
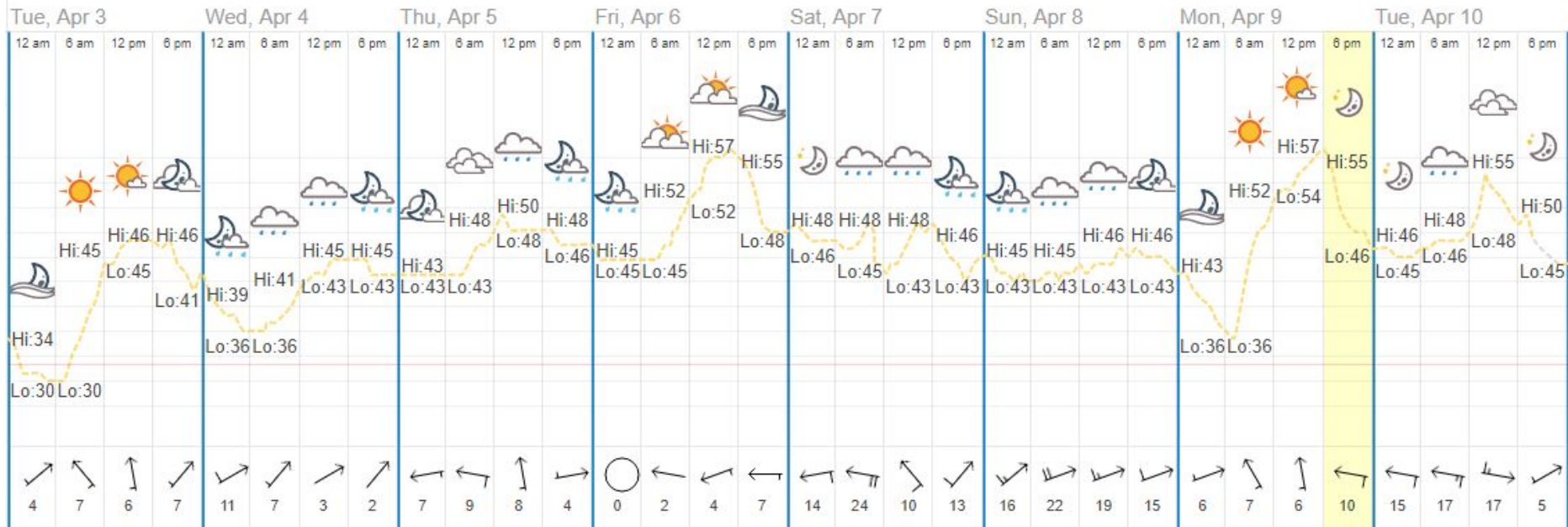


THE ED BUILDING: A SUN SHADING STUDY

Allison Gray & Hanna Kuipers

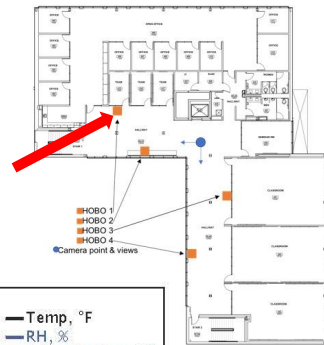


INDEX.

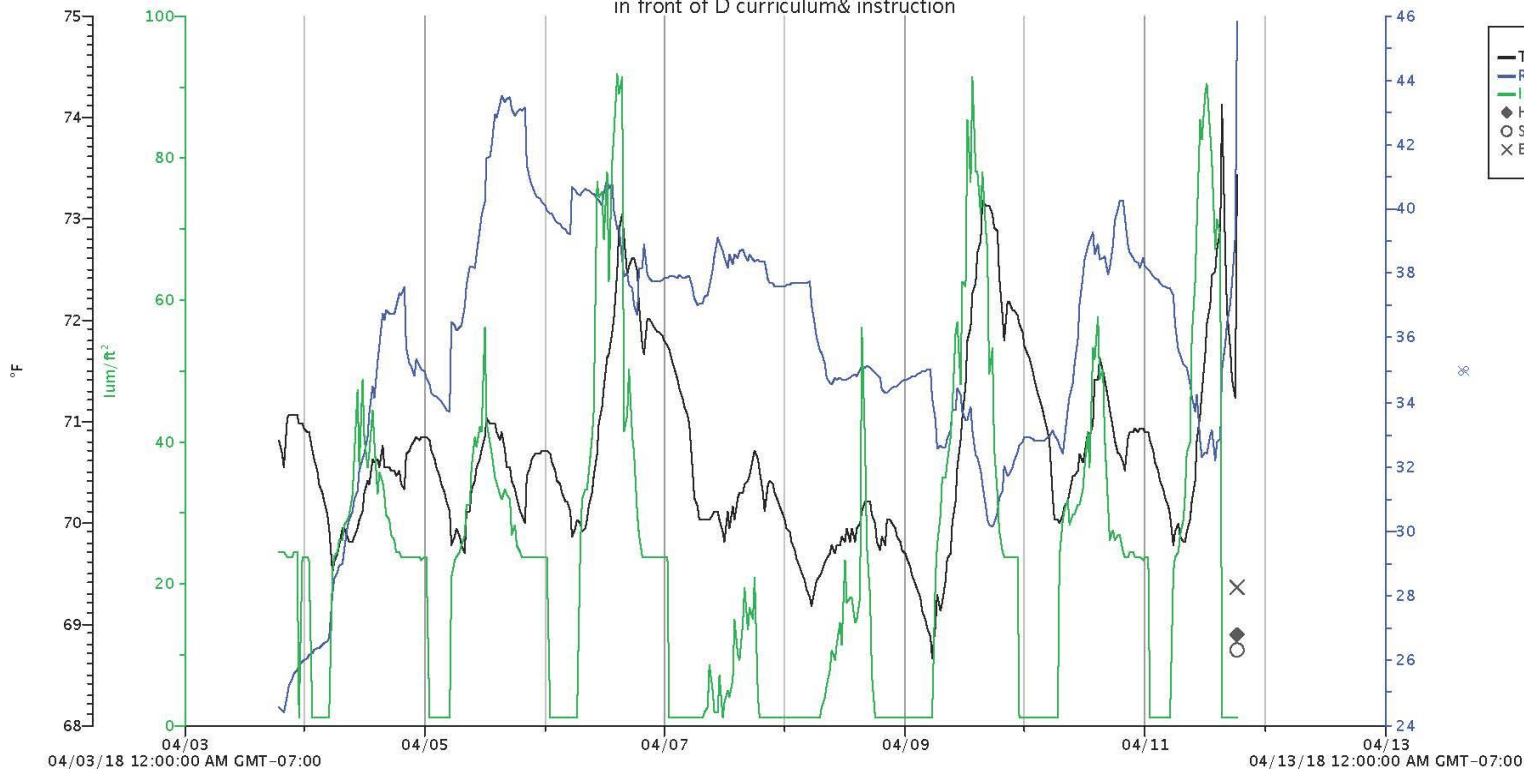


HOBO DATA

HOBO 1 - located in a shaded area near a heavily trafficked and air conditioned area.

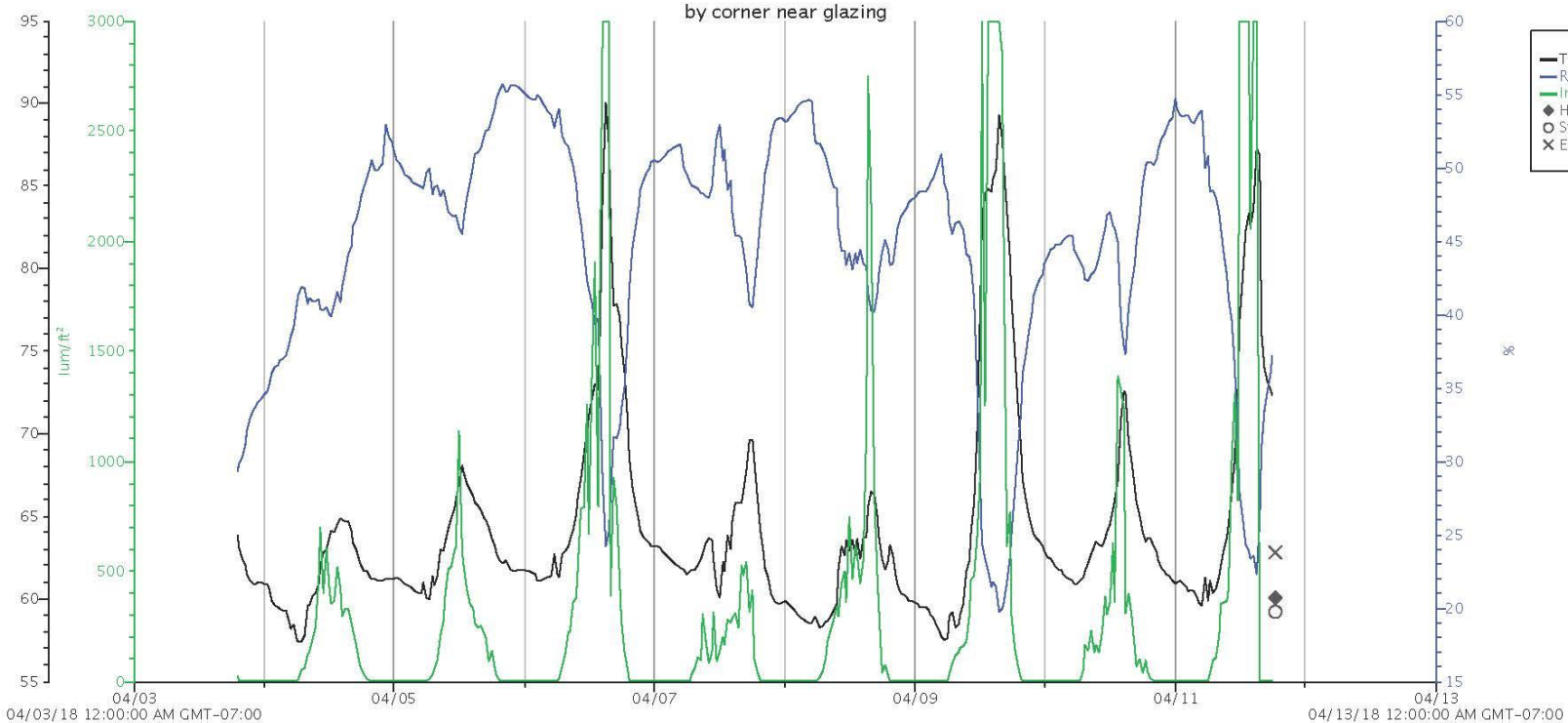
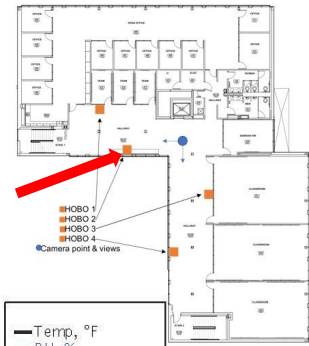


in front of D curriculum& instruction



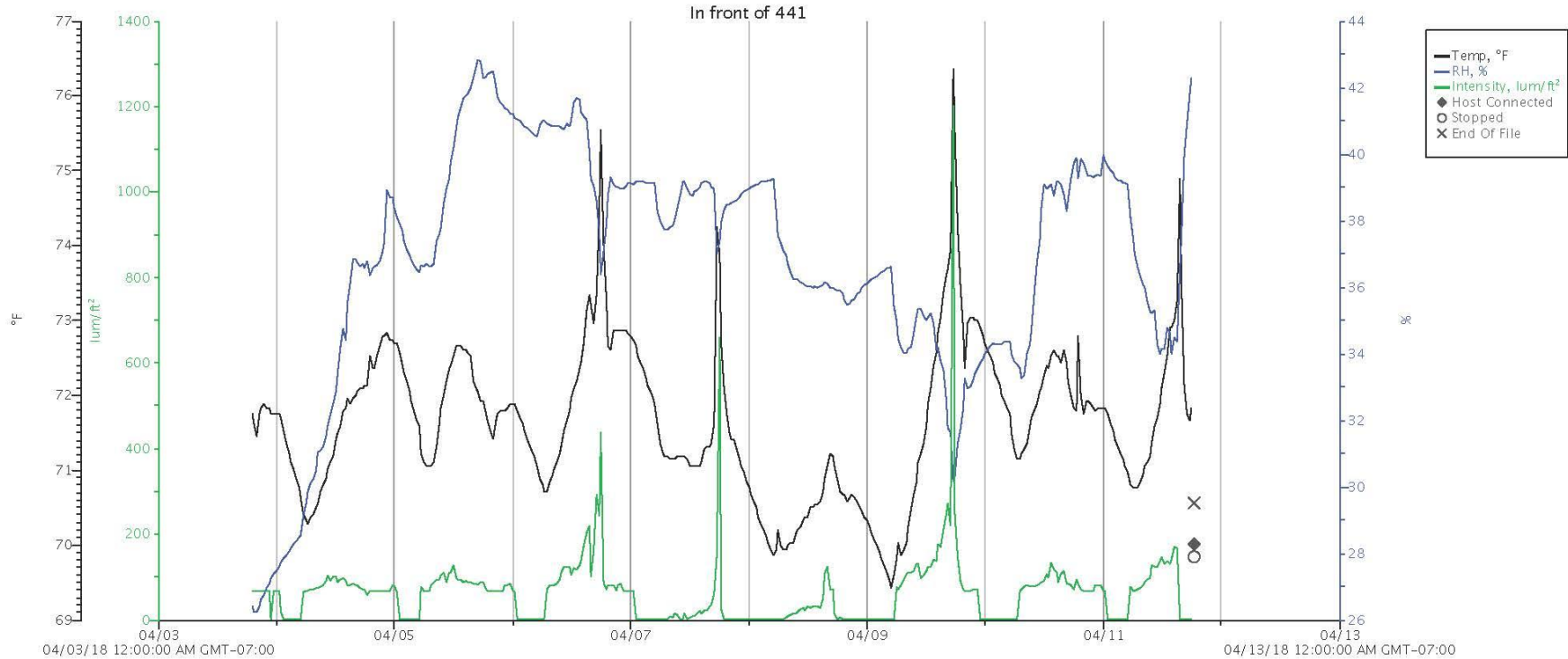
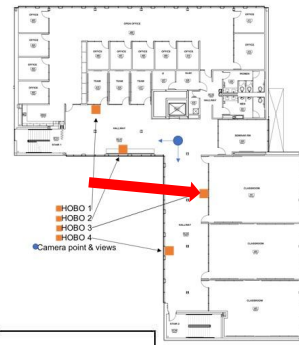
HOBO DATA

HOBO 2 - located in a glare and sun heavy area, no shielding or shading at any time. A/C vents located on window sill which this HOBO was located under.



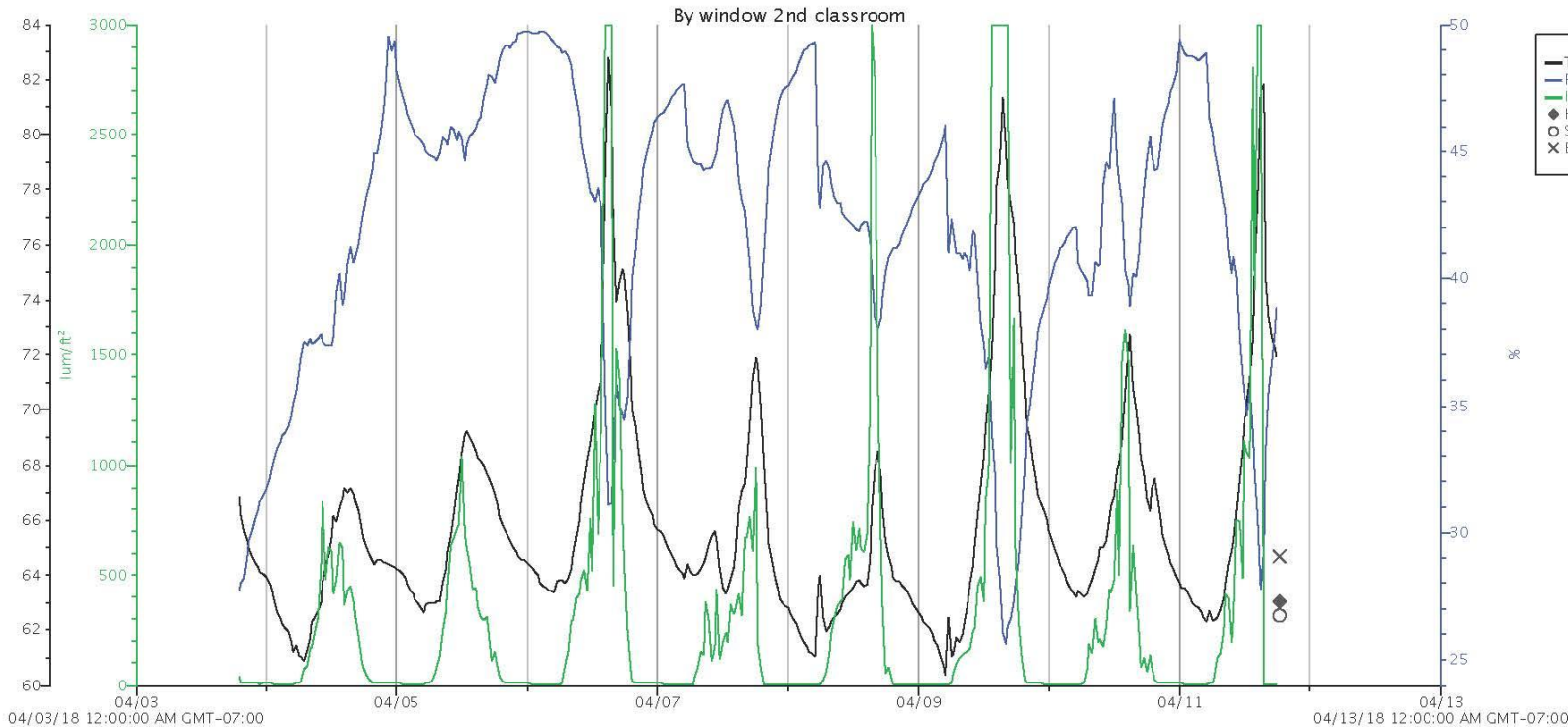
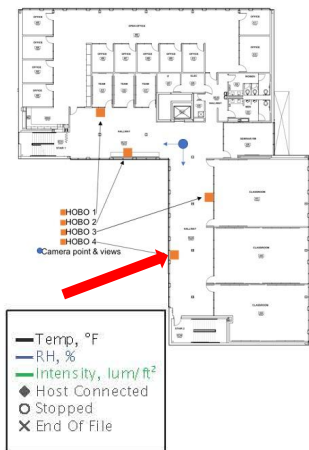
HOBO DATA

HOBO 3 - located in a low traffic area, has glare from two areas (floor and interior glazing wall).



HOBO DATA

HOBO 4 - located in a high intensity area, has some shading i certain hours of the day, just like HOBO 2 this HOBO is also located under an A/C vent.



PYROMETER READINGS

On the right are the charts of the surface temperatures of the conference desk in front of 441 (near HOBO 4) and the work desk in front of the offices (near HOBO 2).

Day & Time	Temp (F)
04/03 9:00am	64
04/03 12:00pm	68
04/03 3:00pm	70
04/04 9:00am	68
04/04 12:00pm	68
04/04 3:00pm	69
04/05 9:00am	66
04/05 12:00pm	68
04/05 3:00pm	69
04/06 9:00am	70

04/06 12:00pm	78
04/06 3:00pm	84
04/07 9:00am	72
04/07 12:00pm	68
04/07 3:00pm	64
04/08 9:00am	62
04/08 12:00pm	64
04/08 3:00pm	68
04/09 9:00am	70
04/09 12:00pm	80
04/09 3:00pm	90

Day & Time	Temp (F)
04/03 9:00am	66
04/03 12:00pm	68
04/03 3:00pm	68
04/04 9:00am	68
04/04 12:00pm	68
04/04 3:00pm	68
04/05 9:00am	68
04/05 12:00pm	70
04/05 3:00pm	72
04/06 9:00am	74

04/06 12:00pm	80
04/06 3:00pm	88
04/07 9:00am	78
04/07 12:00pm	76
04/07 3:00pm	70
04/08 9:00am	64
04/08 12:00pm	66
04/08 3:00pm	68
04/09 9:00am	74
04/09 12:00pm	81
04/09 3:00pm	86

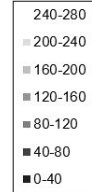
INFRARED CAMERA

These images are a general overview of our findings with the infrared camera. The upper images are on the coolest day, and the lower images were taken on the warmest day.



GLARE ANALYSIS

Glare is an issue that can be resolved using shading and light shelves in order to soften and scatter the natural light entering the space.

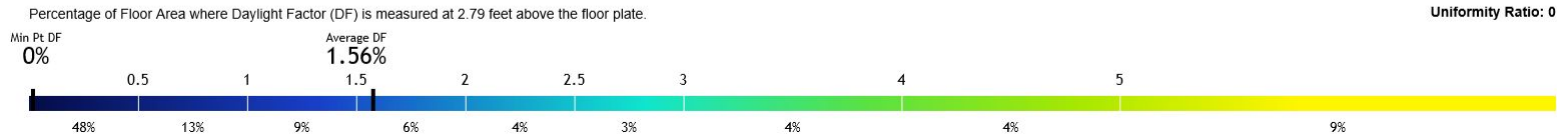
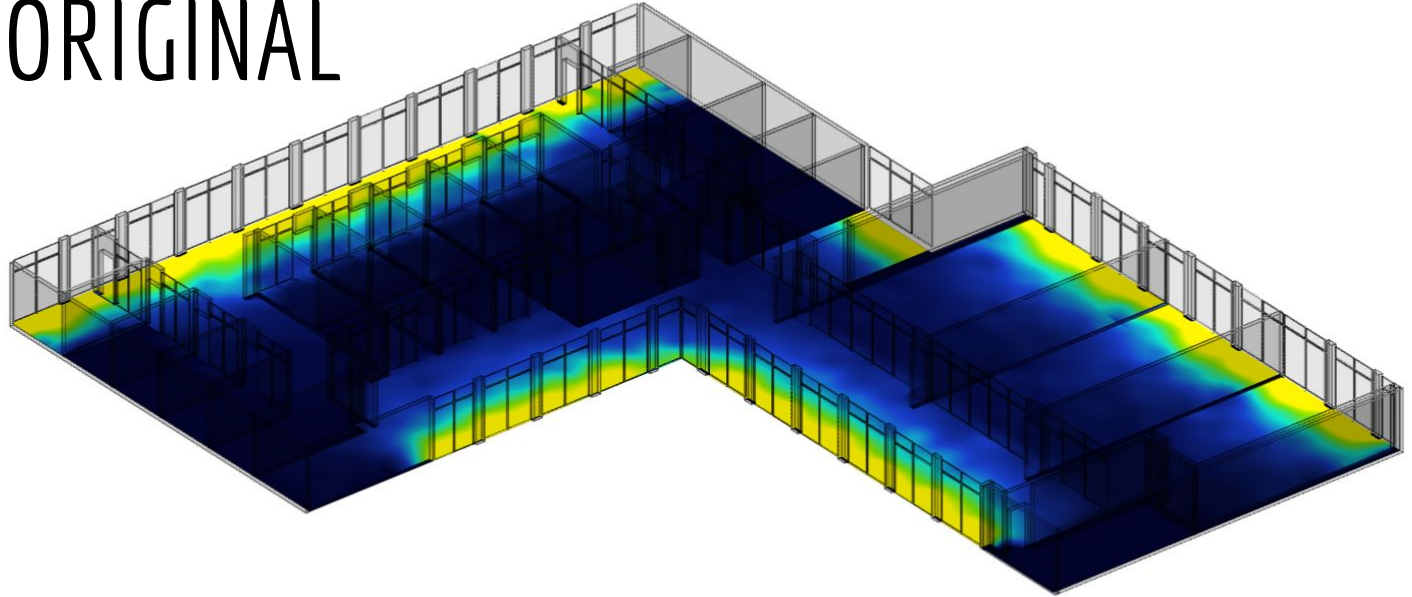


SEFAIRA: ORIGINAL

Daylight Factor

DF- Daylighting factor

The DF is measured 2.79 feet above floor plan while most work areas on the floor are 3.5 feet above work plane.

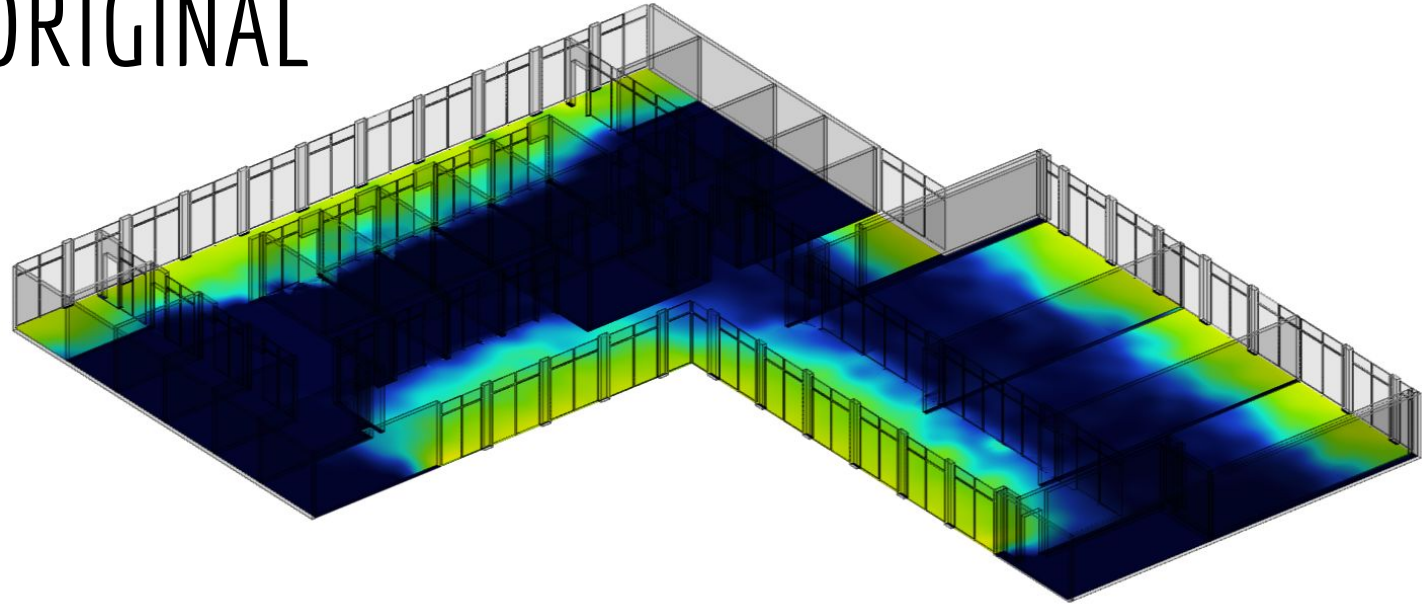


SEFAIRA: ORIGINAL

Annual Footcandles

Foot candle minimum here is set at 37 (which is normal for school environments).

This model represents the percentage of hours that the work plane (3.5 ft above floor plane) is satisfactorily illuminated.



Percentage of occupied hours where illuminance is at least 37 footcandles, measured at 3.61 feet above the floor plate.

0%

25%

50%

75%

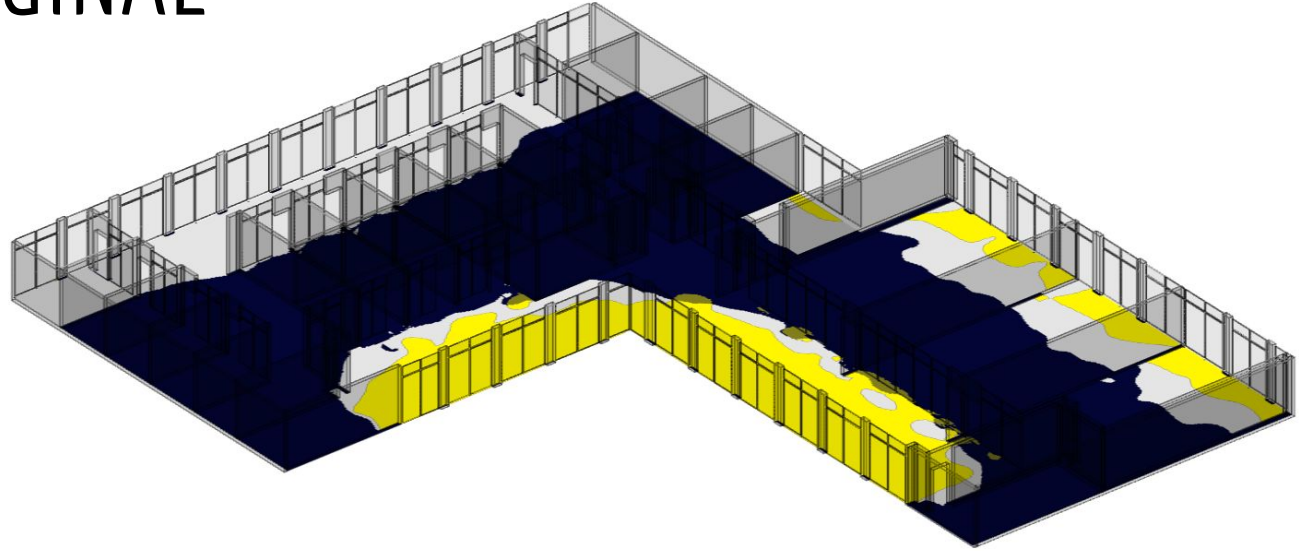
100%

SEFAIRA: ORIGINAL

Underlit/Overlit Spaces

In its current lighting scheme, the student work spaces are very over lit, while staff spaces (on the north end) are well lit.

The middle work rooms and conference rooms are highly underlit as well as the middle of the class rooms. Light is not well distributed through the building.

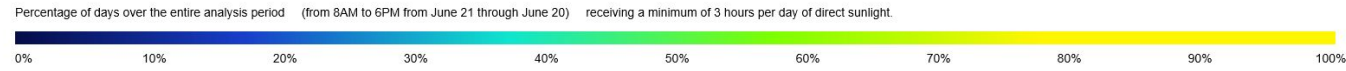
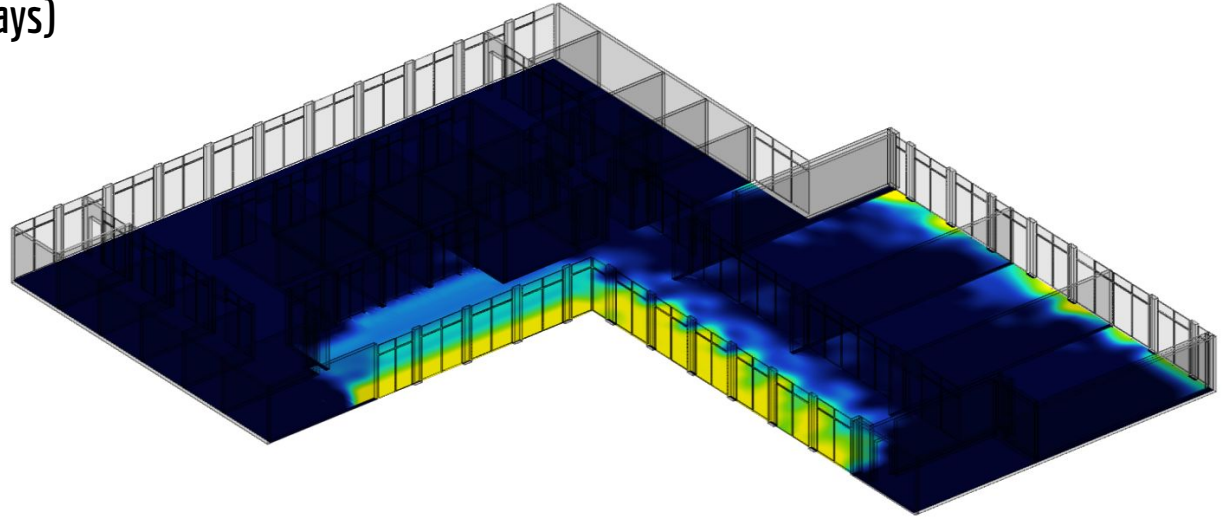


SEFAIRA: ORIGINAL

Direct Sunlight Analysis (365 days)

This model shows an entire year in the building (June 21st to June 20). It displays which places get *at least* 3 hours of daylight daily (ALL YEAR ROUND).

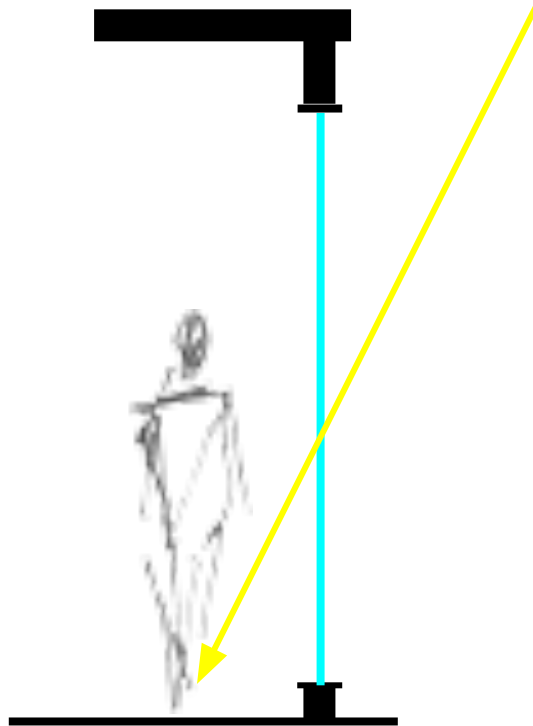
Meaning that our “problem areas” are lit up for at least 3 hours a day for 365 days with direct sunlight.



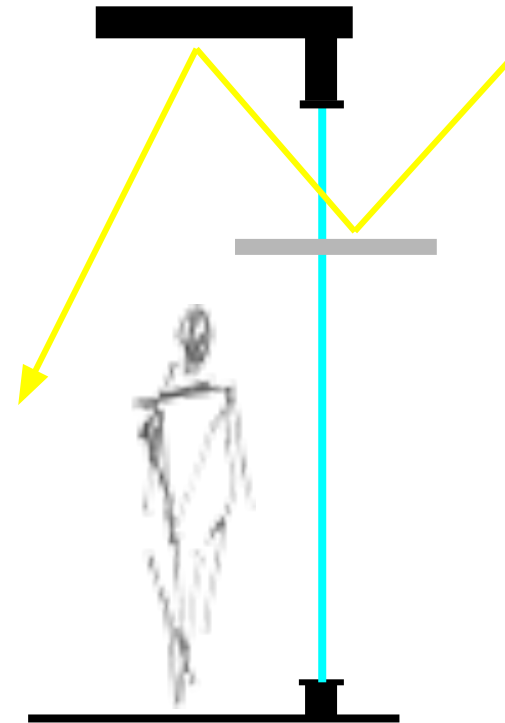
THE LIGHT SHELF

With the installation of light shelves on the glazing wall, daylight will be better distributed into the building. This will allow the interior conference rooms and offices to profit fully from the natural daylight. Currently, the only natural light in the rooms is provided through glare on the floors.

Without Light-Shelf



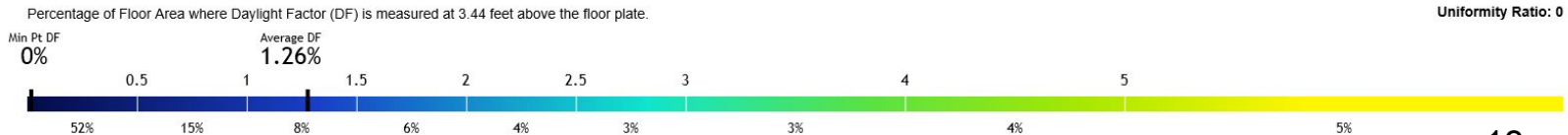
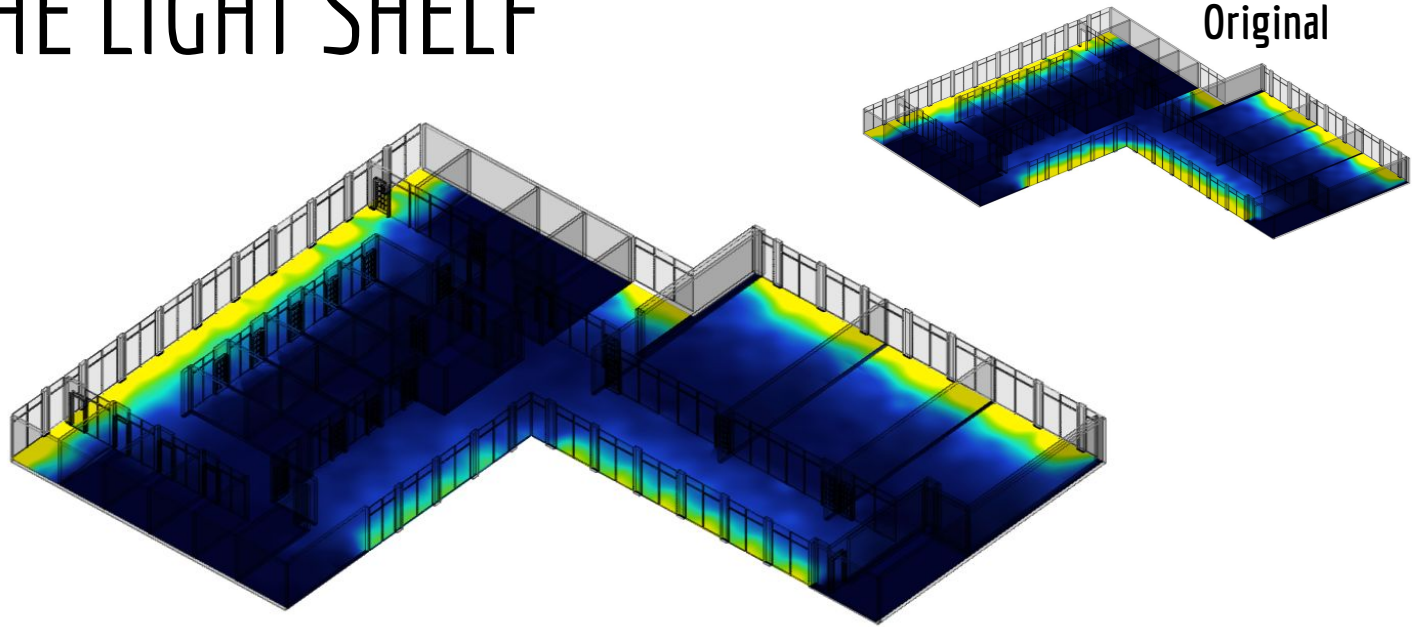
With Light-Shelf



SEFAIRA: THE LIGHT SHELF

Daylight Factor

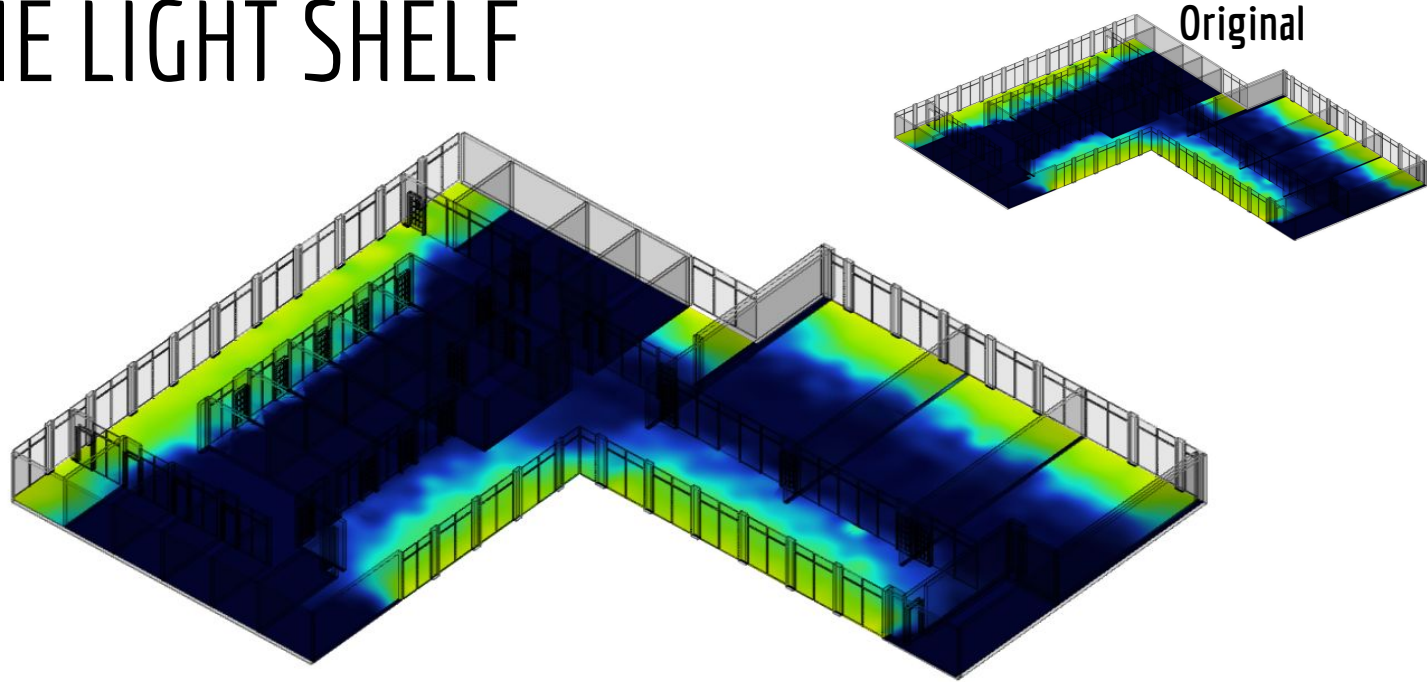
The addition of light shelves successfully distributed daylight further into the space, and decreased the light intensity at the student work areas. The light shelf will not be implemented on the north and east sides as on these ends natural vegetation brings down the daylight factor ratio.



SEFAIRA: THE LIGHT SHELF

Annual Footcandles

At work surface at 3.44 ft., the light shelf alone will not do much to increase the overall illumination. The quality of light should be consistent along the work surface, while driving light further into the offices and classrooms, even if they are visibly lighter due to the light shelf.



Percentage of occupied hours where illuminance is at least 37 footcandles, measured at 3.44 feet above the floor plate.

0%

25%

50%

75%

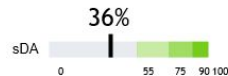
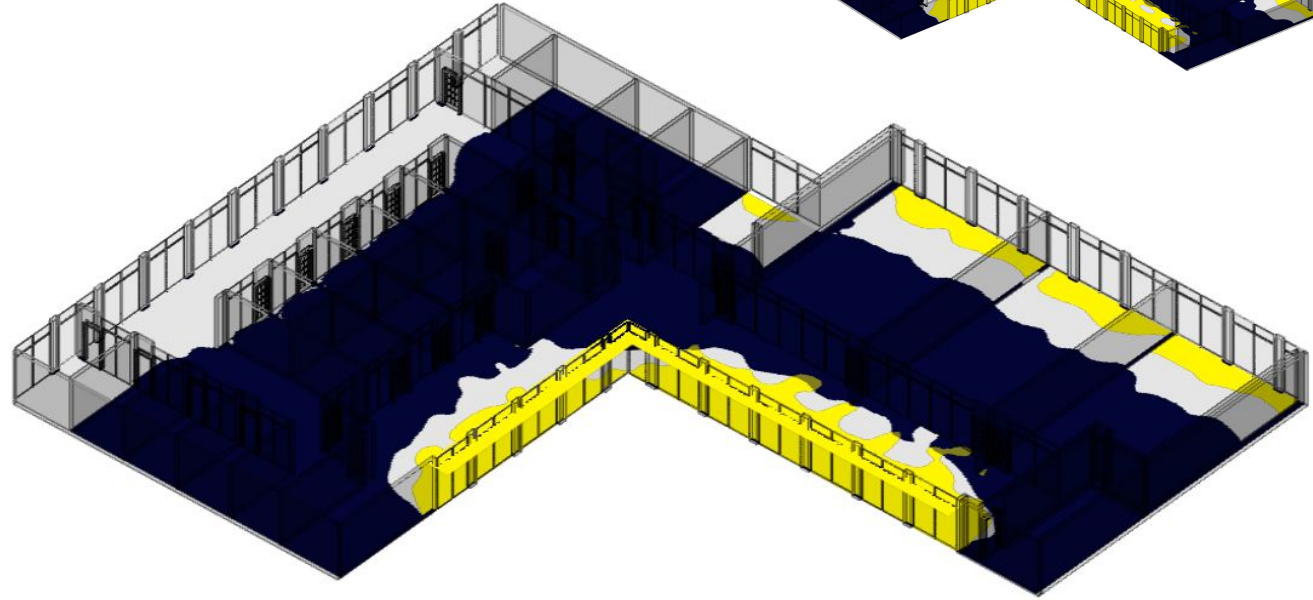
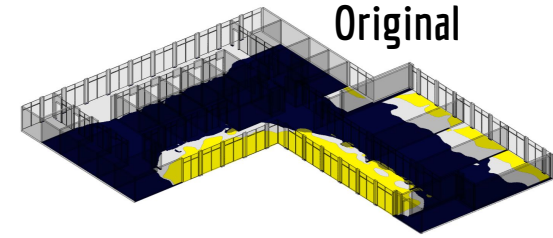
100%

SEFAIRA: THE LIGHT SHELF

Underlit/Overlit Spaces

Though still mostly overlit near the workspaces, the amount of well lit space in near the South & West glazing has greatly increased.

Due to the criteria for “over-lit” and “under-lit” spaces, even minimal change in the areas is very significant.

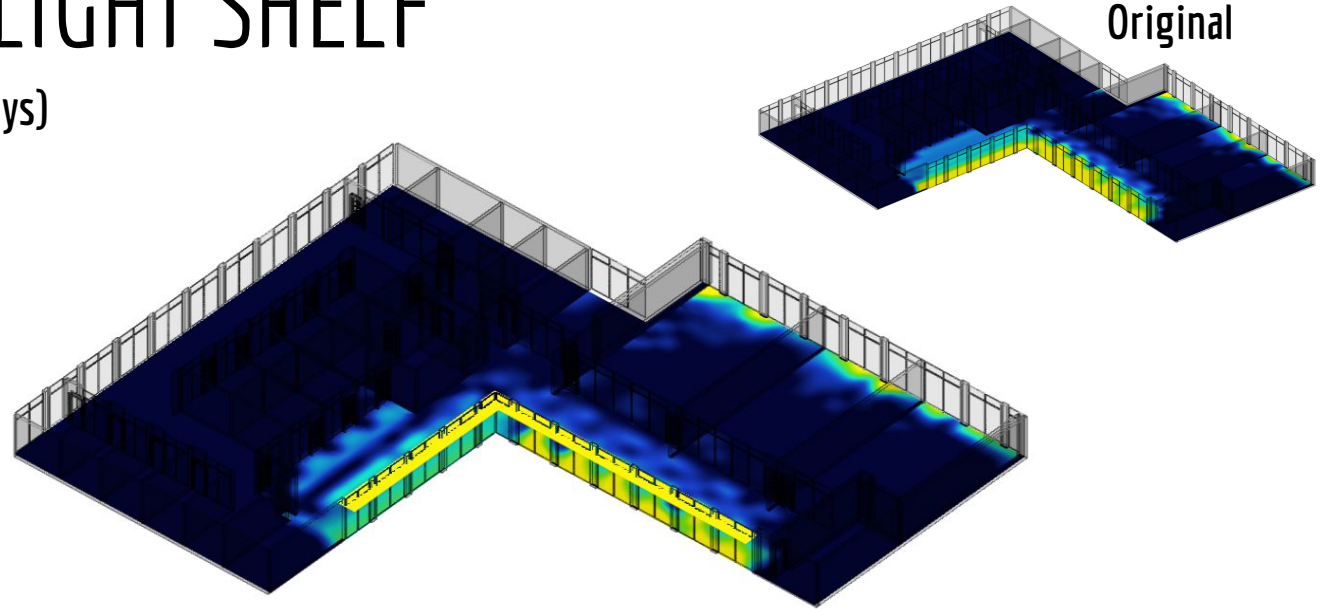


SEFAIRA: THE LIGHT SHELF

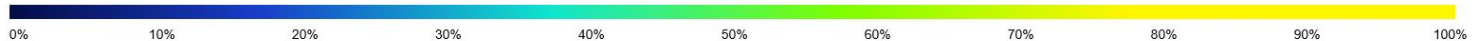
Direct Sunlight Analysis (365 days)

The annual analysis shows the light shelf is helping the overall lighting scheme daily, however, spaces on the south end no longer receive direct daylight *at all* during the year. This means that there is less direct heat gain on those work spaces.

Some of the spaces behind the light shelf still receive daylight by low sun. This leads to some additional glare off of the glossy flooring.



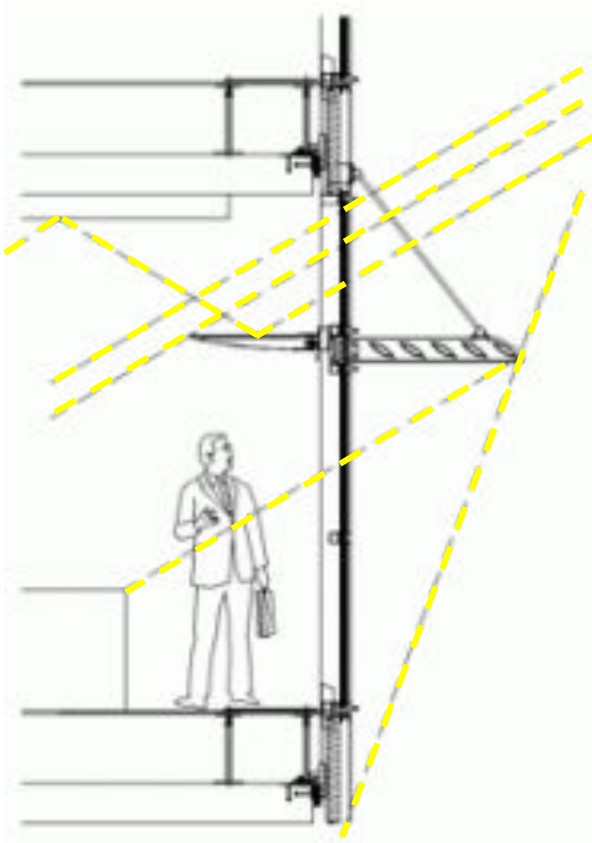
Percentage of days over the entire analysis period (from 8AM to 6PM from June 21 through June 20) receiving a minimum of 3 hours per day of direct sunlight.



THE OVERHANG

This exterior shading device will be integrated with the interior light shelf. This system will allow the light to filter further into the space, decreasing direct heat gain during the summer, while still allowing some direct sunlight and in the winter.

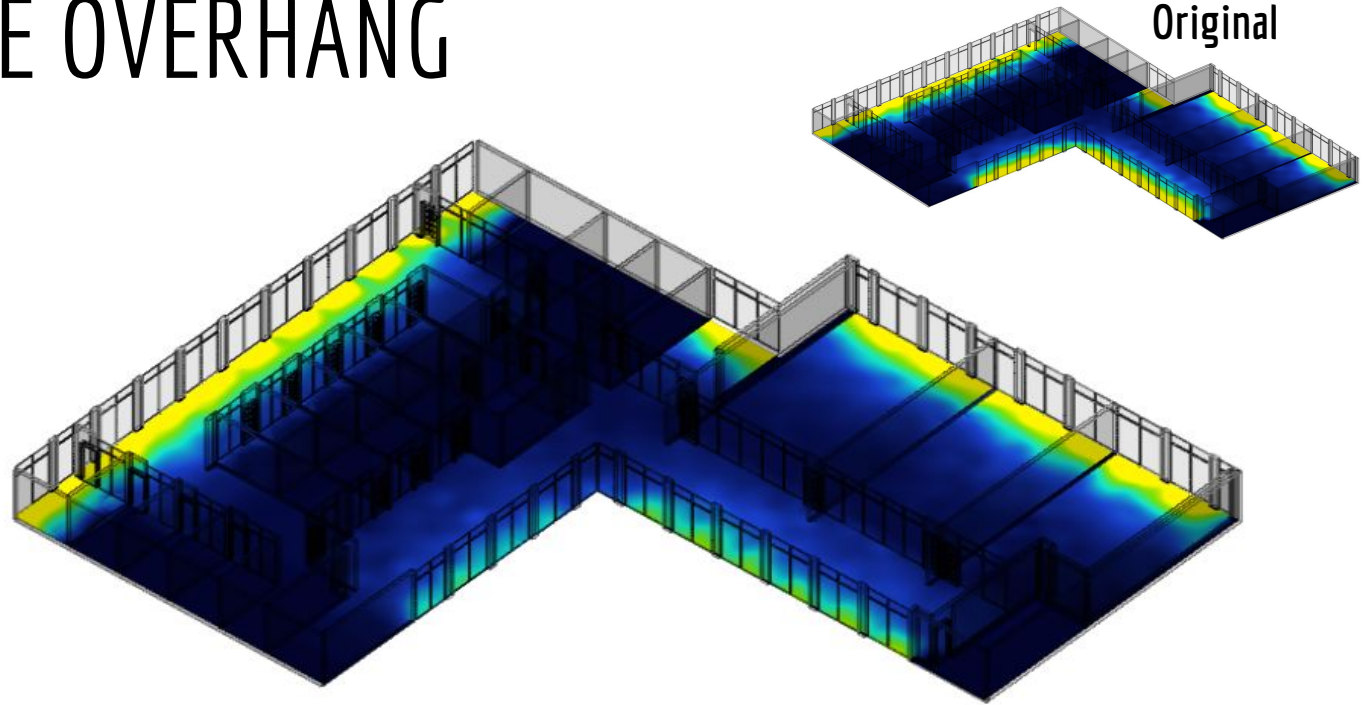
The proposed material is brushed aluminum to minimize exterior glare.



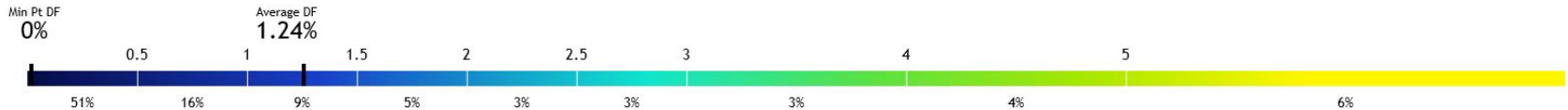
SEFAIRA: THE OVERHANG

Daylight Factor

The light is visibly more evenly distributed within the space, especially along the interior glazing walls. There are still some DF ratio spikes along the west facing facade due to the fact that horizontal shading is not fit to protect from dawning light.



Percentage of Floor Area where Daylight Factor (DF) is measured at 3.44 feet above the floor plate.



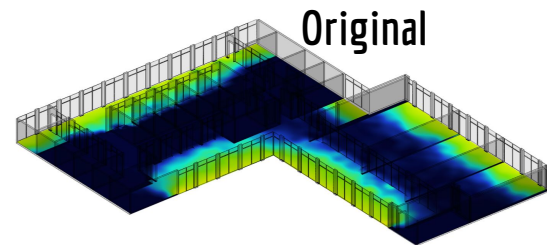
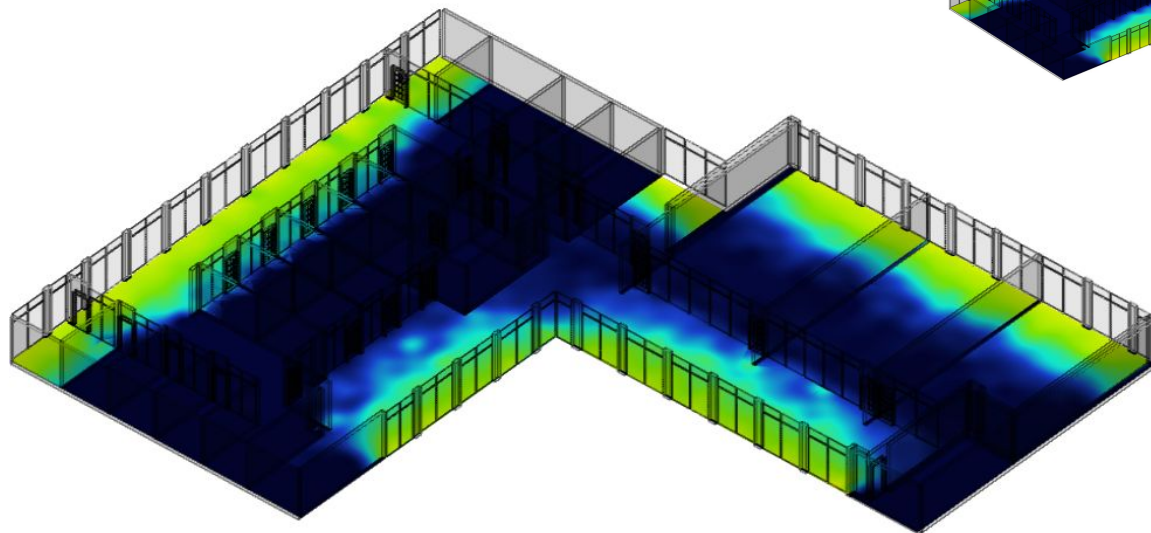
Uniformity Ratio: 0

SEFAIRA: THE OVERHANG

Annual Footcandles

With the addition of the overhang, there is still quite a bit of comfortable and appropriate light along the work spaces. The glazing wall also shows significantly less glare than in the original.

This also decreases the glare caused by the exterior glazing.



Percentage of occupied hours where illuminance is at least 37 footcandles, measured at 3.44 feet above the floor plate.

0%

25%

50%

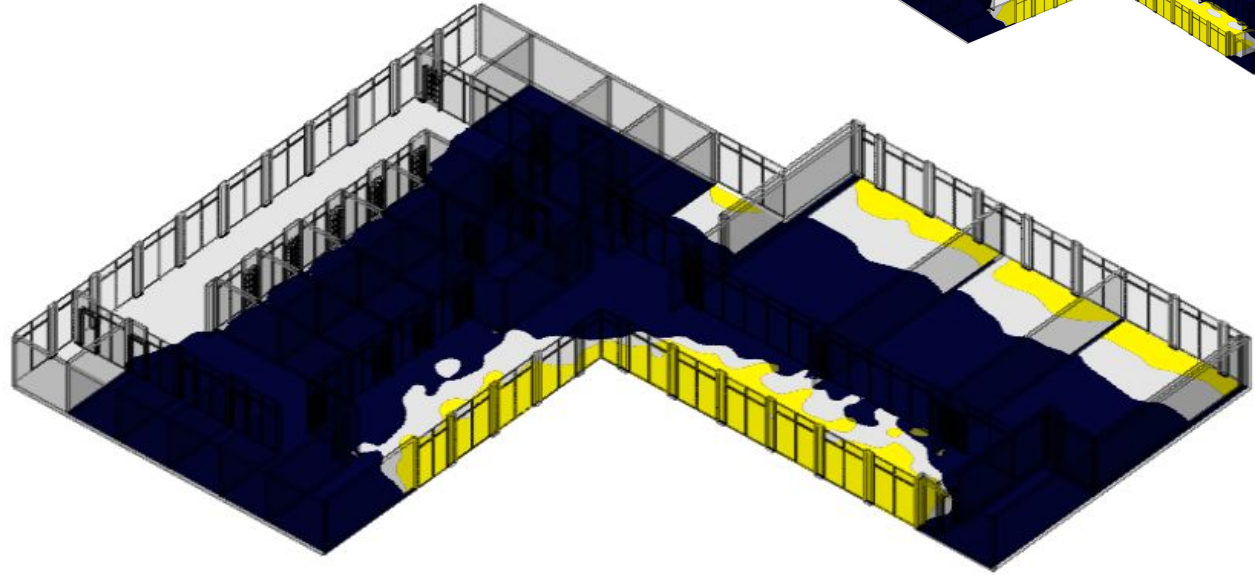
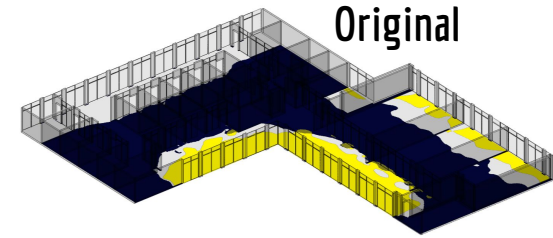
75%

100%

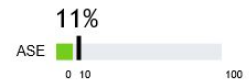
SEFAIRA: THE OVERHANG

Underlit/Overlit Spaces

The frequency of well lit spaces on the south facing sides is improved, and means a more comfortable experience for the office users. This also increases the comfort of passers by in the hallway, possibly encouraging a better use of the space.



■ Underlit ■ Overlit

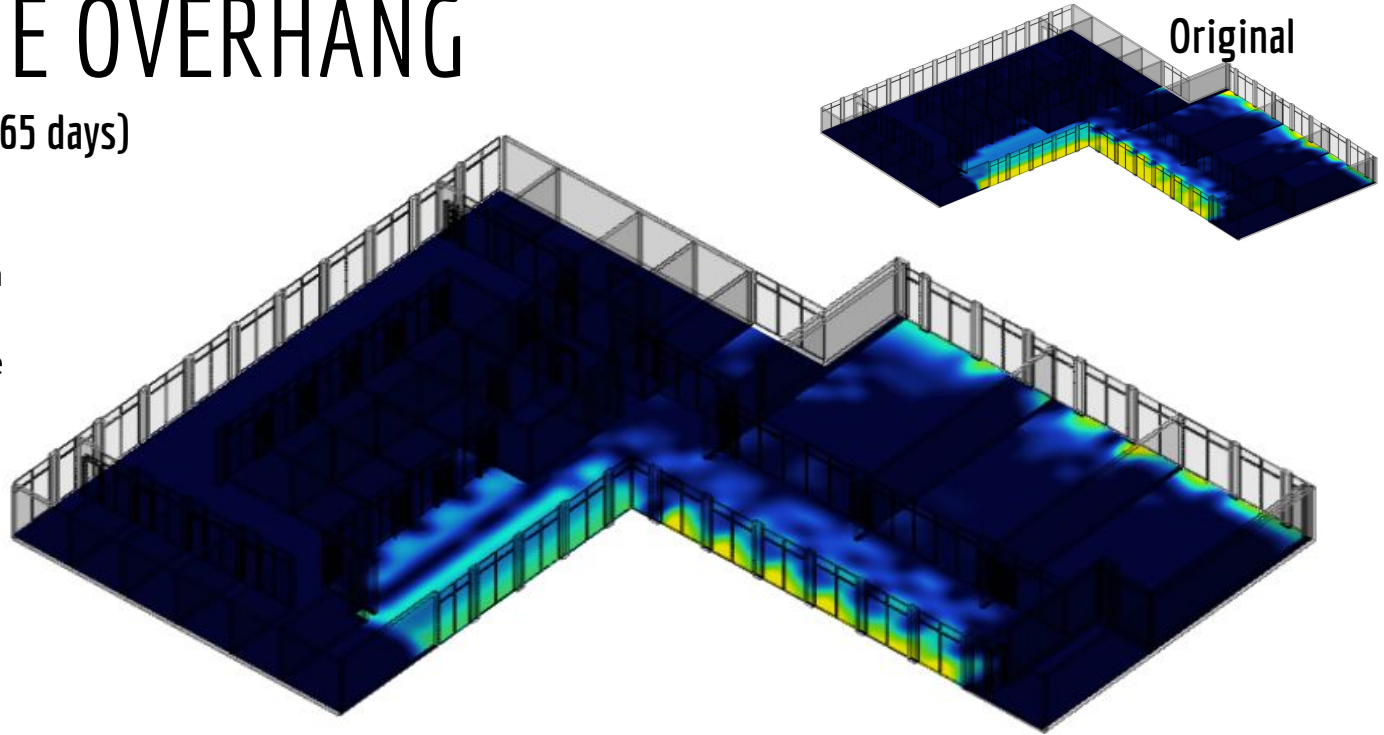


SEFAIRA: THE OVERHANG

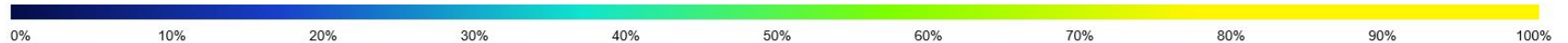
Direct Sunlight Analysis (365 days)

The overhang also greatly reduces the direct sunlight hitting the southern facing side. This means a significant reduction of glare and heat gain on the south facing facade.

The western facing facade still has glare issues due to the orientation of device and facade.



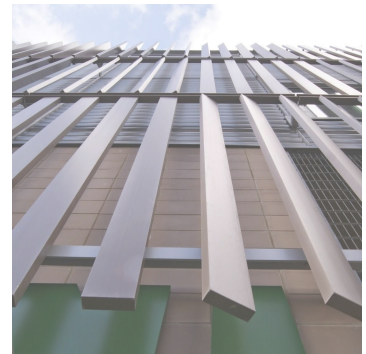
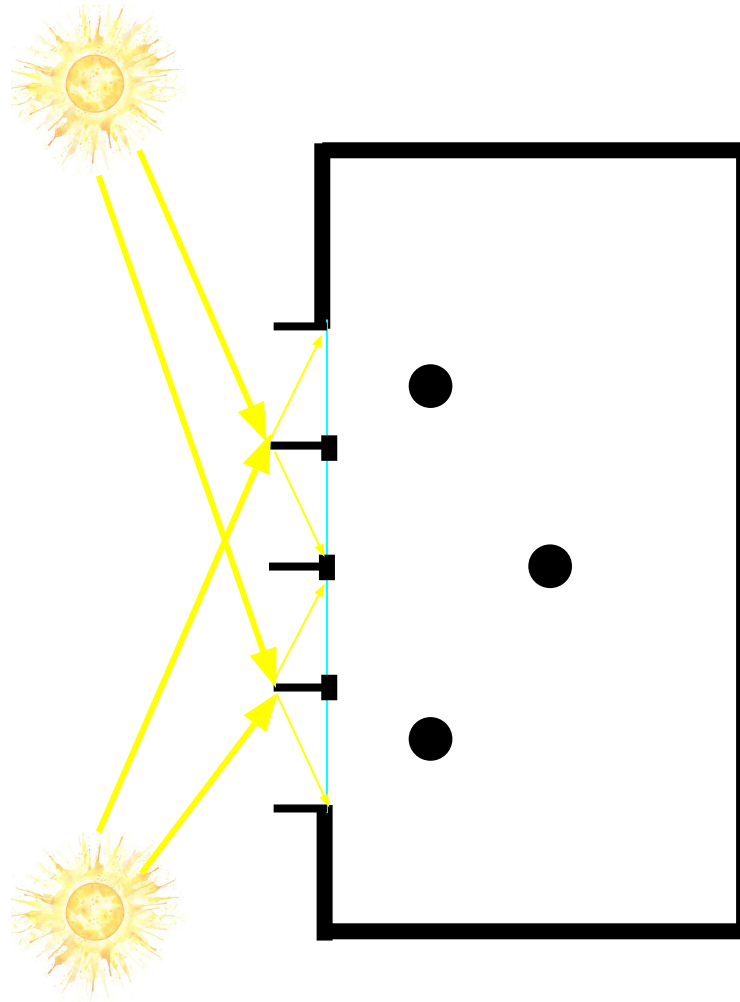
Percentage of days over the entire analysis period (from 8AM to 6PM from June 21 through June 20) receiving a minimum of 3 hours per day of direct sunlight.



THE FIN

As an exterior shading device, the vertical fin will minimize direct solar gain on the west facing facade. It also functions as a secondary light shelf for the intense light in the afternoon. Fins can be also be operable in order to shutter the glazing wall.

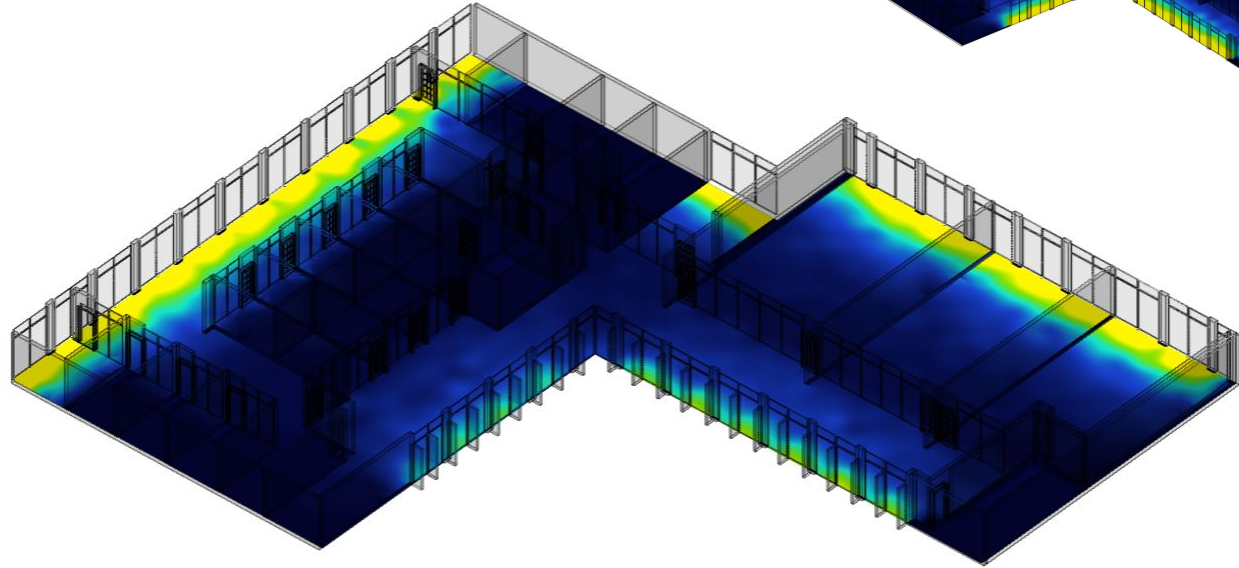
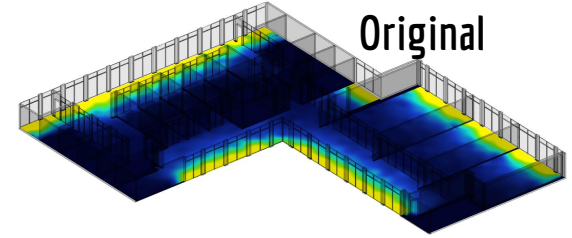
The material for the fins would also be brushed aluminum to decrease external glare.



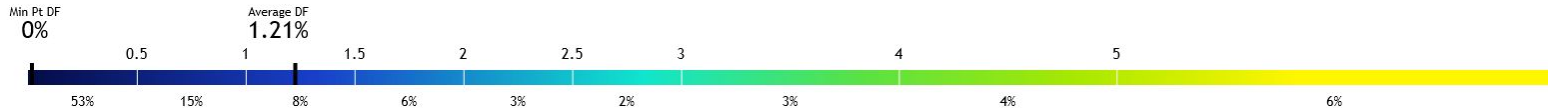
SEFAIRA: THE FIN

Daylight Factor

With the fin integrated with the light shelf, the light is more even along west facade, and the exterior glare decreases significantly.



Percentage of Floor Area where Daylight Factor (DF) is measured at 3.44 feet above the floor plate.

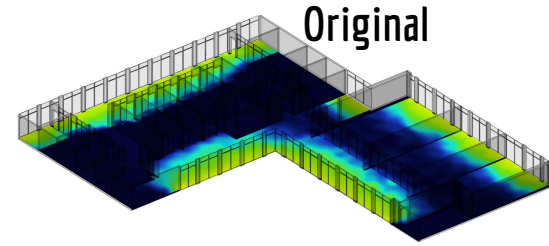
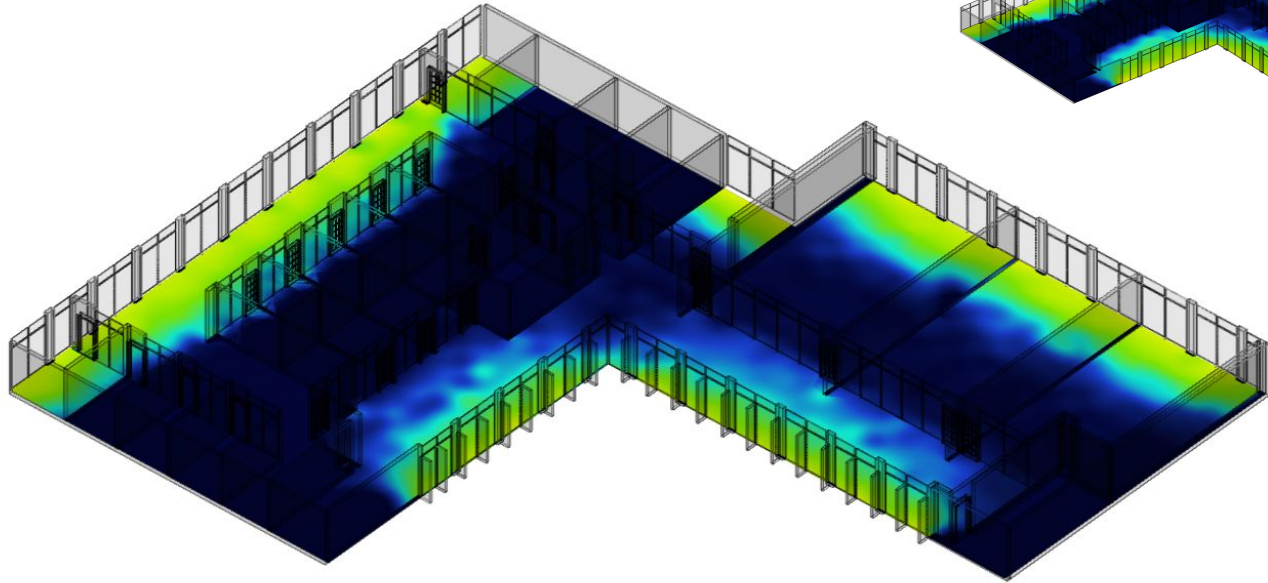


Uniformity Ratio: 0

SEFAIRA: THE FIN

Annual Footcandles

The fin is keeping levels comfortable and appropriate along the west facing side now as well as acting like a vertical light shelf and driving the natural light into the classrooms. This allows most of them to be solely daylit for 25% of the occupied hours (8am-6pm).



Percentage of occupied hours where illuminance is at least 37 footcandles, measured at 3.44 feet above the floor plate.

0%

25%

50%

75%

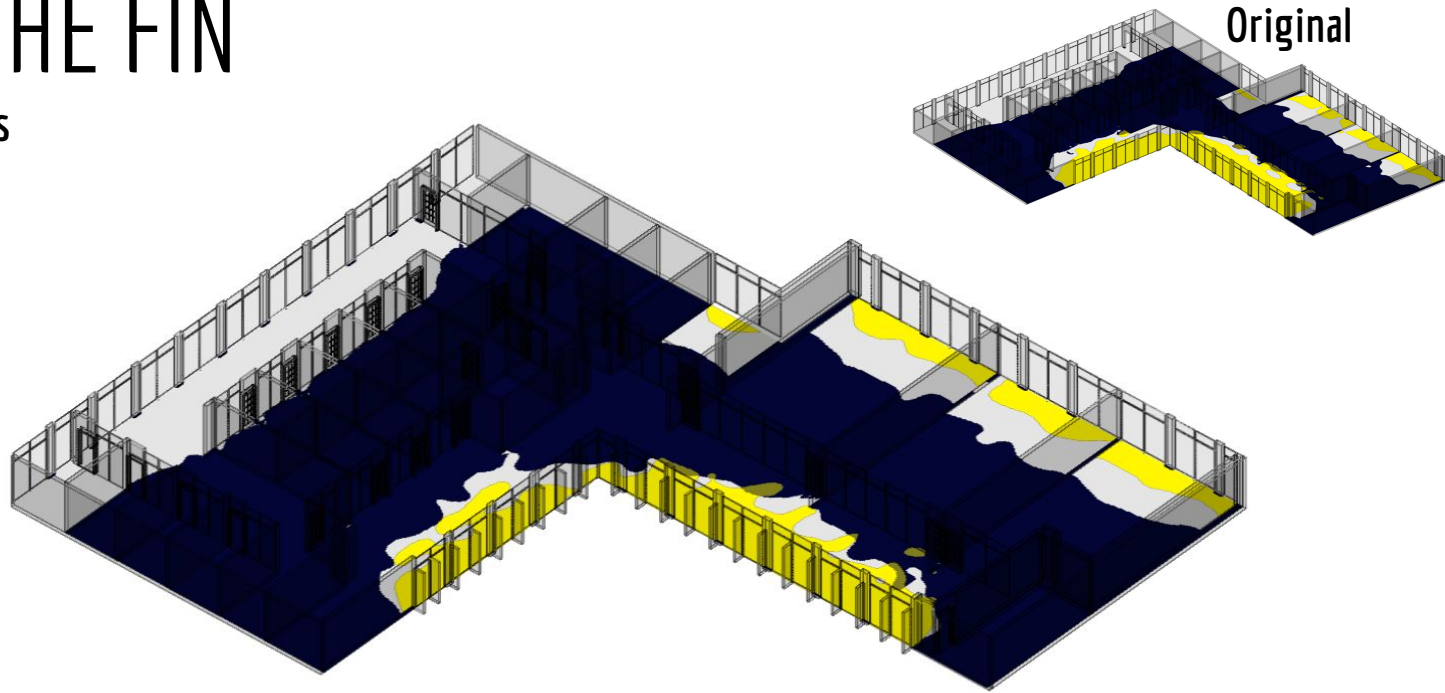
100%

SEFAIRA: THE FIN

Underlit/Overlit Spaces

There is fluctuation on the west facing and south facing facades due to glare caused by the vertical pattern shadows created by the fins.

This could be mediated by having the fins be semi-translucent or dividing up the pattern in a different manner.

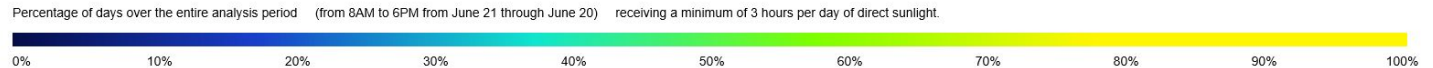
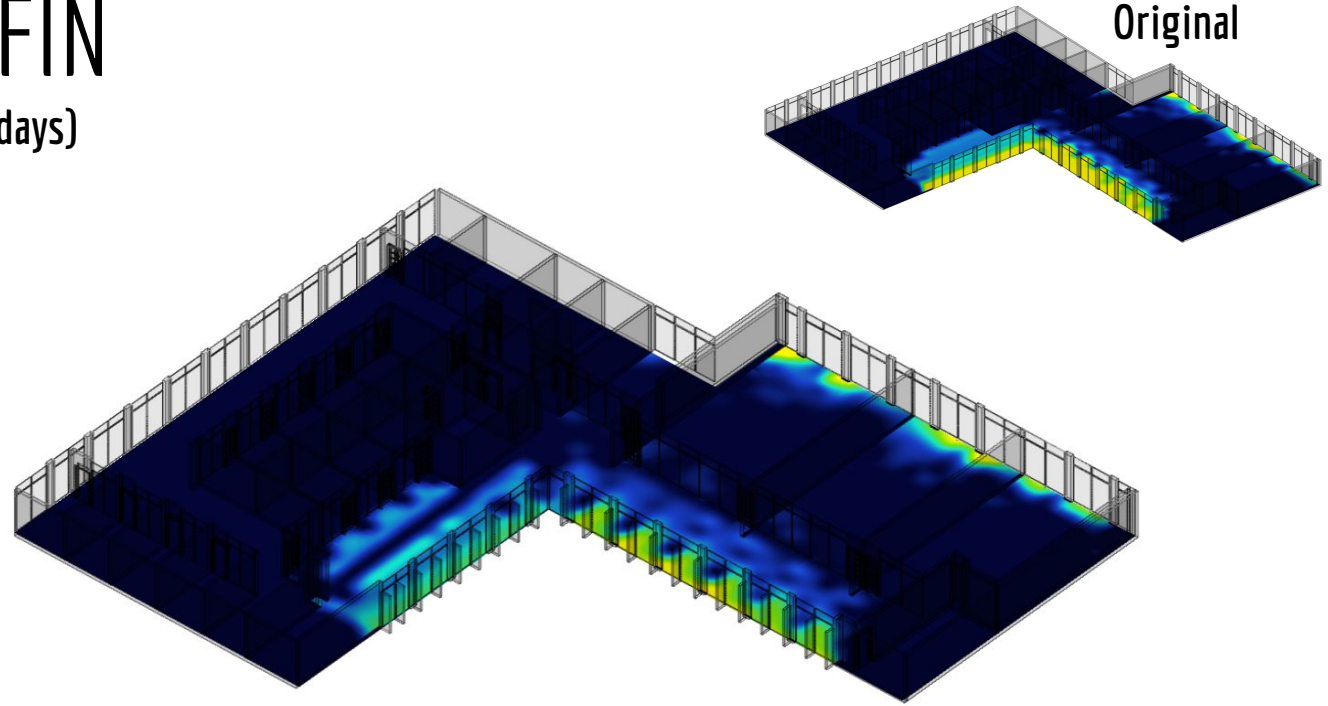


SEFAIRA: THE FIN

Direct Sunlight Analysis (365 days)

Due to qualities of the light shelf, the south facing facade still reduced daily solar heat gain.

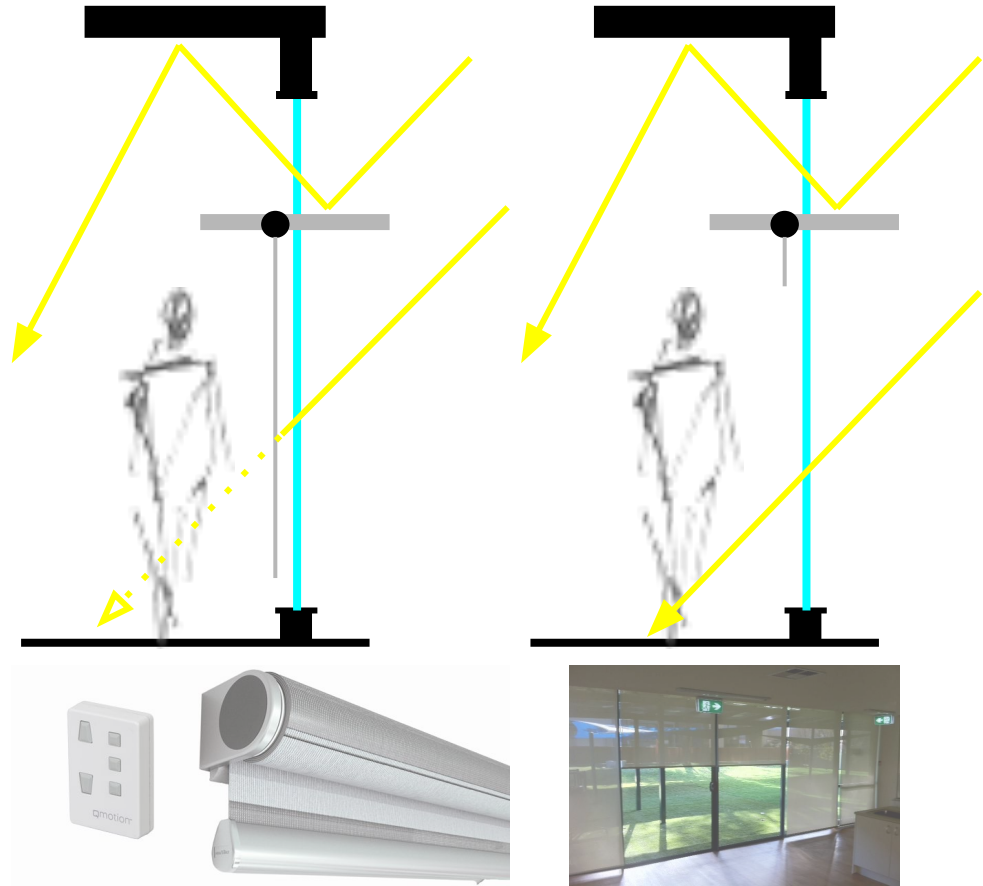
The west facing side performs significantly better, only showing small 2 sqft. spots of intense heat gain. This will decrease internal glare issues into the classrooms and work spaces, increasing overall comfort.



THE BLINDS

Interior shading devices have the ability to be manually adjusted to every season and time of day. The blinds would be set on either a timer or a sensor. These shading devices would be a semi-translucent material that filter the direct sunlight into the building.

There are similar rolling blinds throughout the building.

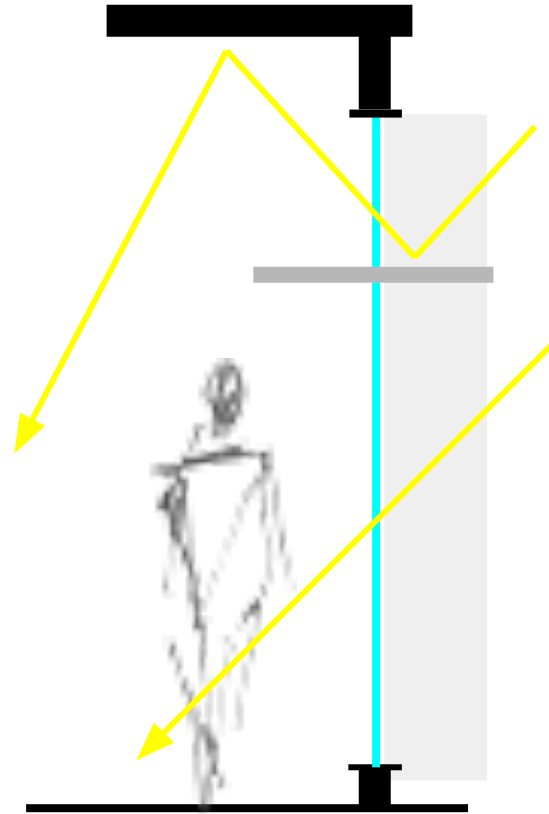


INTEGRATED SHADING PROPOSALS

In addition to the light-shelf we propose two separate solutions one being budget & mechanical, the other architectural & passive.

1. **Budget & Mechanical:** Solely adding the interior shades set on a mechanical system or sensor and resolving about 40% of the problem, and keeping costs low but requiring a mechanical component.
2. **Architectural & Passive:** Installing **fins** on both facades and extending the exterior part of the **light shelf** on the south facing facade. This strategy solves 80% of issues, and involves no mechanical systems keeping the daylighting completely passive.

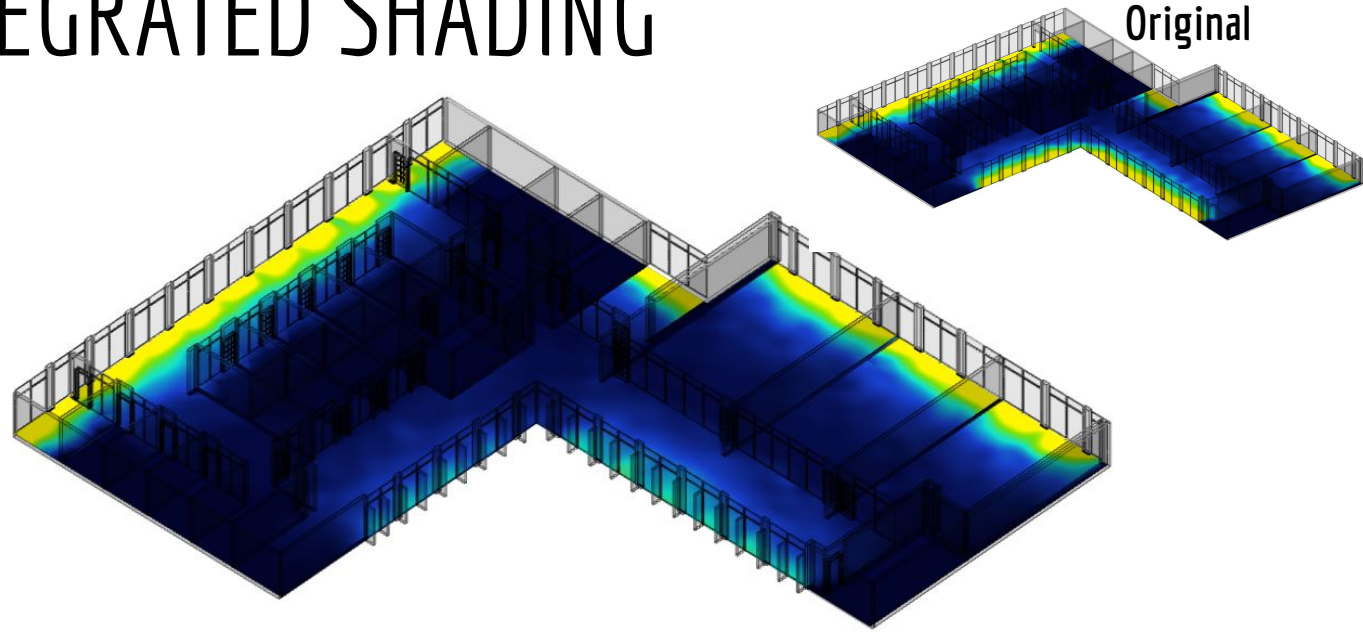
Further in depth strategies such as changing exterior materials and interior materials (especially the floors) would solve 100% of the problem but that intervention we deemed too invasive.



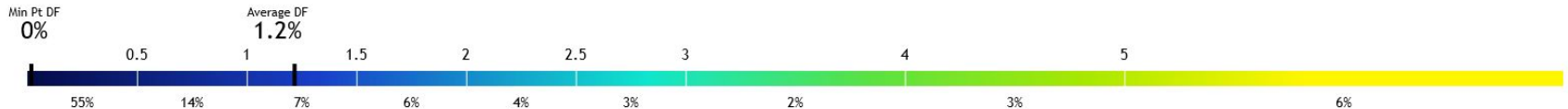
SEFAIRA: INTEGRATED SHADING

Daylight Factor

This analysis shows an even distribution of light throughout the space, and less glare both inside and out. This greatly increases user comfort in the student workspace, encouraging more frequent use.



Percentage of Floor Area where Daylight Factor (DF) is measured at 3.44 feet above the floor plate.



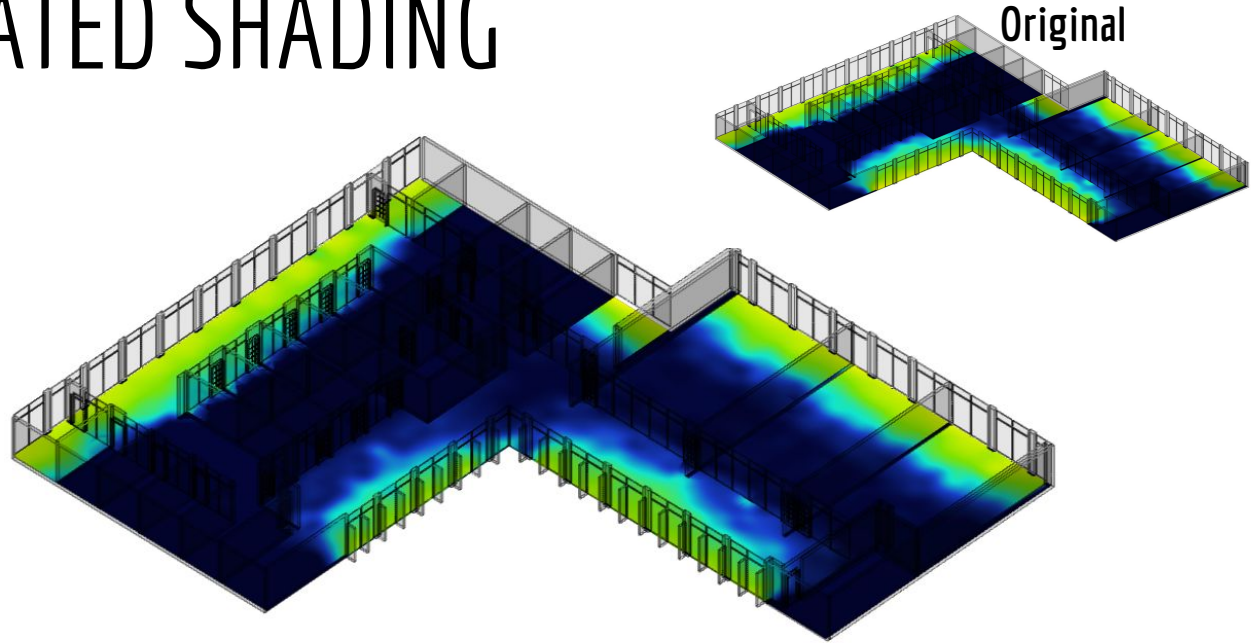
Uniformity Ratio: 0

SEFAIRA: INTEGRATED SHADING

Annual Footcandles

The annual FC analysis shows now that all facades are comfortable and appropriately lit during the ED building's hours of operation. It also reinforces the uniform gradient that spreads nicely through the classrooms allowing those to be solely day lit a quarter of the used hours the ED building operates.

The meeting rooms do not necessarily need to be as uniformly lit as the classrooms due to the monitors for presentations in those rooms.



Percentage of occupied hours where illuminance is at least 37 footcandles, measured at 3.44 feet above the floor plate.

0%

25%

50%

75%

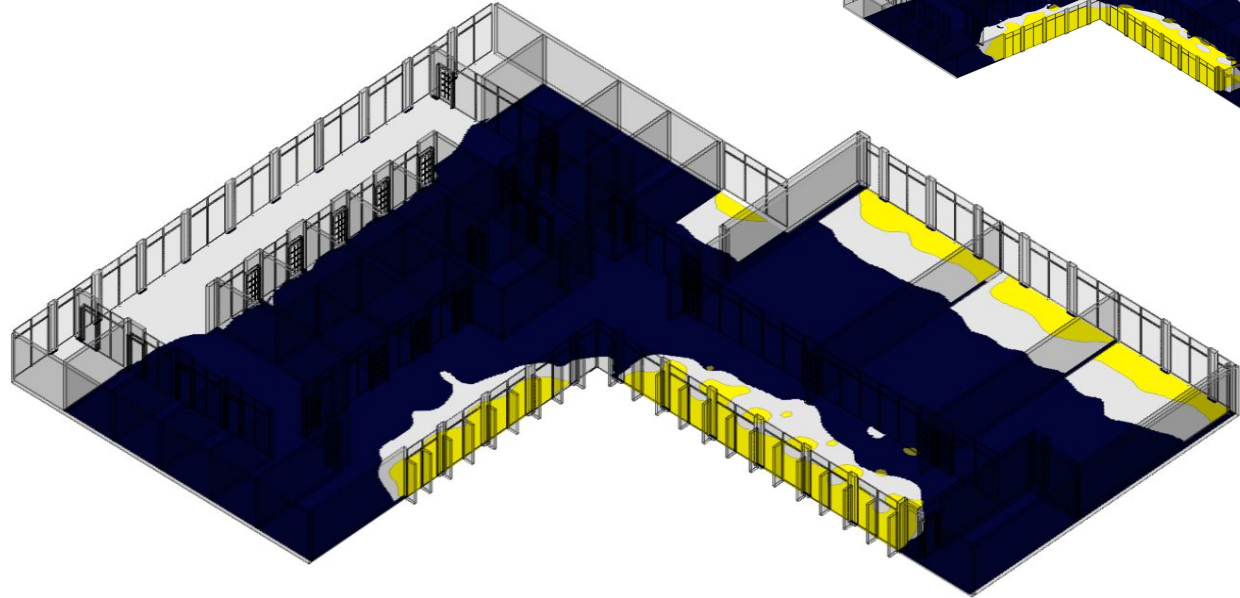
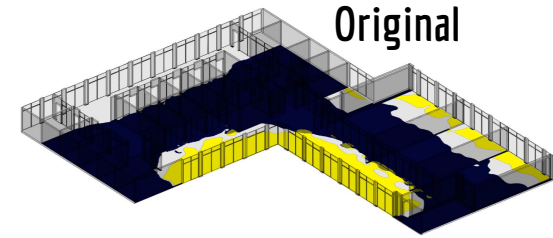
100%

SEFAIRA: INTEGRATED SHADING

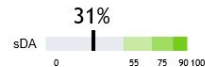
Underlit/Overlit Spaces

In this analysis the contrast between original and revised is very apparent. Most of the space is now well lit rather than over lit.

This is an important distinction when it comes to analysing glare and comfort around the work spaces.



■ Underlit ■ Overlit

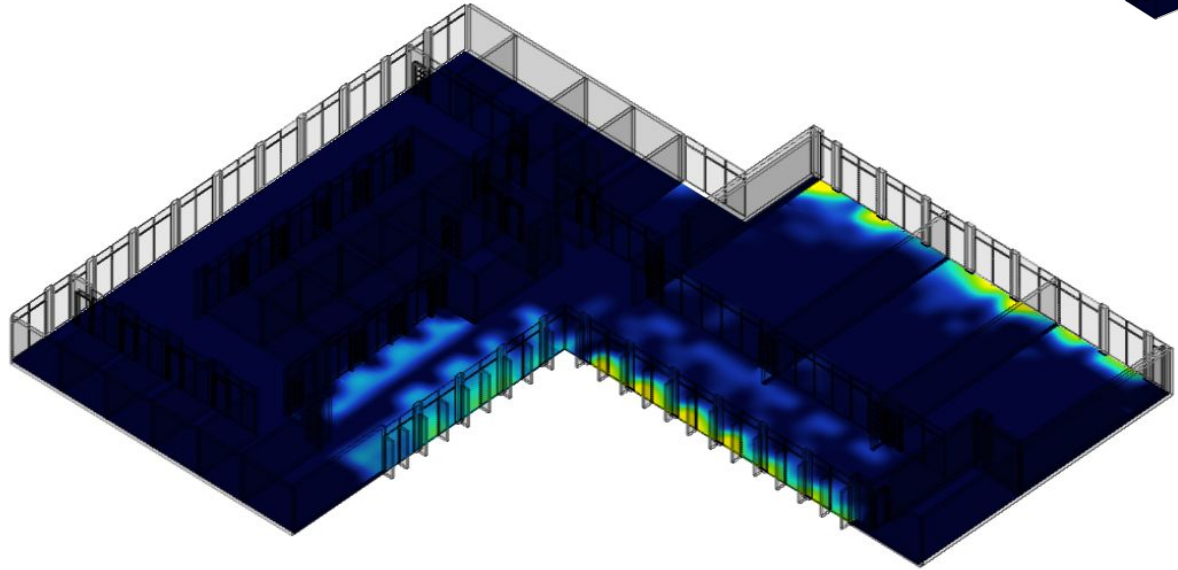
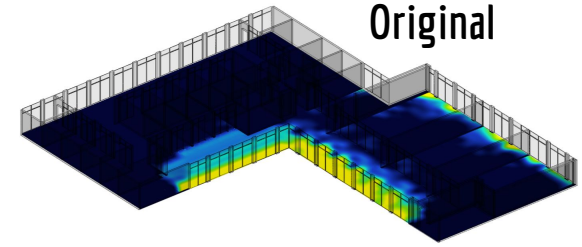


SEFAIRA: INTEGRATED SHADING

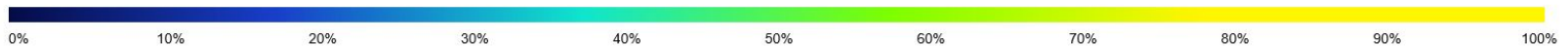
Direct Sunlight Analysis (365 days)

The direct solar gain of the space and decreased drastically as now only small 2sqft spaces on the west glazing have direct solar gain. All other spaces receive little to no direct solar gain.

This is important for glare assessment as both internal and external glare will be decreased drastically. It will also increase comfortability in the work spaces due to less heat gain by objects and individuals.



Percentage of days over the entire analysis period (from 8AM to 6PM from June 21 through June 20) receiving a minimum of 3 hours per day of direct sunlight.



RENDERINGS: BEFORE & AFTER

The image above is a rendering of the original glazing system in the ED building. Here we can see that glare on the shining floors creates a heavy contrast between different faces.

The image below shows the revision of this facade using our architectural & passive option. Here the contrast is less as the light is uniformly distributed. The glare issue above has also been mostly mediated.

Original



Revision



INTEGRATED SHADING

Through the integration of the light shelf and the fin the most desirable lighting scheme is achieved. The light shelf will increase the horizontal shading and diffuse light, the fin will decrease both interior and exterior glare, and aid in shading the west facing facade while acting as a vertical light shelf on all facades.

