DYNAMIC FACADE PROTOTYPE

SOLAR 2015

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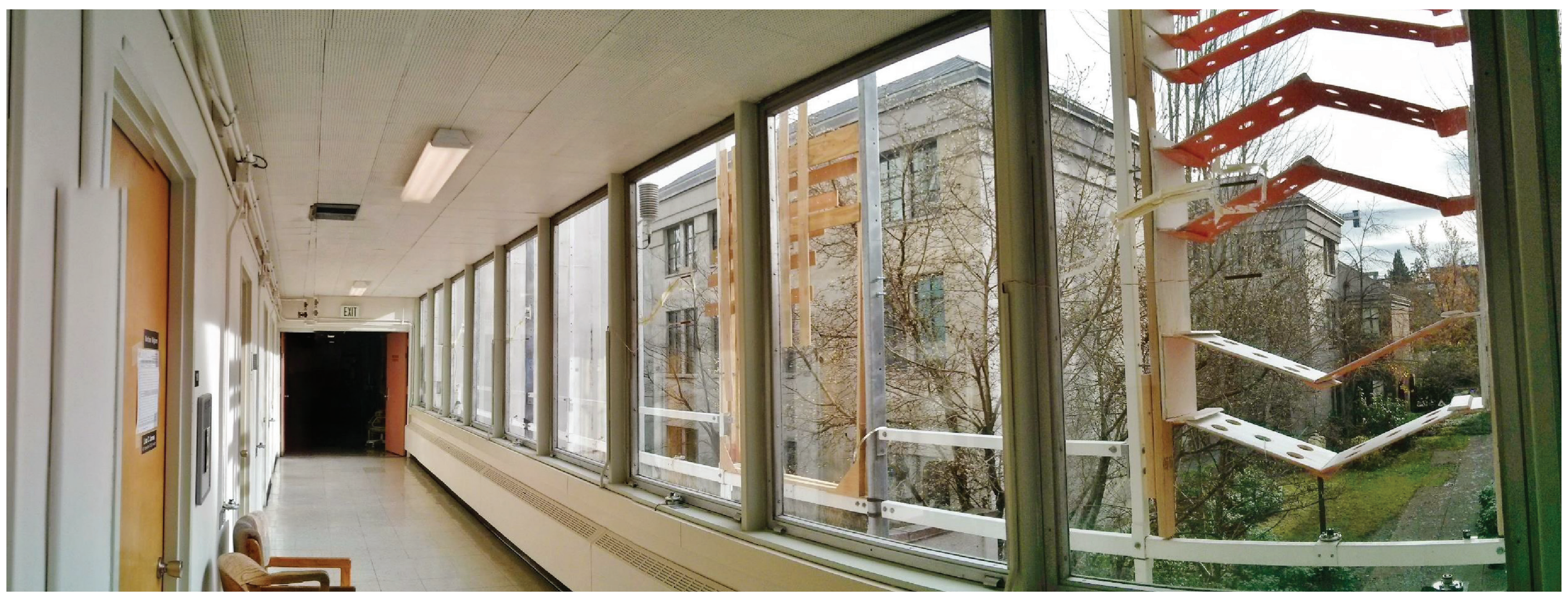
MEASURE TWICE - CUT ONCE : PERFORMANCE OF DYNAMIC FACADES



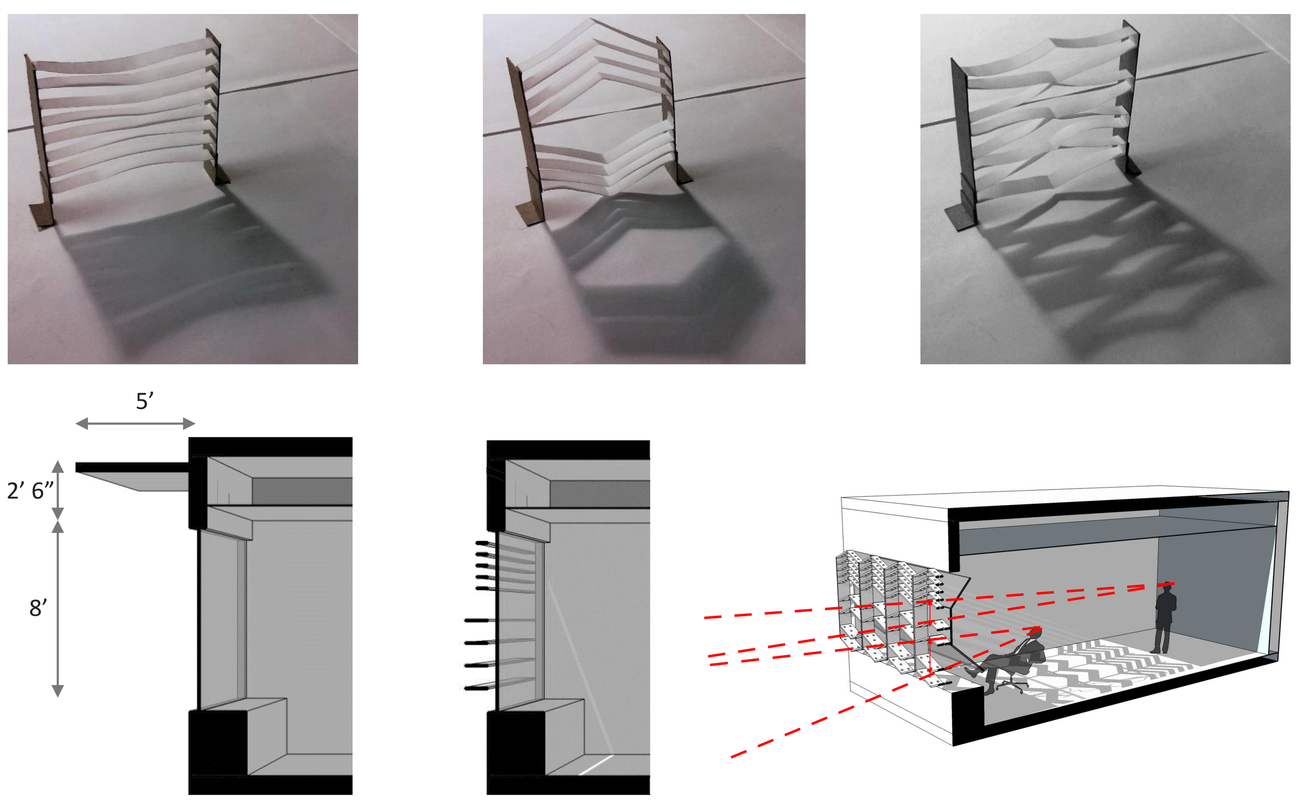
ABSTRACT

The essential roles of the building facades—providing shelter, form, and image—can be expanded to significantly improve building performance, including major reductions in energy use. Rather than a static enclosure, the building facade has the potential to redirect daylight, integrate natural ventilation, manage radiant heat transfers, generate energy, and provide visual and physical connections between inside and out. High performance, dynamic facade design can be realized in new construction and in strategic retrofits of existing buildings. Supported by HiPE lab and Oregon BEST, this project is intended to guide students/young professionals in a year-long investigation of a dynamic facade component leading to a scaled prototype construction and testing of this component. Objectives for the design of this component are:

1. Enhancing transparency and aesthetics from the outside in as well as inside out.
2. Harvesting and redirecting daylight deeper into the building
3. Managing glare and brightness patterns for occupants' visual comfort
4. Solar control management for improved thermal comfort
5. Provide opportunities for ventilation and control heat gains/losses
6. Improved materiality/details and opportunities for scaling to multiple applications

DESIGN CONCEPTS

INITIAL ITERATIONS

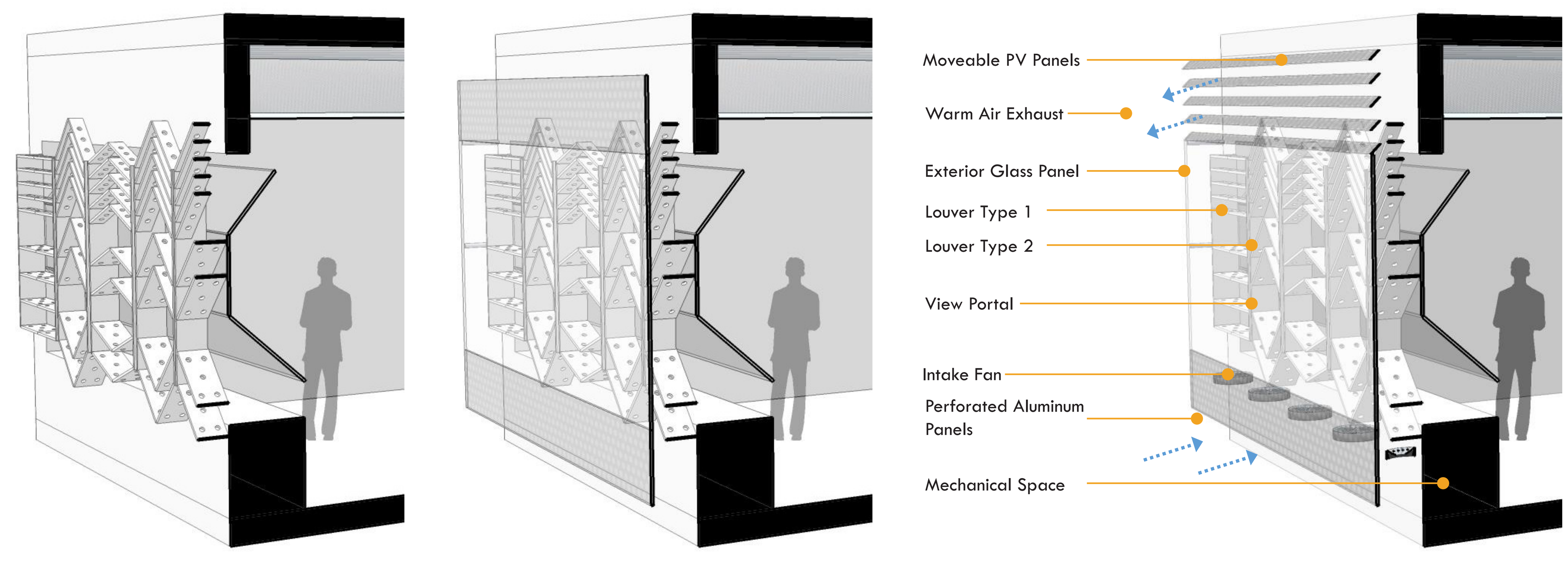


Optimal Overhang for South Facing Facade

Divide Overhang into Louvers

Organize Louvers Based on View Angles

FACADE DETAIL OPTIONS



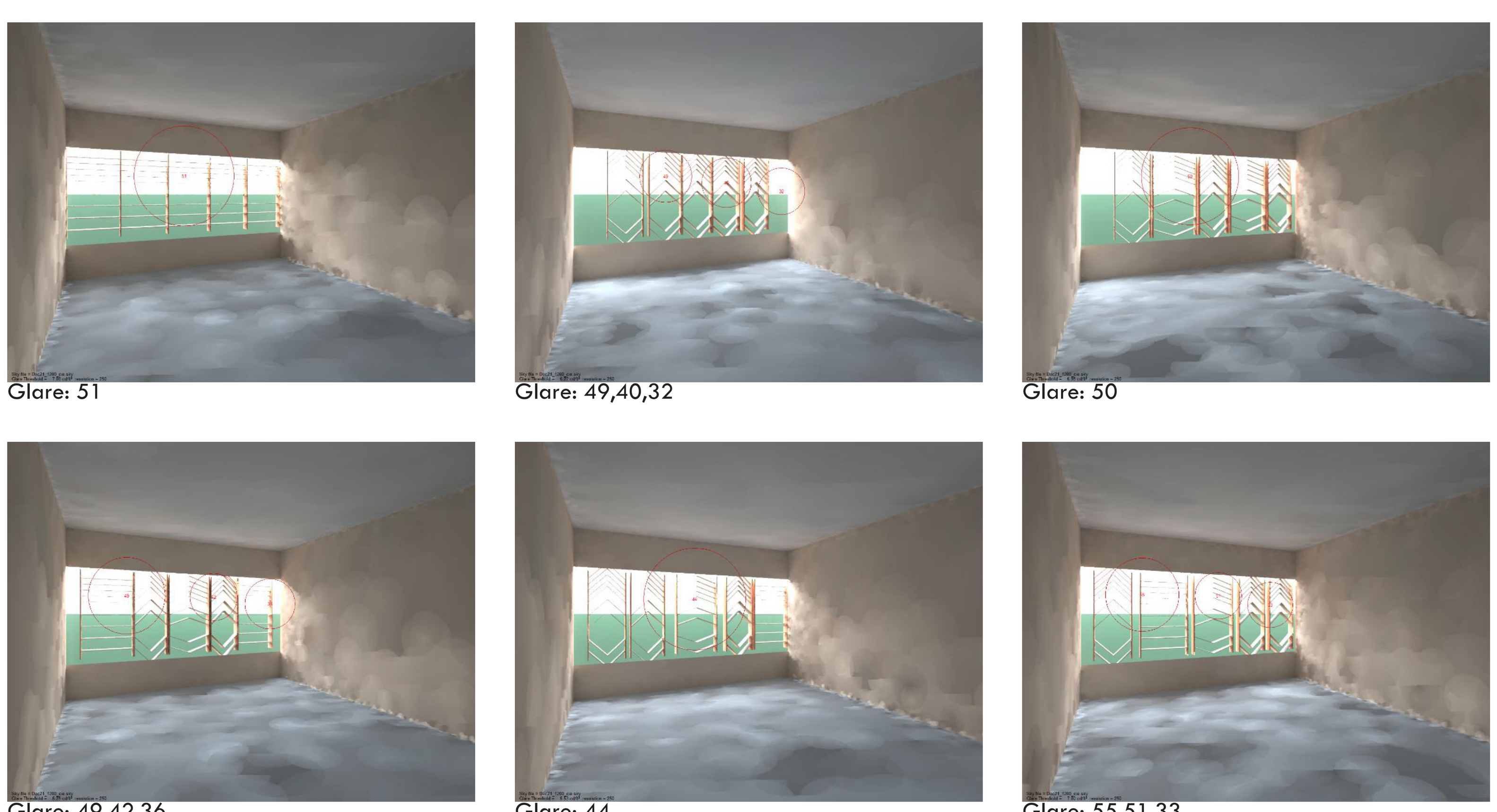
Option 1 - Only Louvers

Option 2 - Double Facade (Glass and Perforated Panel)

Option 3 - Double Facade, Mechanical Intake, and PV Panels

IES - VE DIGITAL ANALYSIS

GLARE CALCULATIONS FOR VARIOUS OPEN CONDITIONS



Glare: 51

Glare: 49,40,32

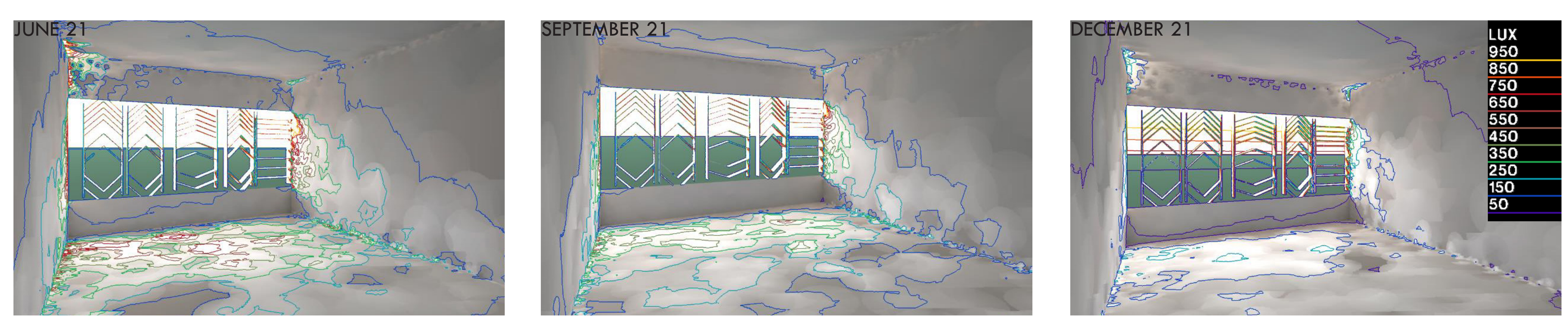
Glare: 50

Glare: 49,42,36

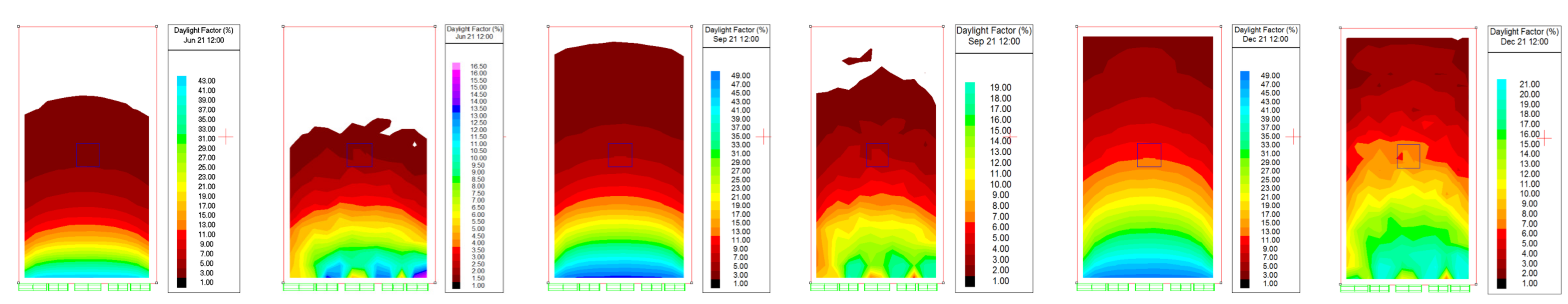
Glare: 44

Glare: 55,51,33

ILLUMINANCE LEVELS AT FOR SELECTED LOUVER PATTERN



DAYLIGHT FACTOR



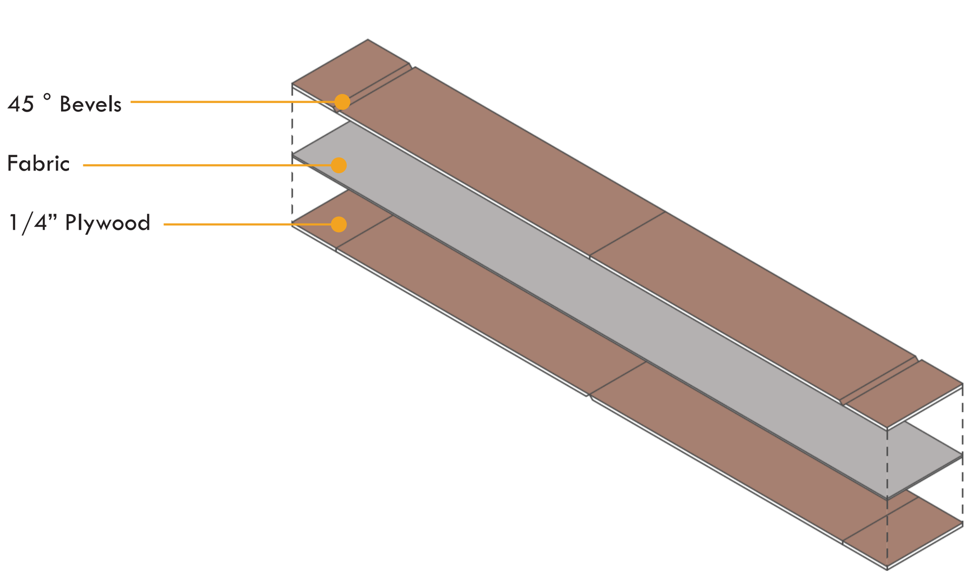
QUANTITY	VALUES			UNIFORMITY (MIN./AVE.)	DIVERSITY (MIN./AVE.)
	MIN.	AVE.	MAX.		
Daylight Factor	0.7%	11.5%	49.6%	0.06	0.01
Daylight Illuminance	5.05 fc	88.90 fc	382.26 fc	0.06	0.01
WITH SHADING DEVICE					
Daylight Factor	0.3%	5.0%	18.4%	0.07	0.02
Daylight Illuminance	2.49 fc	38.13 fc	141.41 fc	0.07	0.02

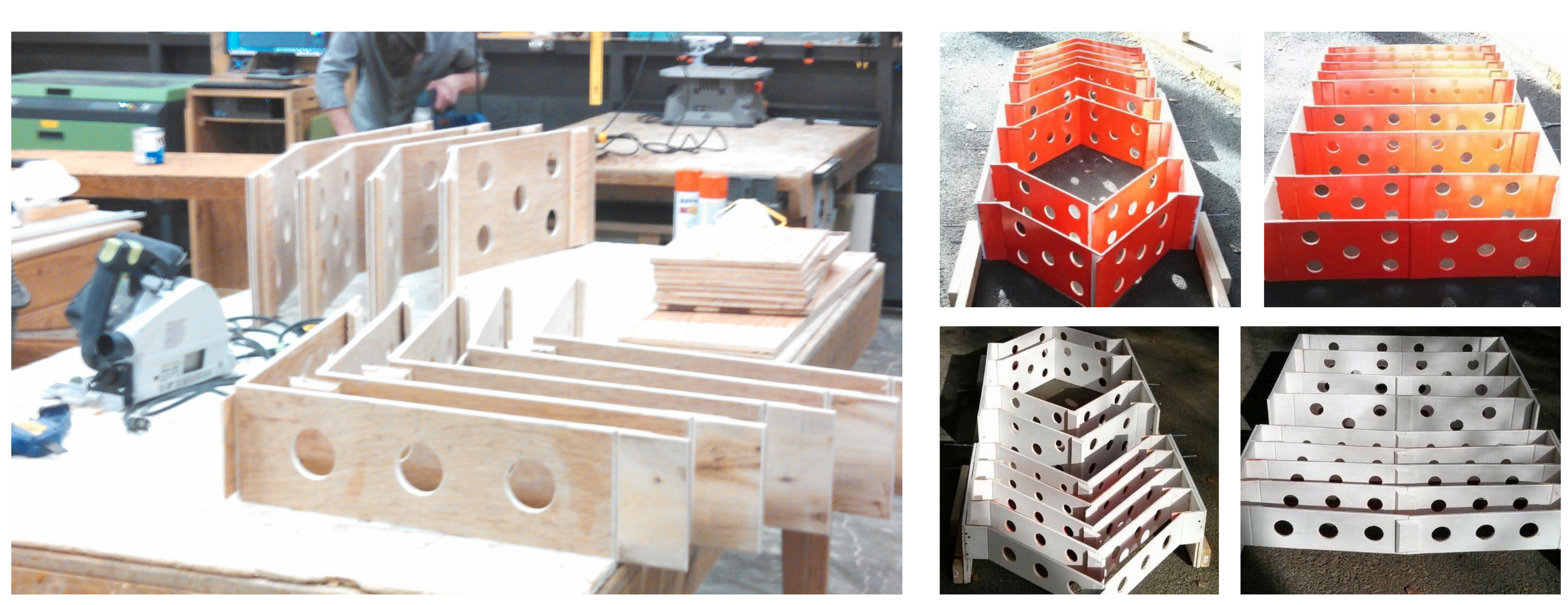
QUANTITY	VALUES			UNIFORMITY (MIN./AVE.)	DIVERSITY (MIN./AVE.)
	MIN.	AVE.	MAX.		
Daylight Factor	0.3%	7.4%	43.0%	0.05	0.01
Daylight Illuminance	2.88 fc	62.45 fc	361.00 fc	0.05	0.01
WITH SHADING DEVICE					
Daylight Factor	0.2%	2.8%	15.7%	0.06	0.01
Daylight Illuminance	1.40 fc	23.60 fc	131.82 fc	0.06	0.01

QUANTITY	VALUES			UNIFORMITY (MIN./AVE.)	DIVERSITY (MIN./AVE.)
	MIN.	AVE.	MAX.		
Daylight Factor	1.5%	15.0%	48.2%	0.10	0.03
Daylight Illuminance	8.14 fc	84.19 fc	269.94 fc	0.10	0.03
WITH SHADING DEVICE					
Daylight Factor	0.8%	7.7%	20.4%	0.10	0.04
Daylight Illuminance	4.27 fc	43.41 fc	114.34 fc	0.10	0.04

CONSTRUCTION

DETAILS AND PROCESS





INSTALLATION

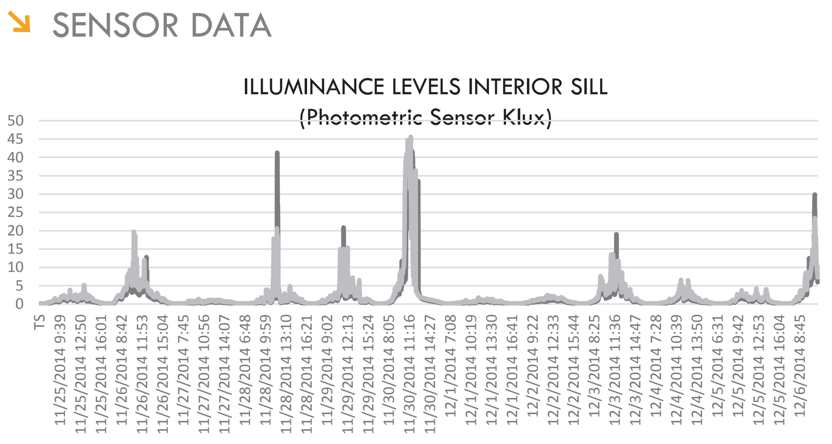
VIEWS

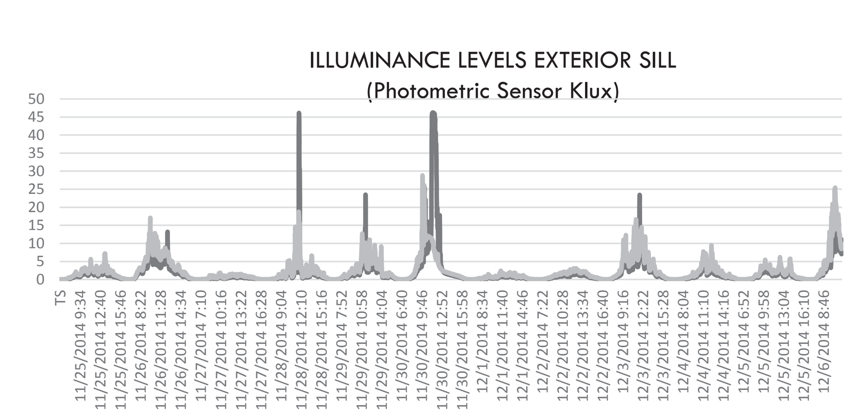
View From Interior

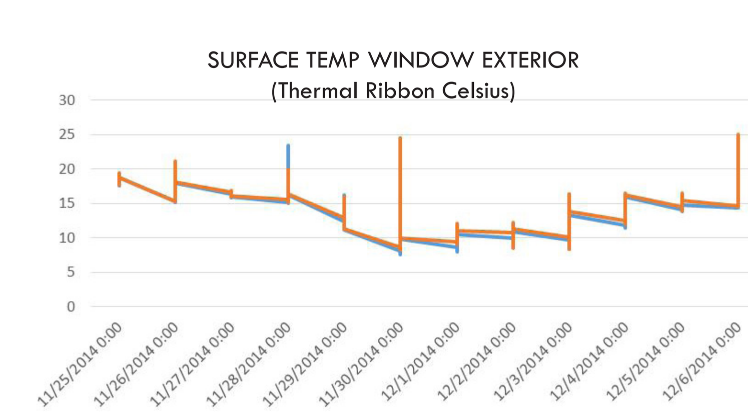
View From Exterior

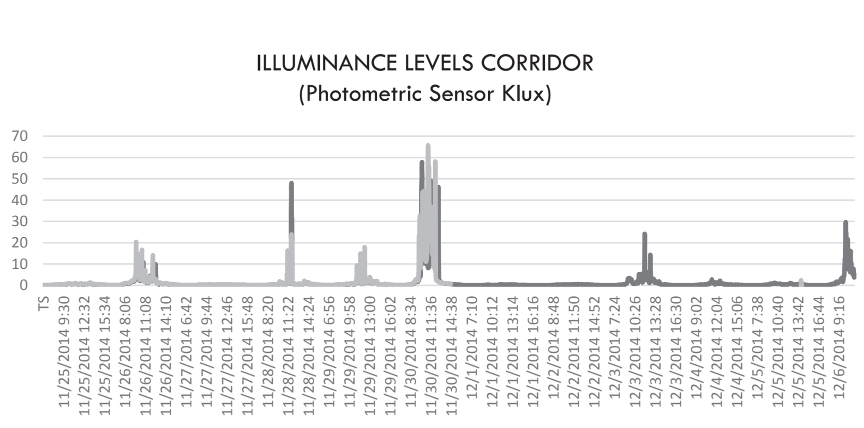
PERFORMANCE TESTING

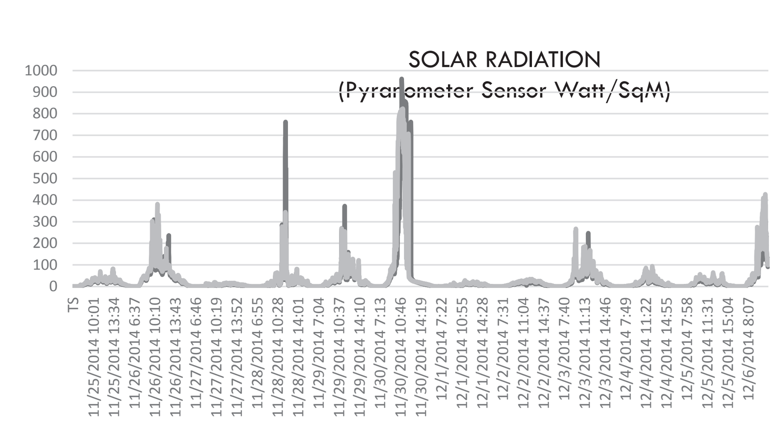
SENSOR DATA

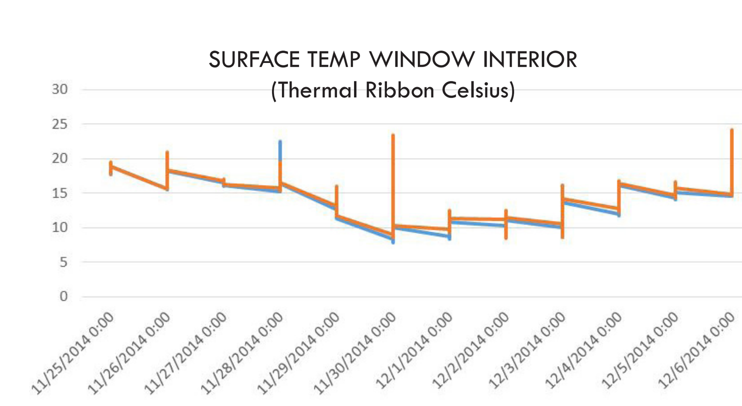












ANALYSIS

Looking at the Photometric sensor data it can be determined that for large portions of the day, both bays perform essentially equal. However there are times of the day when the bay with the prototype shows much higher illuminance levels than the unshaded bay. This shows that the shading device is successful at providing more day light into the space. The highly reflective surfaces of the louvers play a part in elevating these illuminance levels. Similarly the Pyranometer data set shows an increase of solar energy in almost the same pattern as the illuminance data set.

The Thermal Ribbon (PRT) data set shows that there is a significant decrease in the temperature when comparing the bay with our shading device with an unshaded bay. This would prove to be beneficial during summer months when heating loads are high; however, not as advantageous during the winter months.

These data sets show a limited evaluation on the performance of the shading device. In order to get a more complete understanding of the device's performance, more data would need to be gathered. For example, these measurements were only taken when the shading device was locked in the intermediate position (20 deg). Taking measurements when the device is completely closed (0 deg) and completely open (45 deg) would provide greater insight into the performance of the system. Recording data during different times of the year would also improve the analysis.