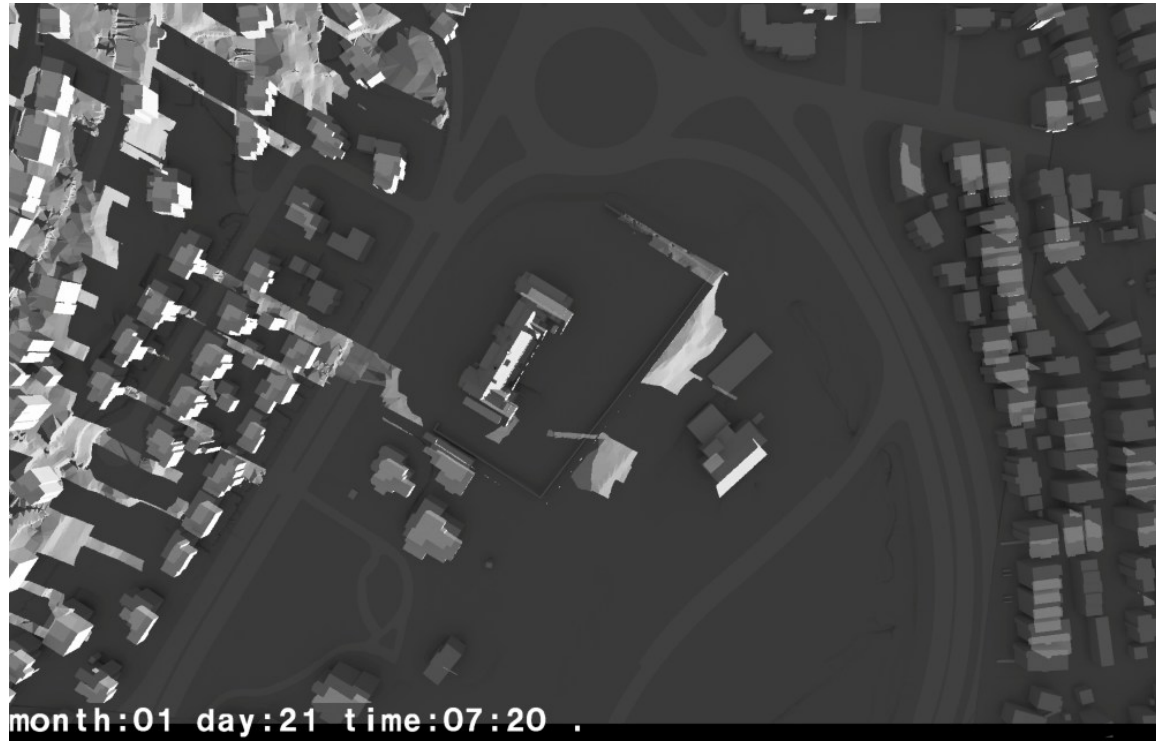
- A10's role is to recommend design changes to improve solar access for plantings whilst also maintaining human comfort for if plantings are in an occupied area.



# **Simplest Form – Changes in Direct Sun Access**

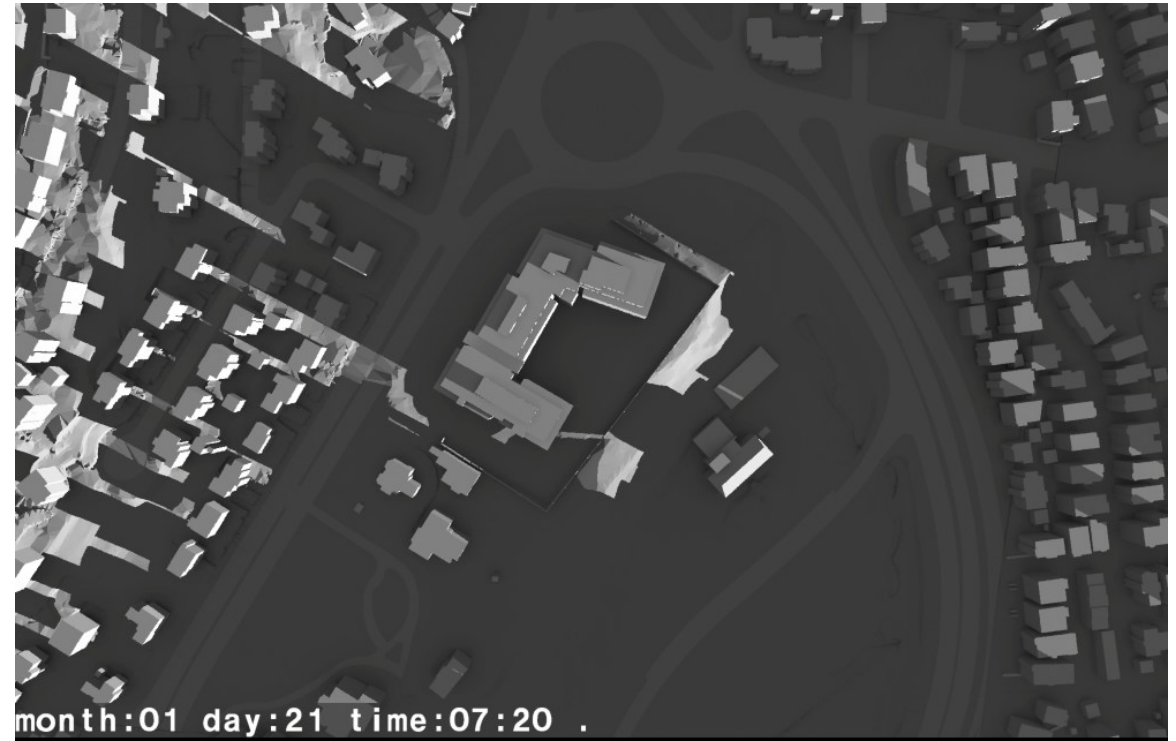
# Direct Sun Study

Existing Condition



month:01 day:21 time:07:20 .

New Development



month:01 day:21 time:07:20 .



# Spring – March 21<sup>st</sup>

Sunset @ 7PM

No. of hours with increased shadows over site area: +2 hrs/day

Development increases shade on site and neighboring buildings

Existing Condition

3PM



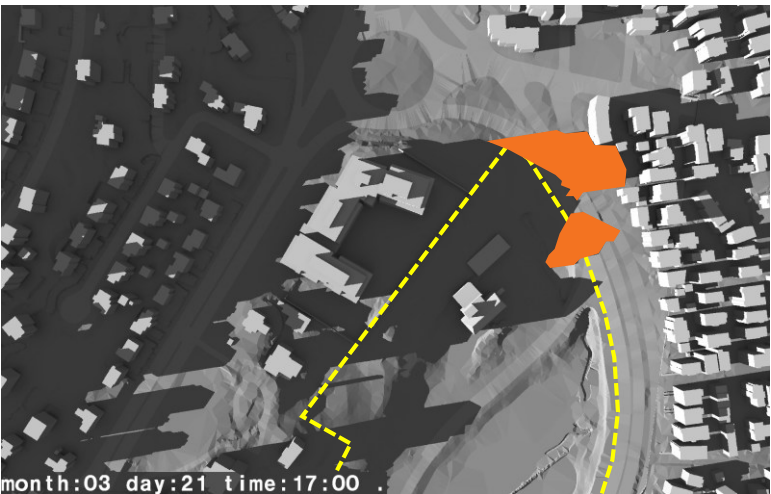
4PM



5PM



New Development



 New Shadow

 Site Extent



# Summer – June 21<sup>st</sup>

Sunset @ 8.30PM

No. of hours with increased shadows over site areas: +3 hrs/day

Development **significantly** increases shade on site and neighboring buildings

Existing Condition

4PM



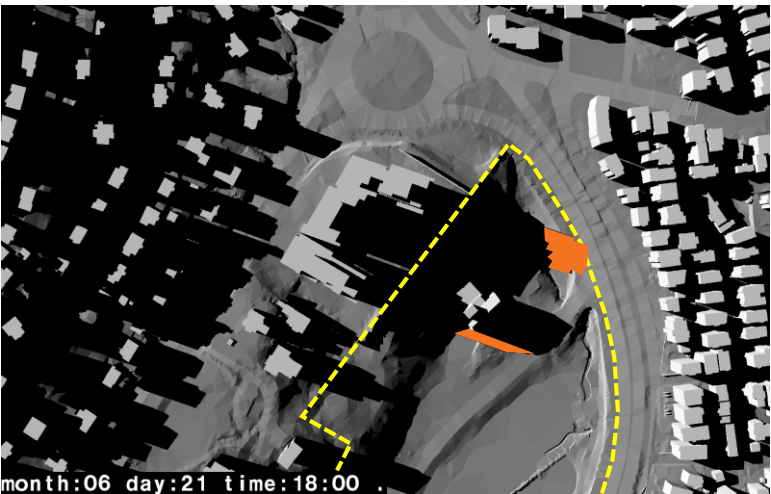
5PM



6PM



New Development



 New Shadow

 Site Extent



# Fall – September 21<sup>st</sup>

Sunset @ 6.30PM

No. of hours with increased shadows over site areas: +2 hrs/day

Development increases shade on site and neighboring buildings

Existing Condition

3PM



4PM



5PM



New Development



 New Shadow

 Site Extent



# Winter – December 21<sup>st</sup>

Sunset @ 4PM

No. of hours with increased shadows over site areas: +0 hrs/day

Development increases shade on neighboring buildings

Existing Condition

1PM



2PM



3PM



New Development



 New Shadow

 Site Extent



**Time to add more depth ...**

# When?

## Questions we discuss with landscape team:

1. What months will the plantings be dormant, not requiring sunlight? What is the growing season of the plantings?
2. Do all the plantings follow the same schedule? Are there any evergreen plantings?
3. What hours of light do each of your plantings prefer? Does it benefit from all light or does it only prefer morning or afternoon light?
  - A lot of trees are negatively impacted by excess afternoon light given the higher intensity.
  - Flowers may require afternoon light to flower!

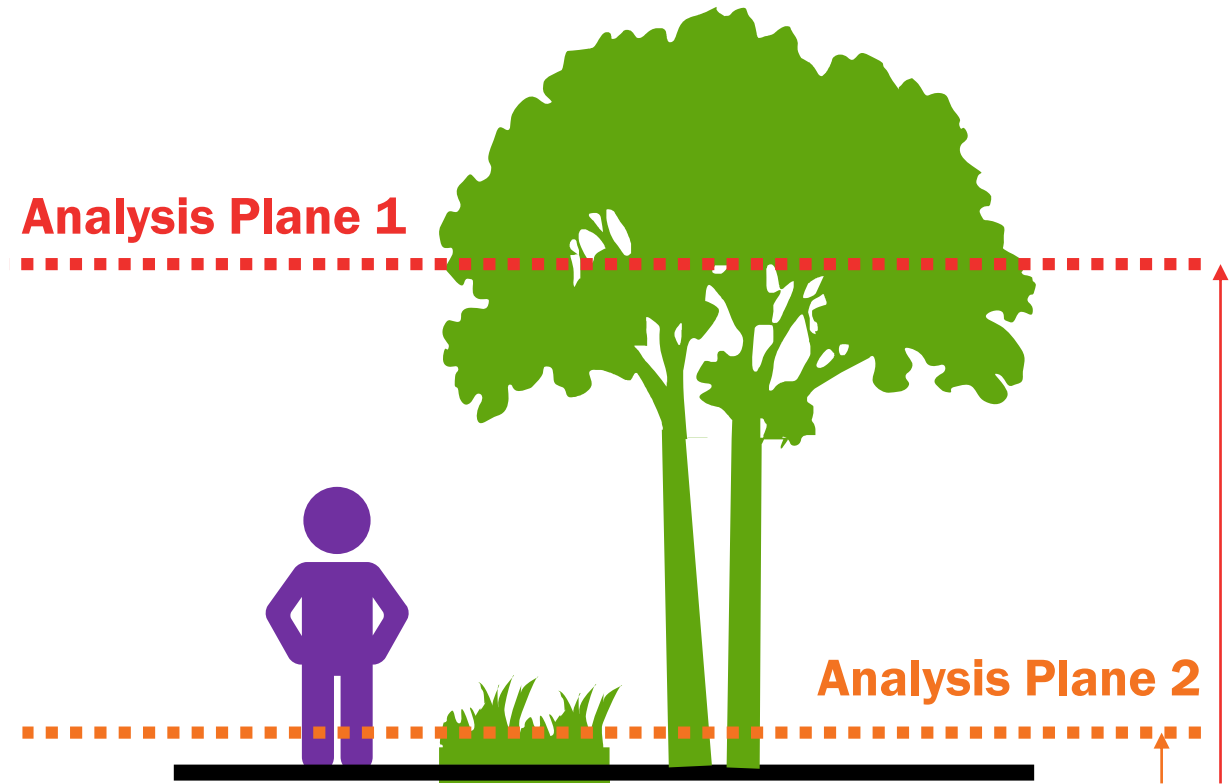


# Where?

Plants/trees are photosynthetically active at the top of their canopy. Identifying where solar exposure should be evaluated is crucial before study.

## Questions we discuss with landscape team:

1. Are the trees already established for your project? If so, what are the canopy heights to consider for analysis?
2. Are you planting any new trees? How does the sun exposure change at ground height (first planted) to full mature height?
3. If the tree canopy heights are similar, is there an average height we can use for the analysis?



# What?

Now we establish what the light requirements are for each of the plantings in the design.

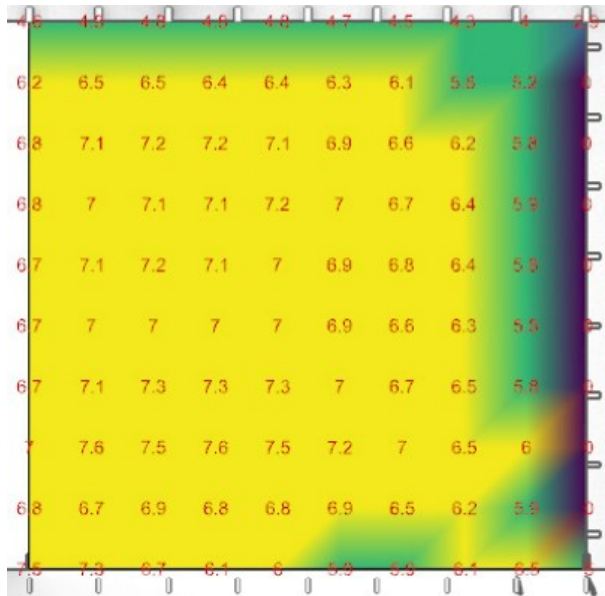
Crucial to discuss this with the landscape team to understand what metric is most suitable to them and their understanding of the planting condition.



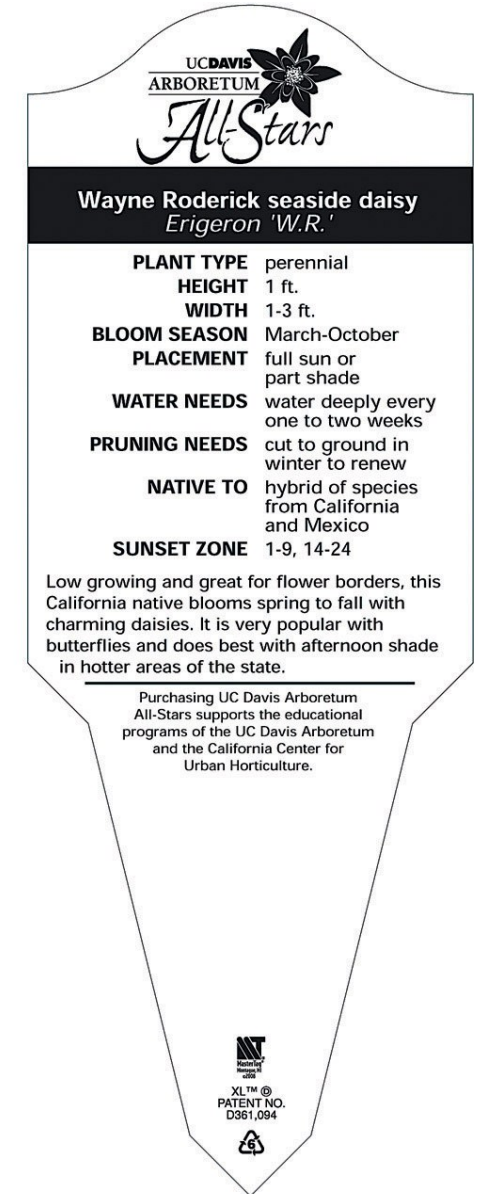
# Average Daily Direct Sun Hours

A common method of evaluating solar exposure for outdoor plantings is using the average daily sun hours over the growing season.

Research/contact local nurseries and growers to identify the sun hour ranges for on-site plantings.



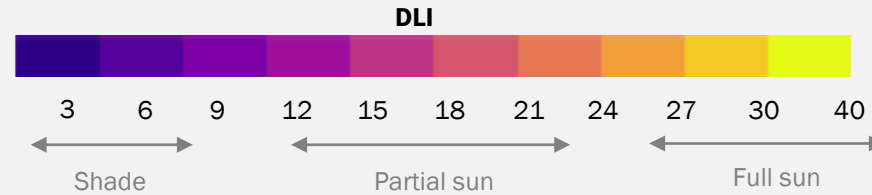
Average Sun Hours



<https://howtoorganicgarden.wordpress.com/2014/04/04/deciphering-a-plant-label/>

**Let's add intensity ...**

# Tree - Daily Light Integral Ranges



5- 10



**Shade**



Beech



Eastern  
Hemlock /  
Evergreens

10-25



**Partial sun**

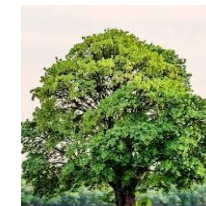


Dogwood

25 - 40



**Full sun**



Oak

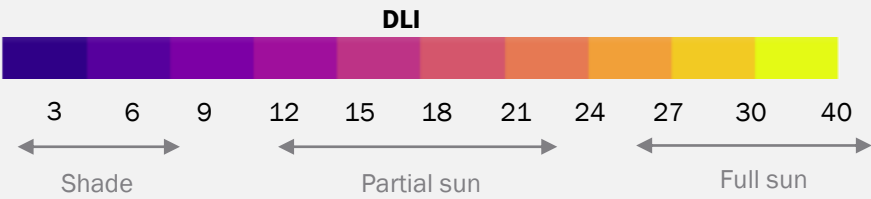


Maple



Fruit Trees

# Plants - Daily Light Integral Ranges



2-10



Oxalis



4-6



Pteridaceae fern



4-8



Hoya



4-12



Monstera



6-12



Ficus



4-14



Aglaonema



4-16



Aspidistra



7-30



Schefflera



30-50



Succulents



Zamioculcas



Alocasia



Croton



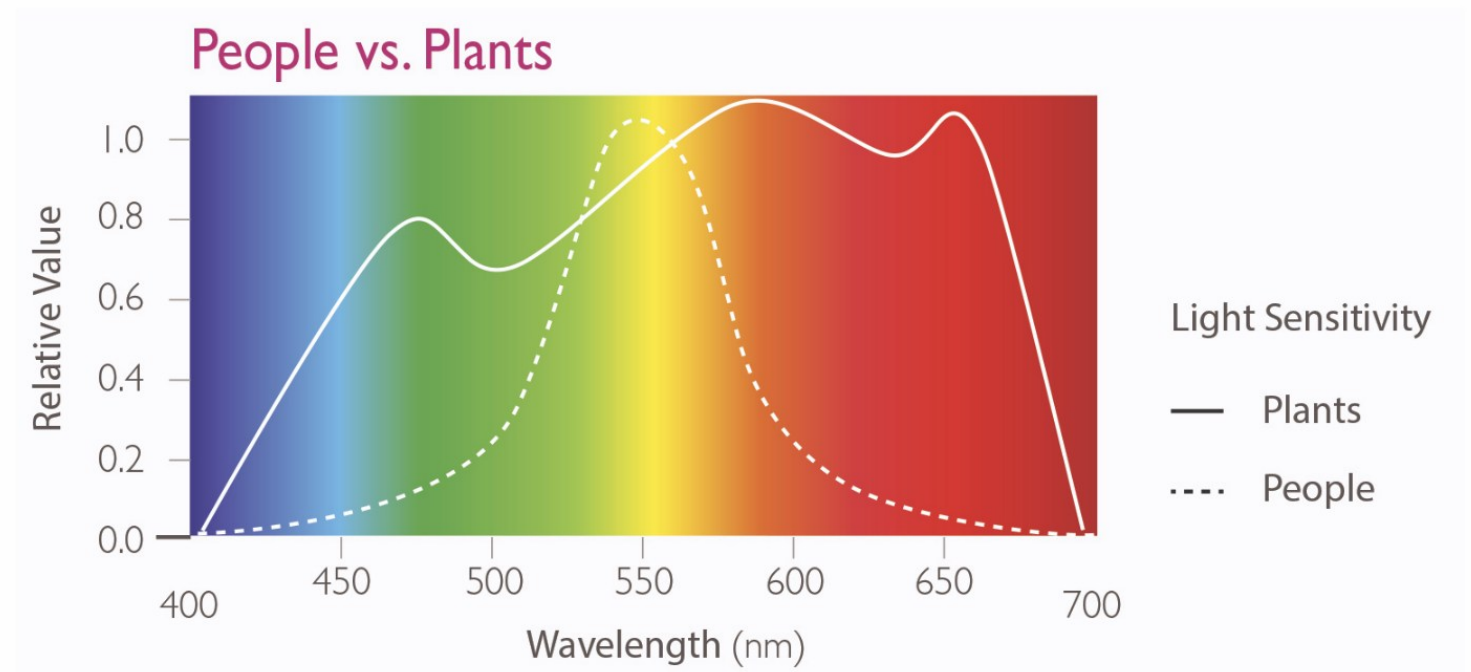
Aloe

- Dracaena
- Money tree
- Philodendron
- Polka dot
- Pothos
- Snake plant
- Syngonium
- ...

# Humans vs. Plants

- The Photosynthetically Active Radiation (PAR) spectrum that is applicable to plants spans wavelengths between 400nm and 700.
- Human eyes are most sensitive to green and yellow light, good at seeing red and blue light, and cannot perceive infrared and ultraviolet light.
- Plants can perceive a greater extent of red and blue light as well as detect the ultraviolet and infrared light that is not perceivable by people.

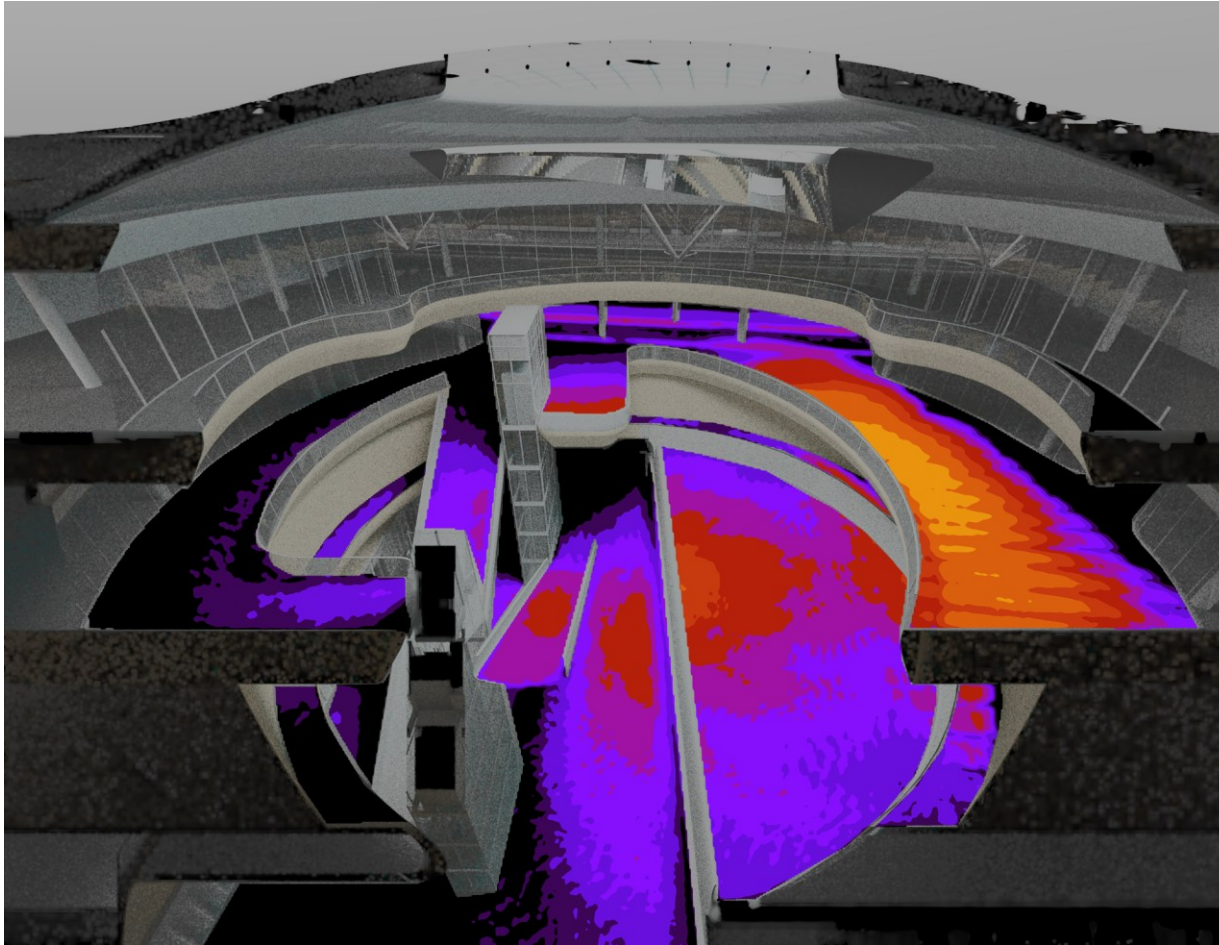
**Plants require much more light than people, and what might be an optimal conditions for vegetation my result in visual and thermal discomfort for occupants.**



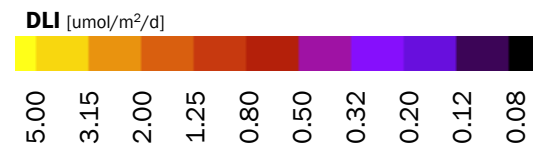
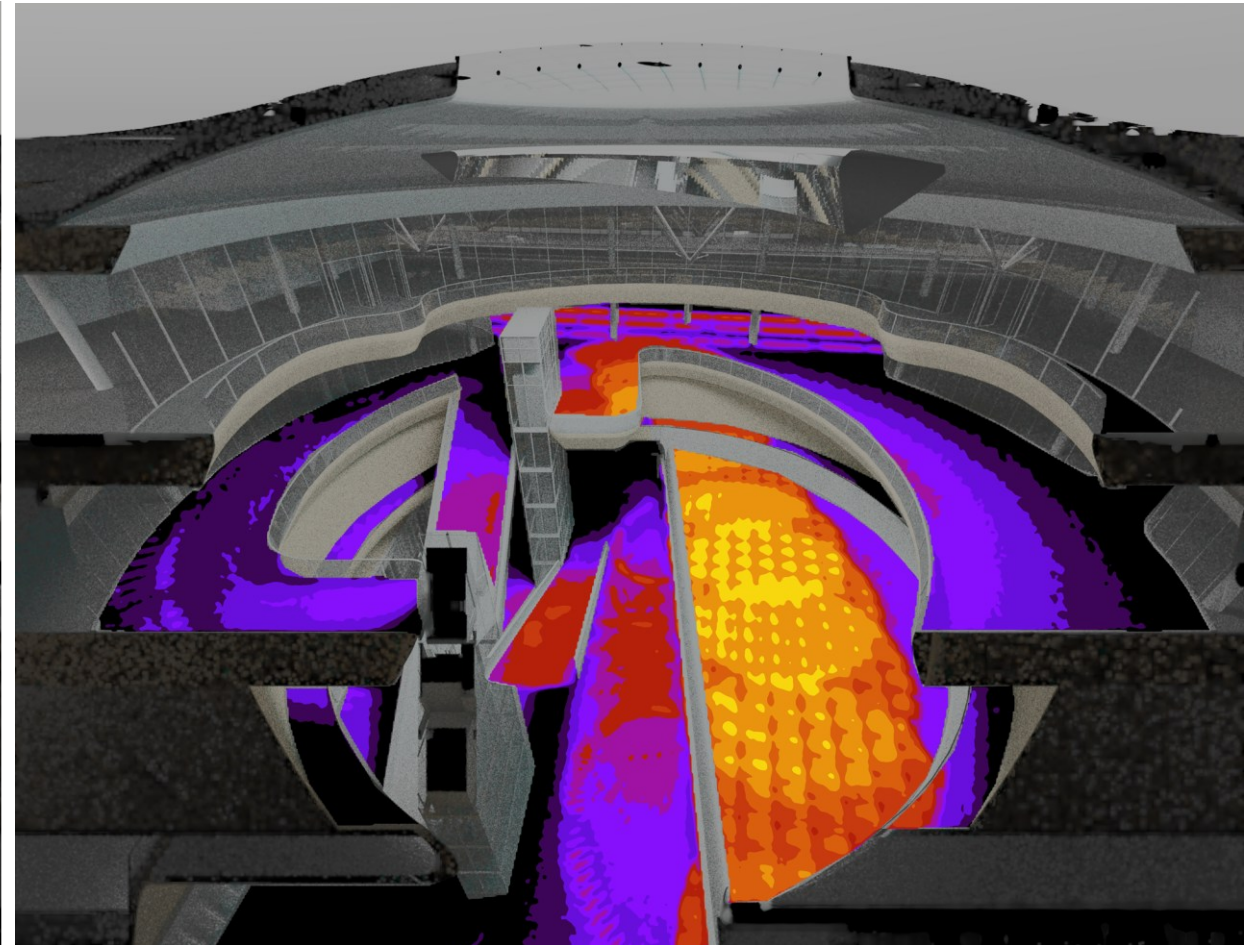
# Monthly Average DLI

Earlier Design Phase – No Plantings Selected – Aim to Maximize Solar Exposure for Garden

MARCH



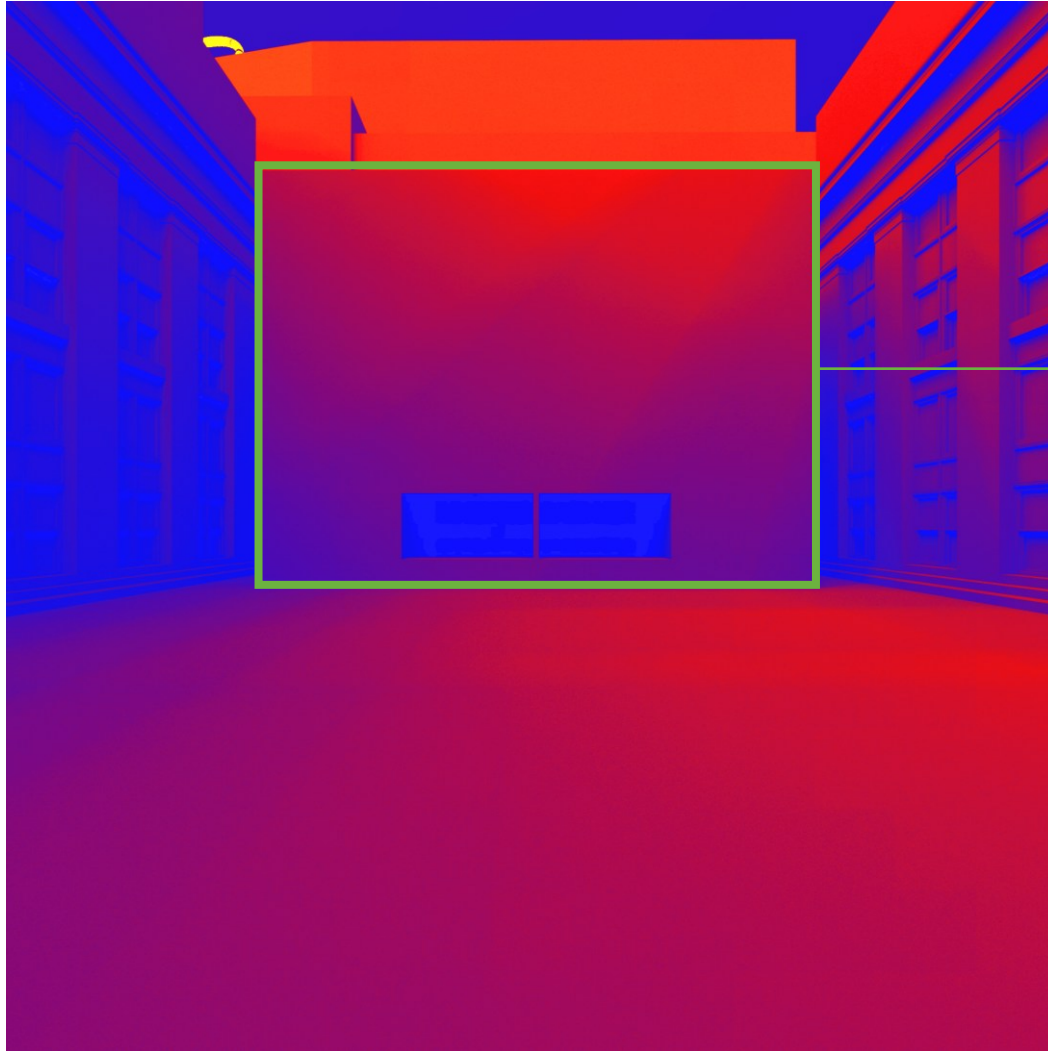
JUNE



# Green Wall Study

Daily Light Integral & Annual Sun Exposure Maps

During Design – Planting for Green Wall Selected – Aim to Determine Feasibility of Planting



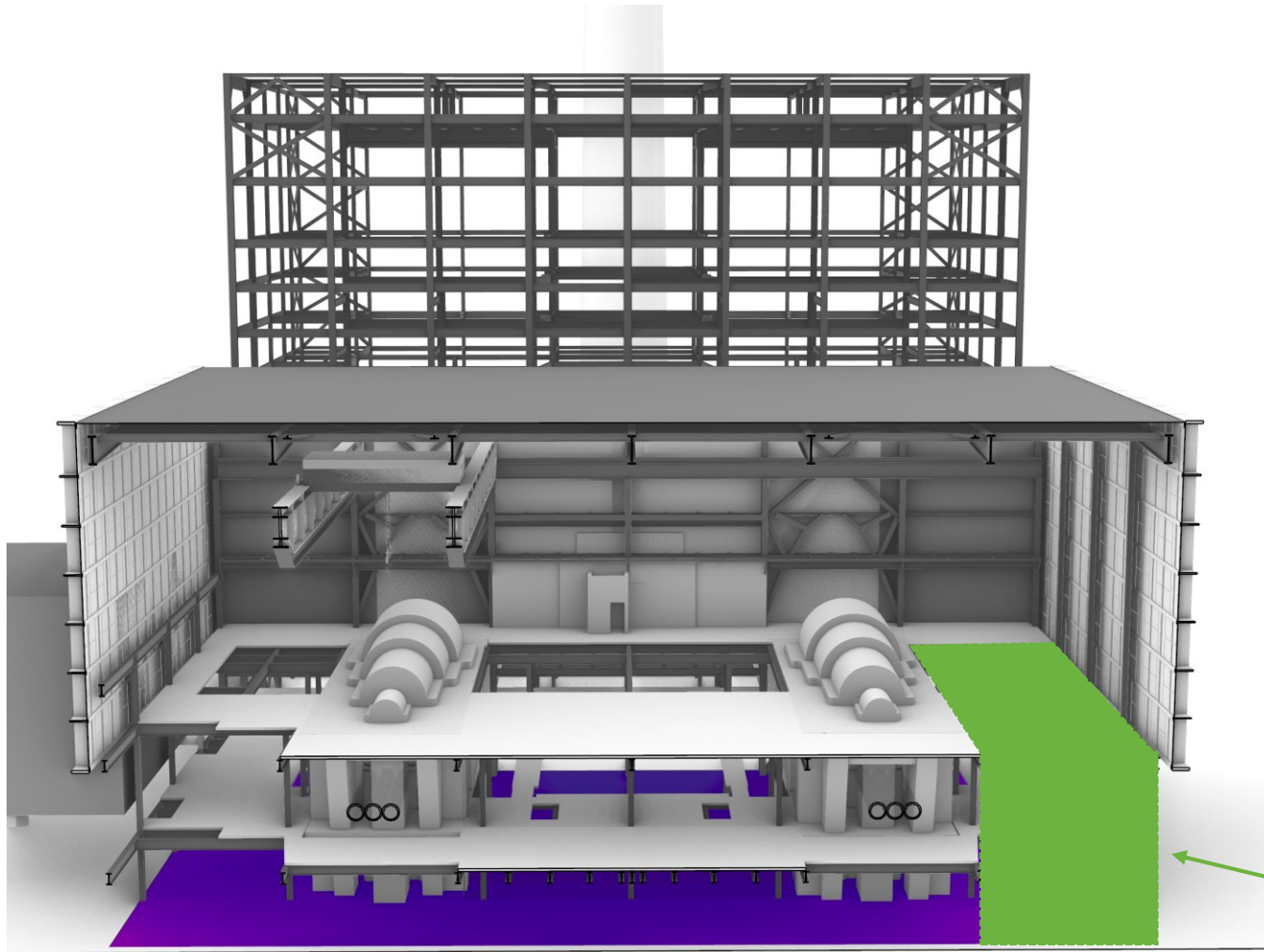
Range of DLI on  
green wall surface



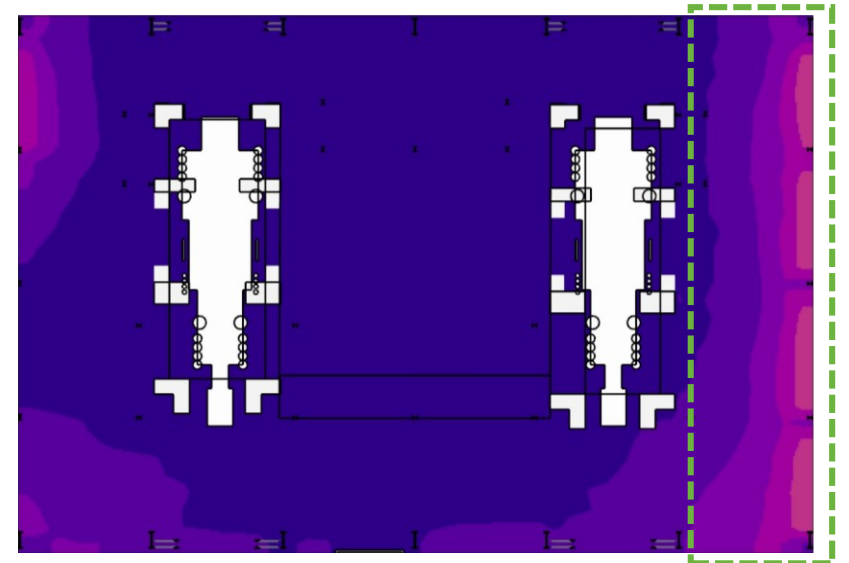
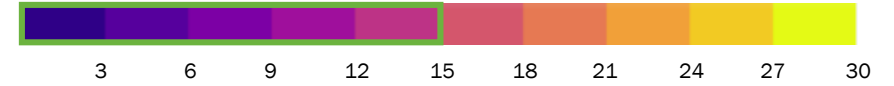
- Ferns require a minimum DLI of 2 and is high quality with a DLI of 10.

# Turbine Hall DLI Study

Tier 1



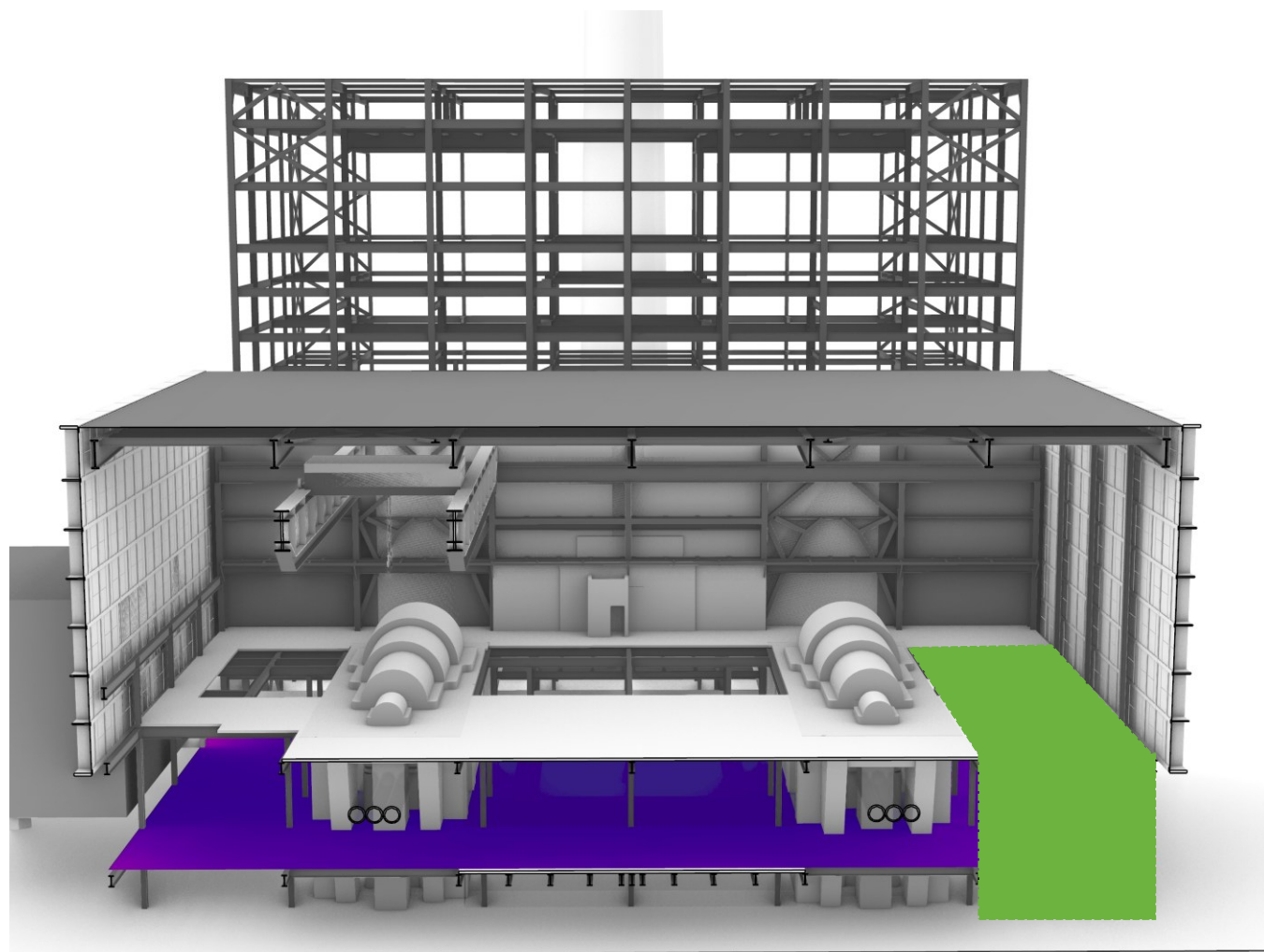
DLI  
MOL/M<sup>2</sup>/DAY



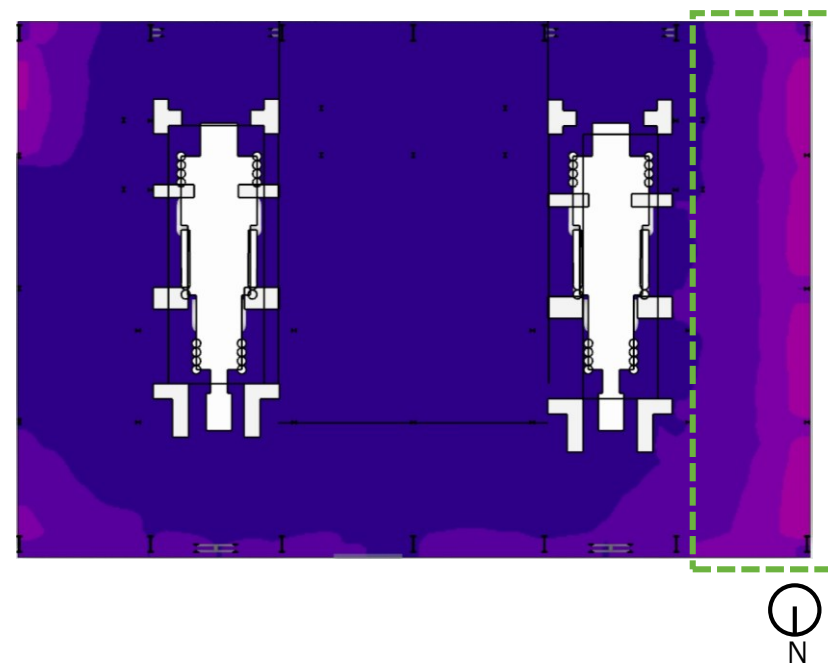
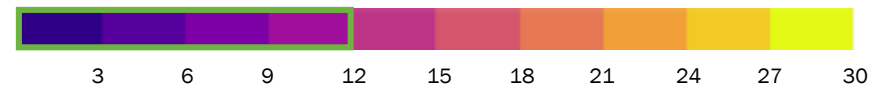
West area has the greatest potential for vegetation due to the exposed lower levels.

# Turbine Hall DLI Study

Tier 2



DLI  
MOL/M<sup>2</sup>/DAY

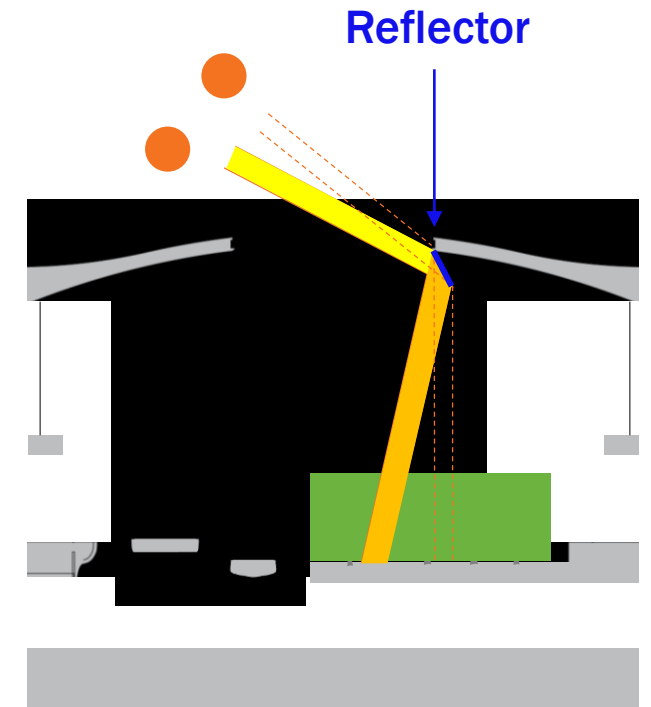


# Alternate Approach

## Design Problem

Designing a skylight to allow sunlight for both people and plantings in an airport waiting area.

Team was interested in redirecting direct sun onto vegetated areas for **plant growth**.



# Seasonal Illuminance Animations

## Overview

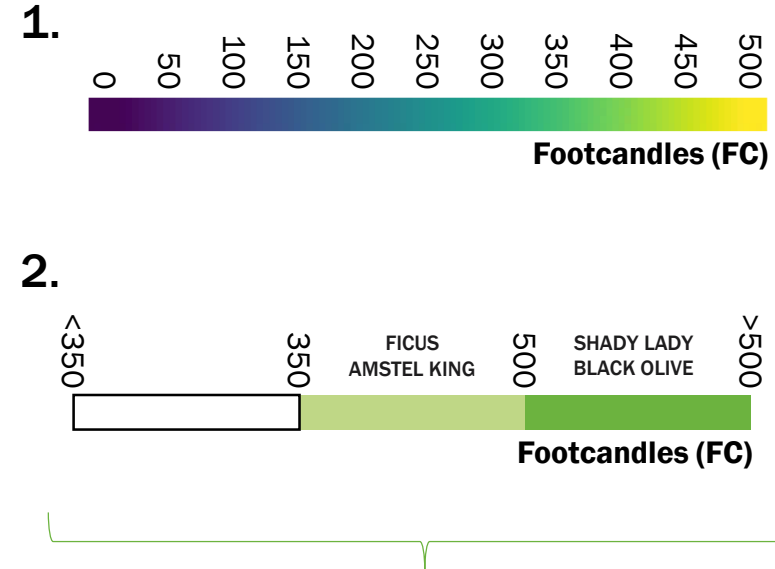
To evaluate the effectiveness of the optimized skylight and reflector design (Specular reflector + 70% VLT skylight) at promoting plant growth - Atelier Ten conducted a series of **seasonal illuminance animations**. Each animation represents a typical day of each season as follows:

1. Spring – March 21<sup>st</sup>
2. Summer – June 21<sup>st</sup>
3. Fall – September 21<sup>st</sup>
4. Winter – December 21<sup>st</sup>

Based on coordination with the landscape consultant, the **illuminance requirements for the plant species** in the space are listed below:

1. Average of 12 hrs of illumination per day
2. Minimum illuminance of:
  1. **Ficus Amstel King** – 350 footcandles
  2. **Shady Lady Black Olive** – 500 footcandles

*ASSUMPTION: Analysis plane is 5ft above floor level*



**The illuminance results are represented in two ways:**

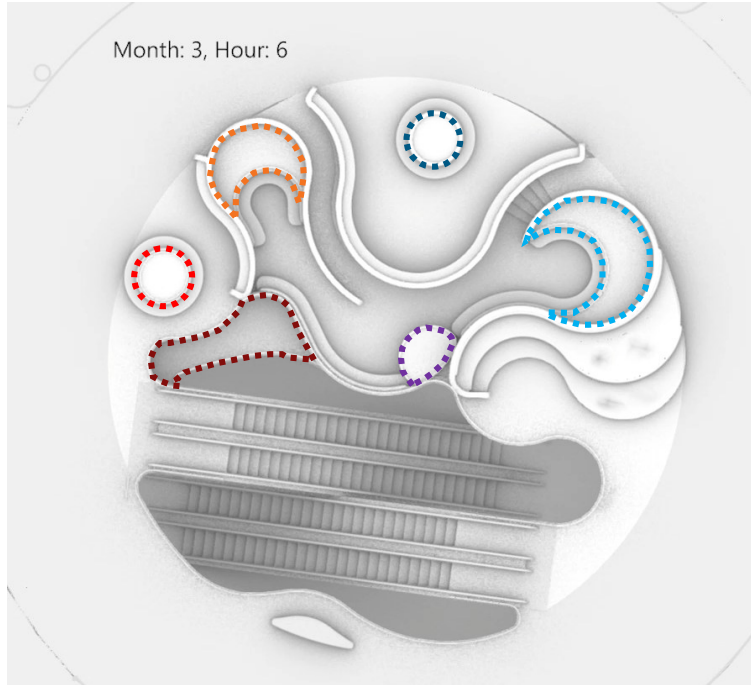
1. Continuous scale
2. Bucketed scale per plant species requirements

# Illuminance – Spring

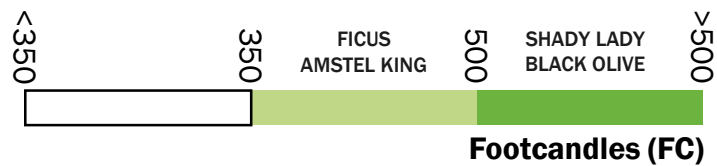
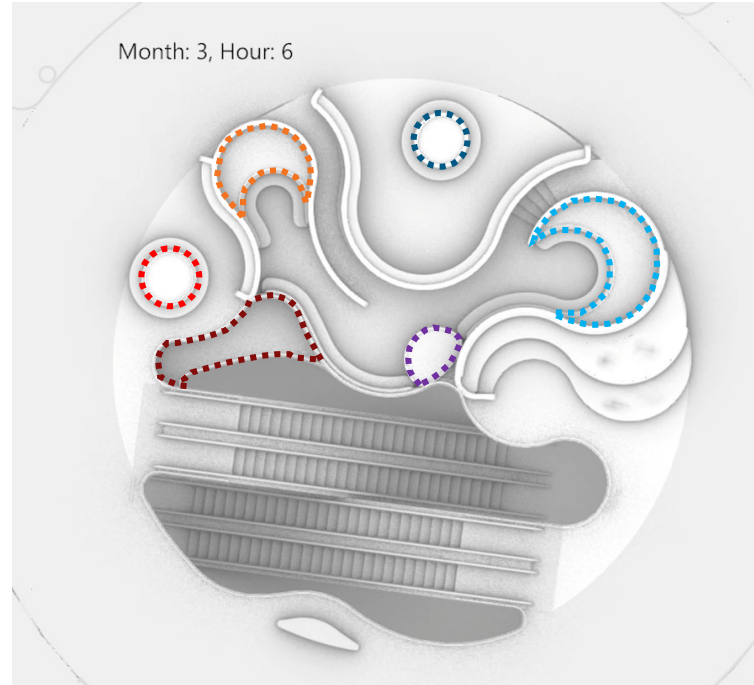
March 21<sup>st</sup>

*\*Note that spaces only exceed 350 lux when they are hit with direct sun, which also corresponds to exceeding 500 lux. In other words, hours with illuminance >350 lux are the same as those with >500 lux. See appendix 3 for full continuous illuminance scale animations*

## Baseline without Reflector



## With Reflector



## ● Additional Benefit due to Reflector

### Hours w/Illuminance > 500 fc\*

#### Planter A

0 hrs ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ 12 hrs

#### Planter B

1 hrs ● ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ 12 hrs

#### Planter C

3 hrs ● ● ● ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ 12 hrs

#### Planter D

0 hrs ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ 12 hrs

#### Planter E

0 hrs ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ 12 hrs

#### Planter F

1 hrs ● ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ 12 hrs

# Summary

## Seasonal Illuminance

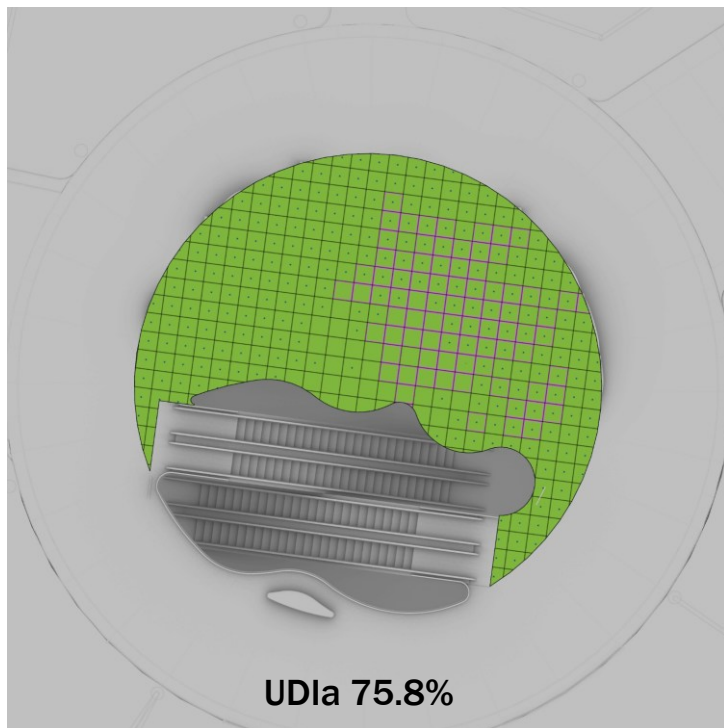
| Season                                        | No. of Hours per Day with Illuminance >350 & >500 lux |           |           |           |           |           |
|-----------------------------------------------|-------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|
|                                               | Planter A                                             | Planter B | Planter C | Planter D | Planter E | Planter F |
| <b>Spring</b><br>(March 21 <sup>st</sup> )    | 0                                                     | 1         | 3         | 0         | 0         | 1         |
| <b>Summer</b><br>(June 21 <sup>st</sup> )     | 3                                                     | 2         | 3         | 3         | 3         | 3         |
| <b>Fall</b><br>(September 21 <sup>st</sup> )  | 1                                                     | 2         | 2         | 0         | 0         | 0         |
| <b>Winter</b><br>(December 21 <sup>st</sup> ) | 1                                                     | 0         | 0         | 0         | 1         | 0         |

To increase the number of hours of light for each planting to 12 hours for healthy plant growth, artificial grow lighting is needed.

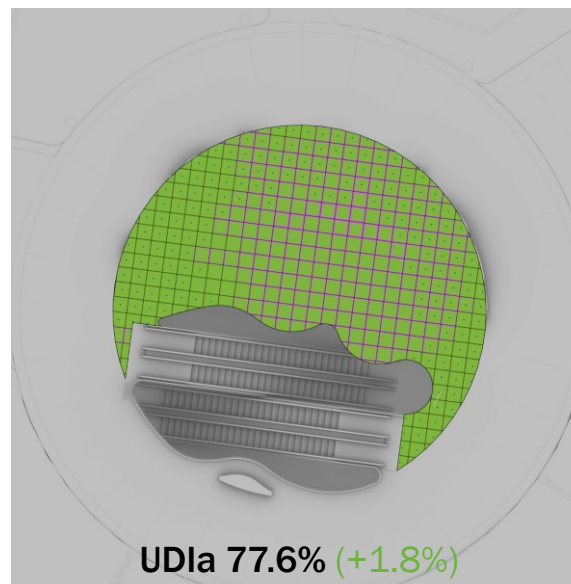
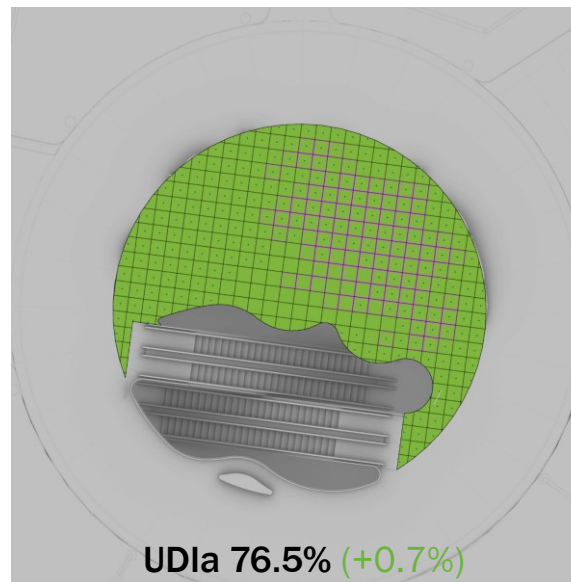
# Useful Daylight Illuminance (UDI)

Annual Results

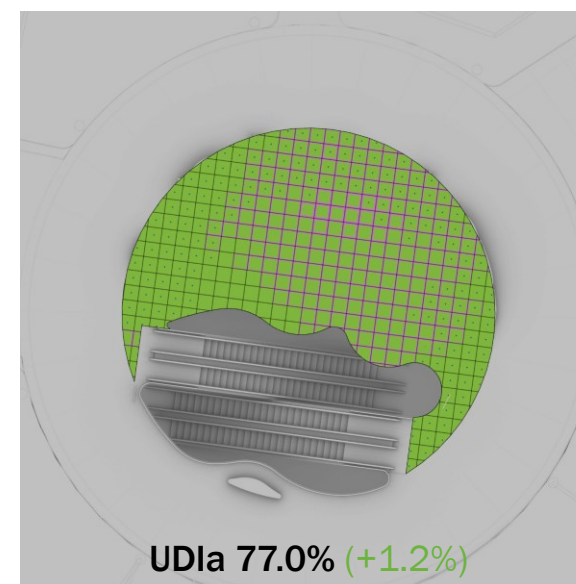
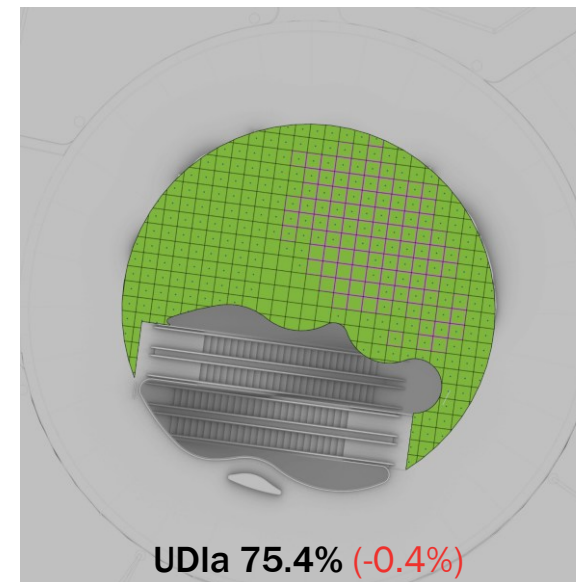
## BASELINE – NO REFLECTOR



## Diffuse Reflector

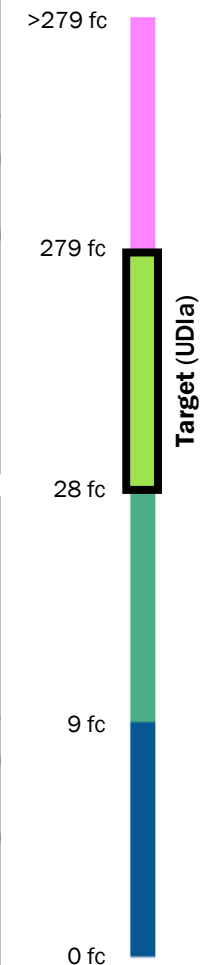


## Specular Reflector



Base VLT – 55%

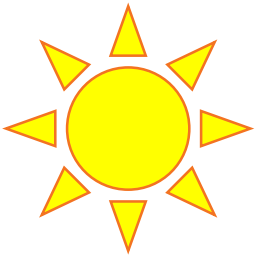
Higher VLT – 70%



# What Next?

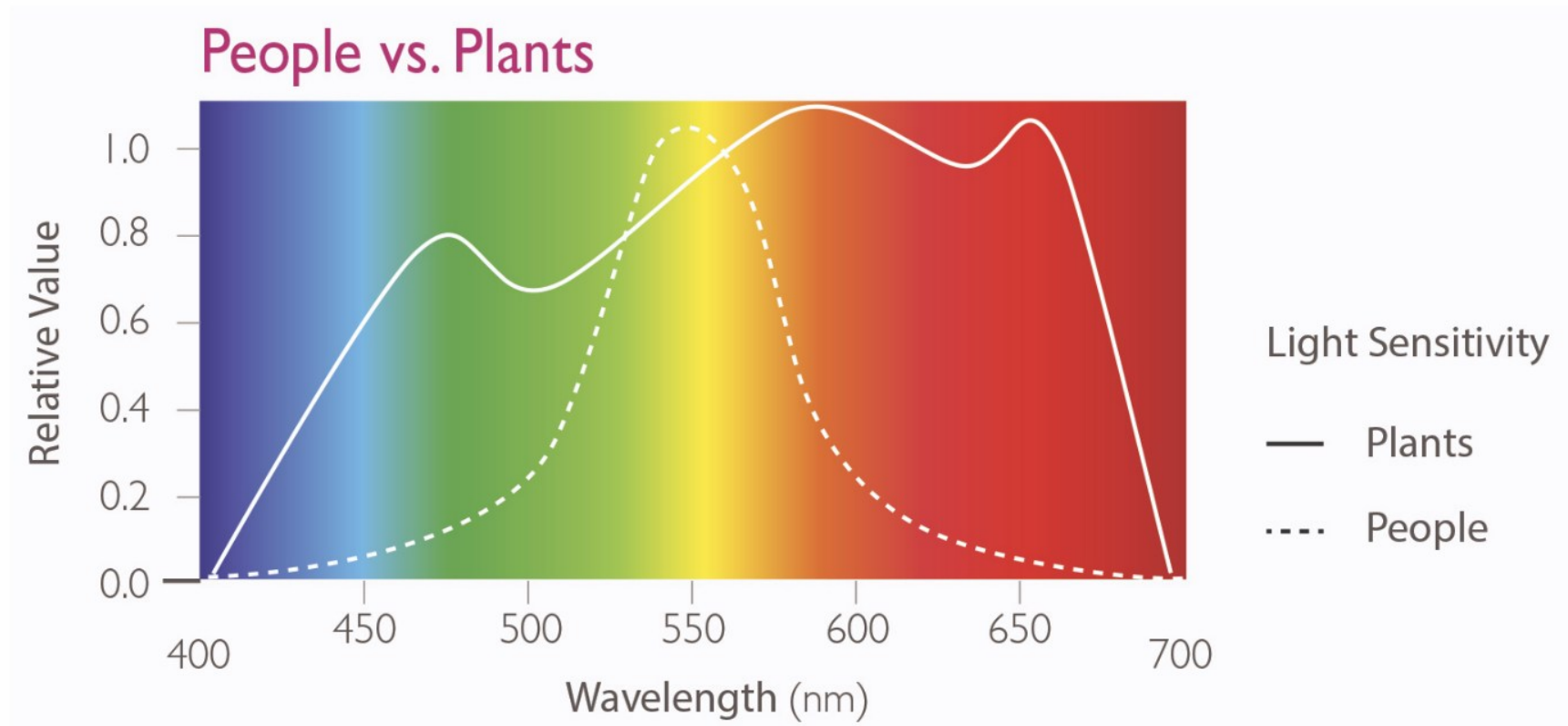
Below are a few questions that we are addressing through active discussions with arborists and horticulturists:

1. How do we account for time of day preference in our metric?
2. Is there a quantitative way to take into account specific site conditions?
3. What is the “maximum” adaptability range of plantings when their access to solar exposure drastically changes in a short period of time?
4. How does the construction phase play a role in the health of plants?



# What Next?

**Currently exploring spectral simulation for people, plantings, and animals!**



[Image taken from: pilight.com/understanding-lighting-metrics/](https://pilight.com/understanding-lighting-metrics/)

# Questions?

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