ENERGY.DAYLIGHT.GLARE.COMFORT

Bringing it all together

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“The Board of Regents is committed to providing sustainability leadership through responsible stewardship of the state’s natural and physical resources.”

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Learning Objectives

1) Understand the methodology parametric building design.

2) Showcase the use of rapid feedback method in design process to save time.

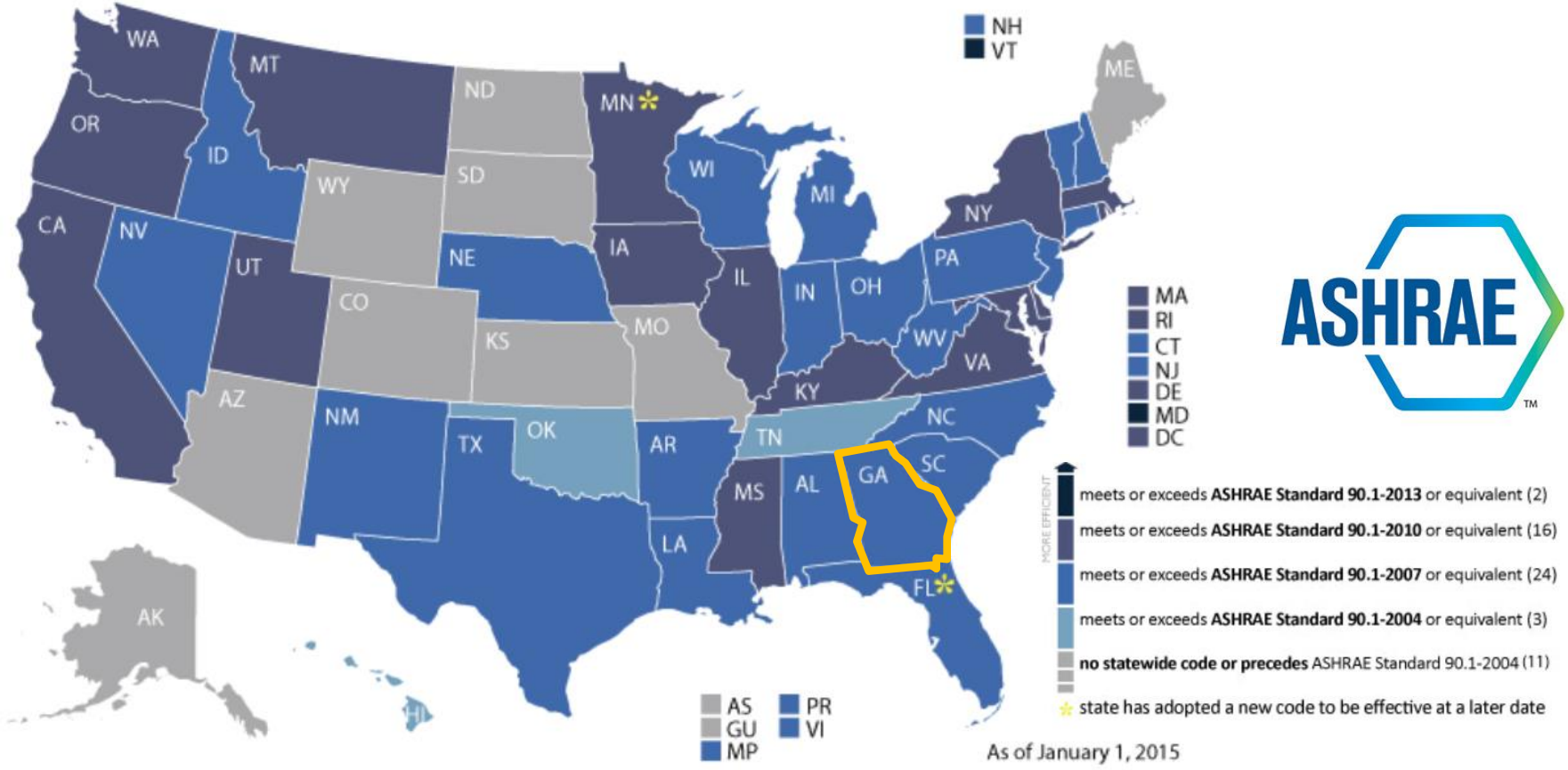
3) List the key metrics of success for a high performance buildings

4) Learn how to compare building options for performance.

CONTEXT

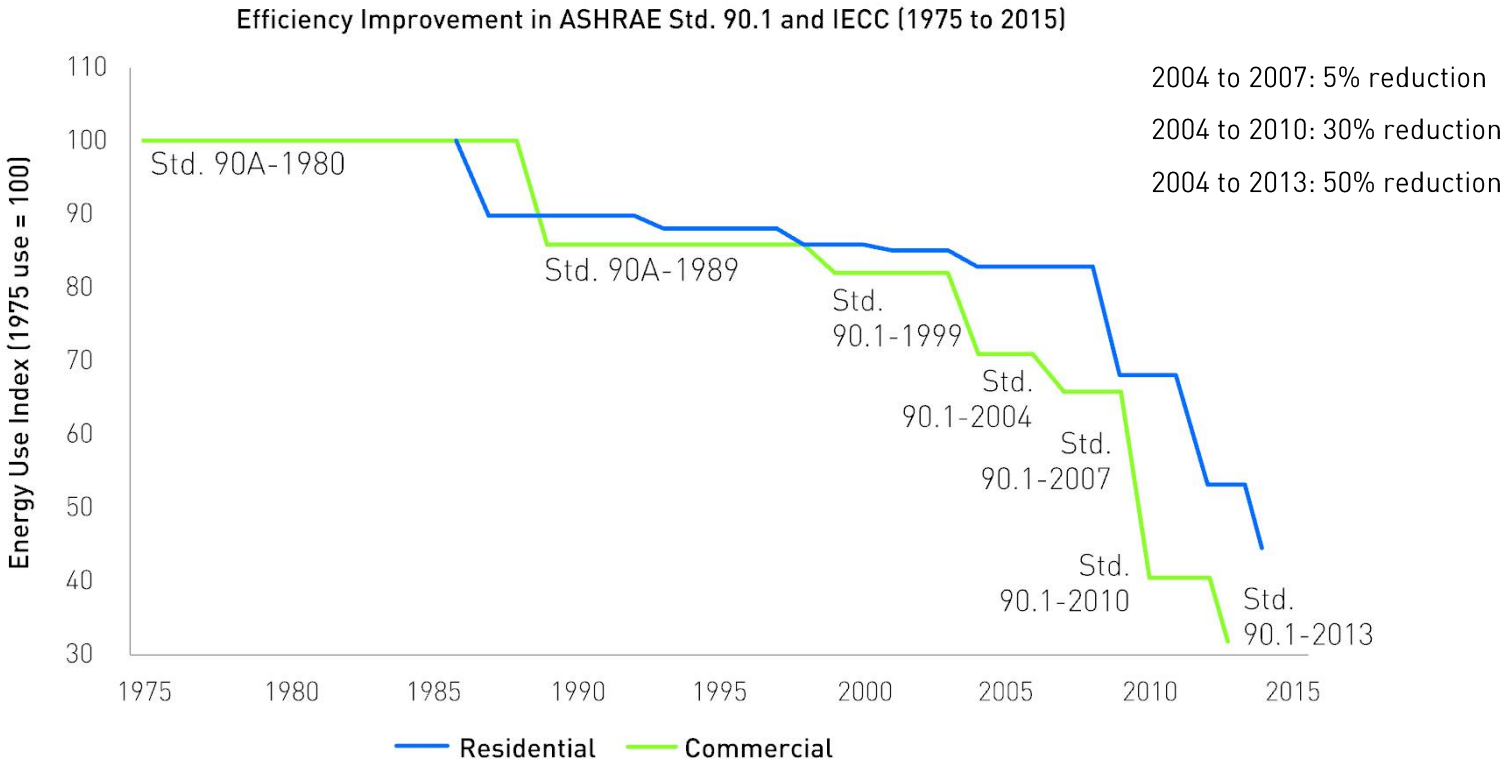
CURRENT ENERGY CODES

Georgia Currently using ASHRAE 90.1 – 2007. Will adopt 2010 version this Year.



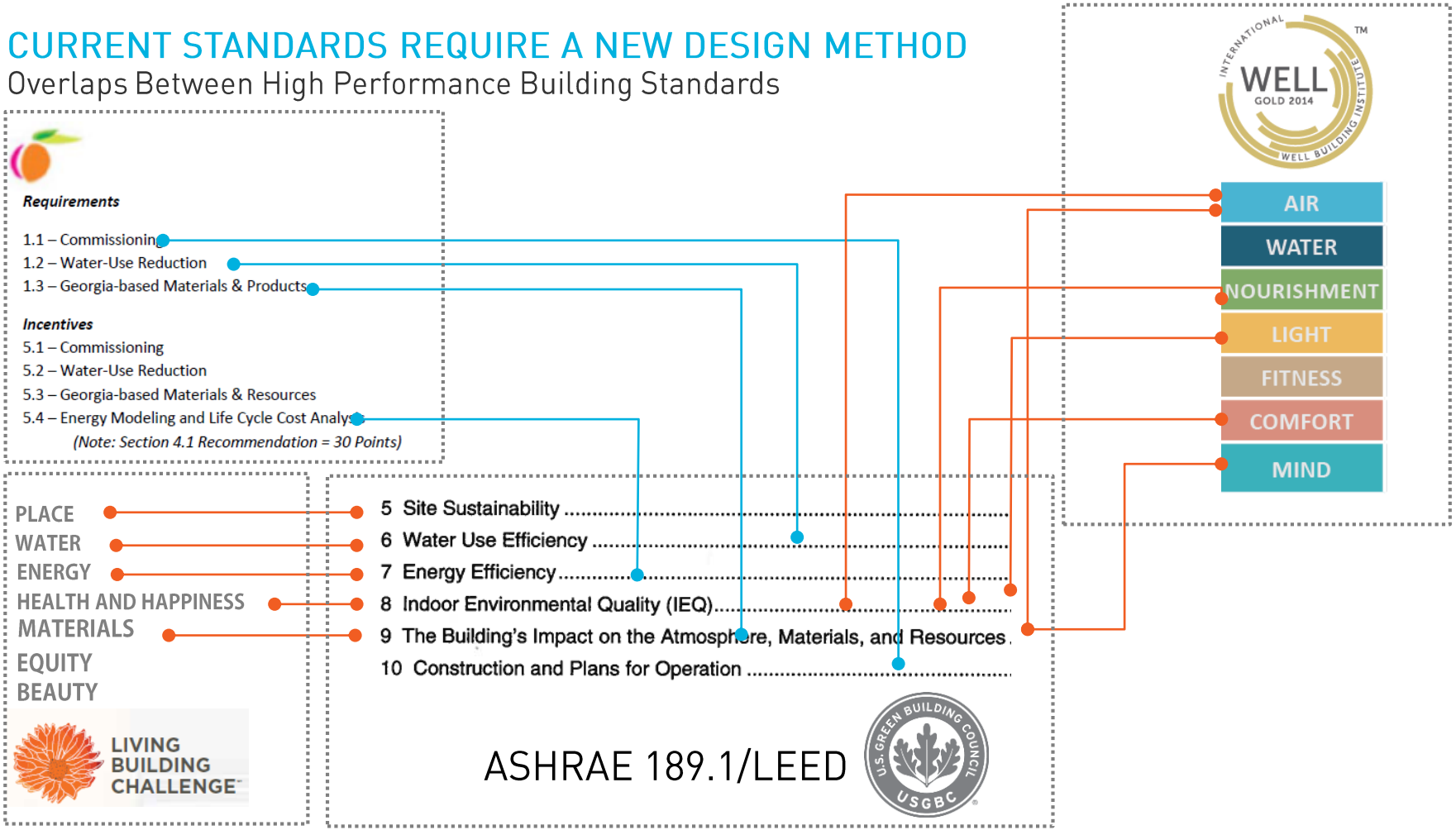
ASHRAE 90.1 STANDARD EVOLUTION

Energy codes are changing in the United States.



CURRENT STANDARDS REQUIRE A NEW DESIGN METHOD

Overlaps Between High Performance Building Standards



KEY OBJECTIVES TO CREATE VALUE

Value is created by architects balancing 5 competing objectives

KEY METRICS FOR MEASURING VALUE

To evaluate the success of a strategy, there are five major metrics every team should use.

Total Energy

Daylight

Glare

Thermal Comfort

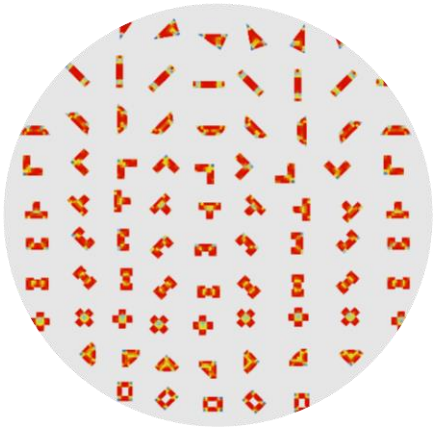
Cost

KEY STRATEGIES

Teams should use the 4 main strategies in the design process and measure success using the 5 metrics

Shading

Glazing



Orientation

Schedules

CASE STUDIES

Project: Public Safety Facility
School: Georgia Institute of Technology
Architect: Pond/Houser Walker Architects

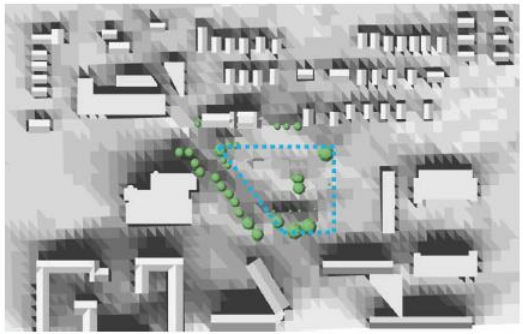
Project: Student Services and Success Center
School: Atlanta Metropolitan State College
Architect: GSSTJ

Project: Lecture Hall and Art Science Building Renovation
School: Clayton State University
Architect: Flynn Finderup Architects / JW Robinson & Associates

Project: Public Safety Facility
School: Georgia Institute of Technology
Architect: Pond/Houser Walker Architects

Image Credit: Houser Walker Architects

SHADOW STUDY
SITE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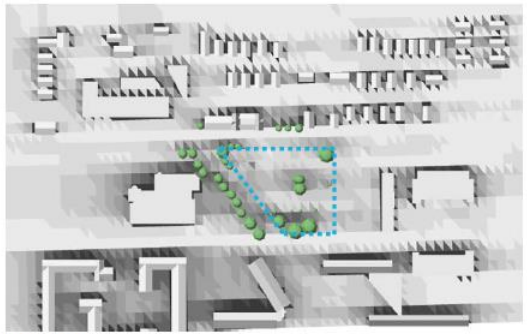
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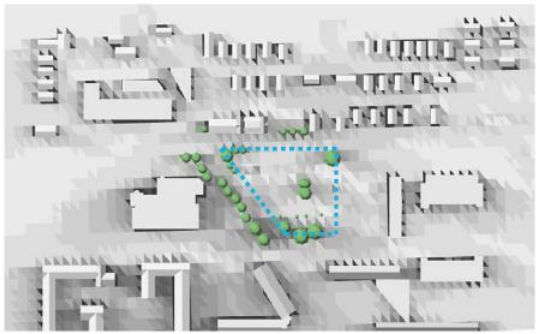
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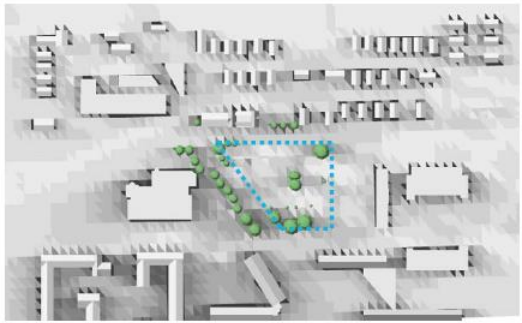
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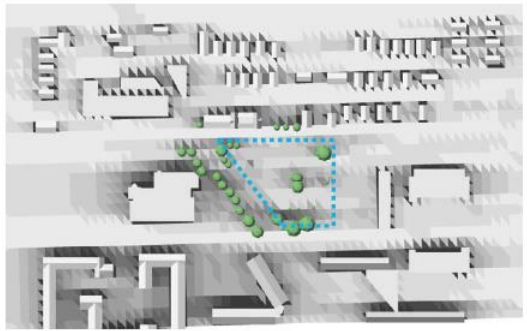
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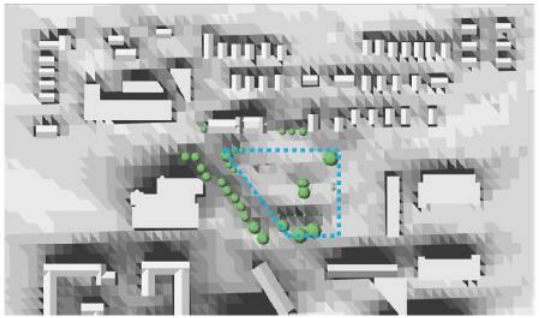
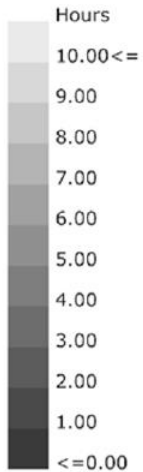

November

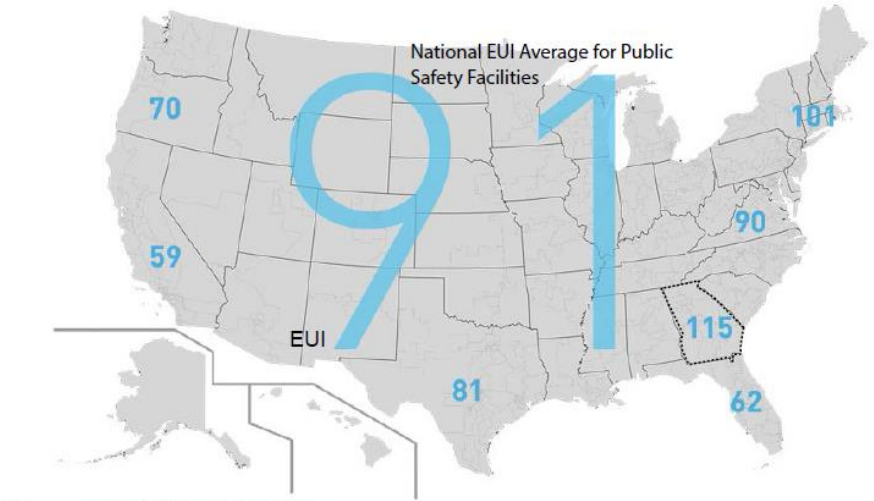


BENCHMARKS
WHERE DO WE NEED TO BE

National Average
91
KBTU/sf/yr

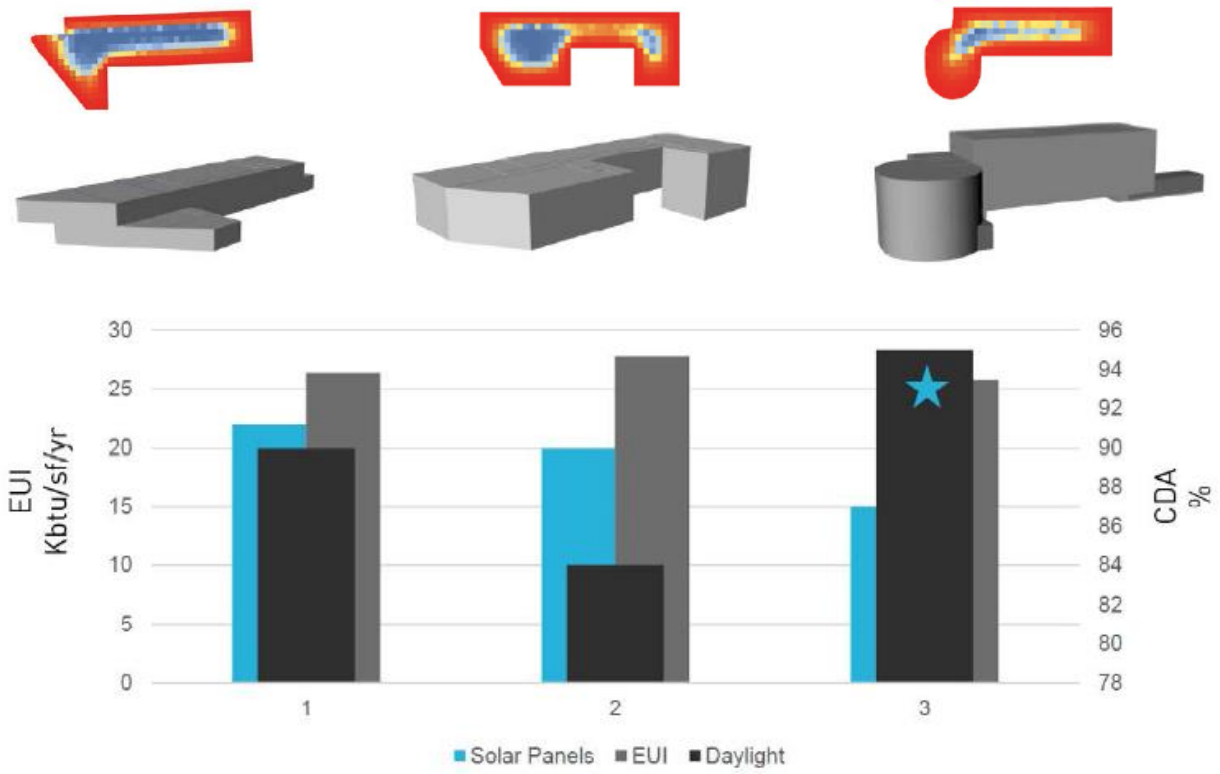
Georgia Average
115
KBTU/sf/yr

Net Zero Ready
40
KBTU/sf/yr

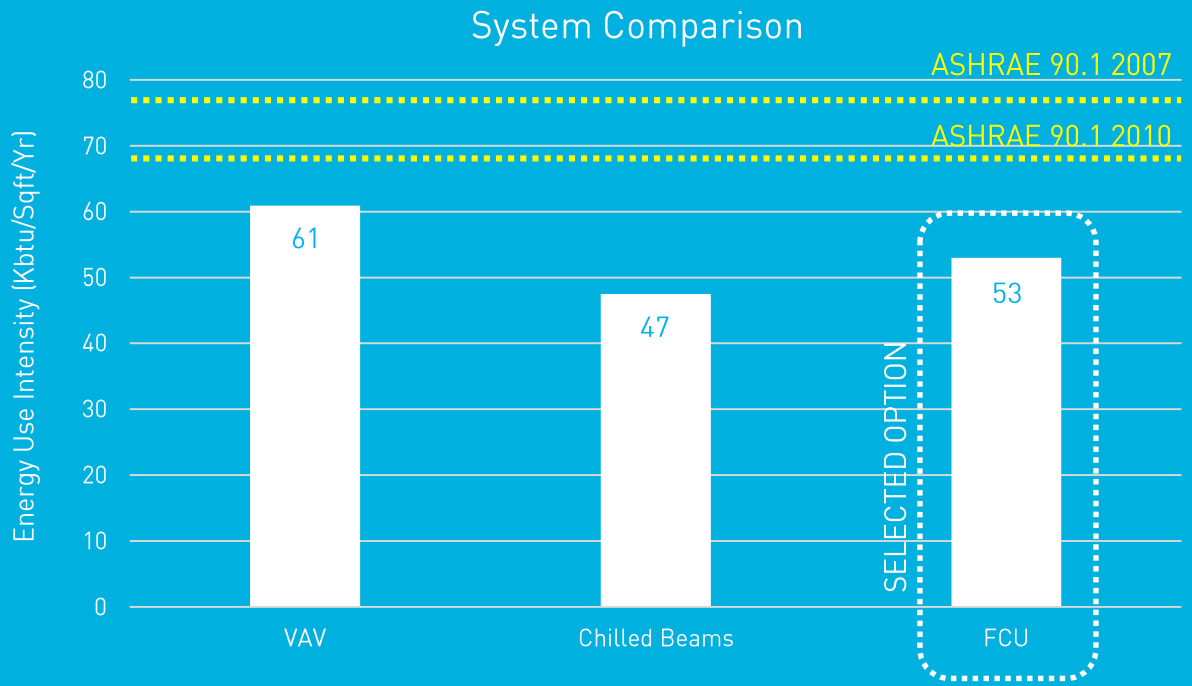


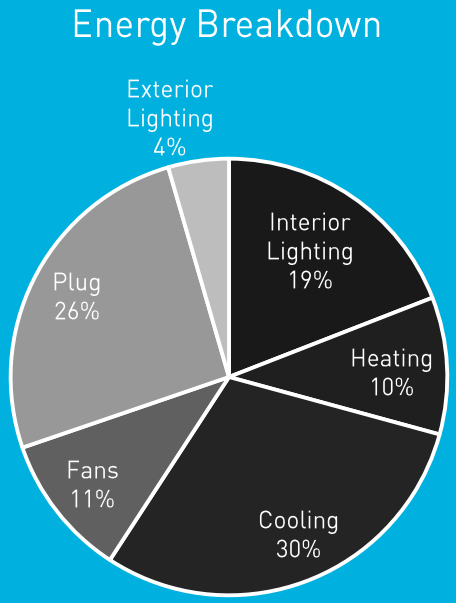
Measured EUI of Public Safety Facilities
Data from Building Performance Database by LBL

TESTING ALTERNATIVES
WHICH MASSING TO CHOOSE

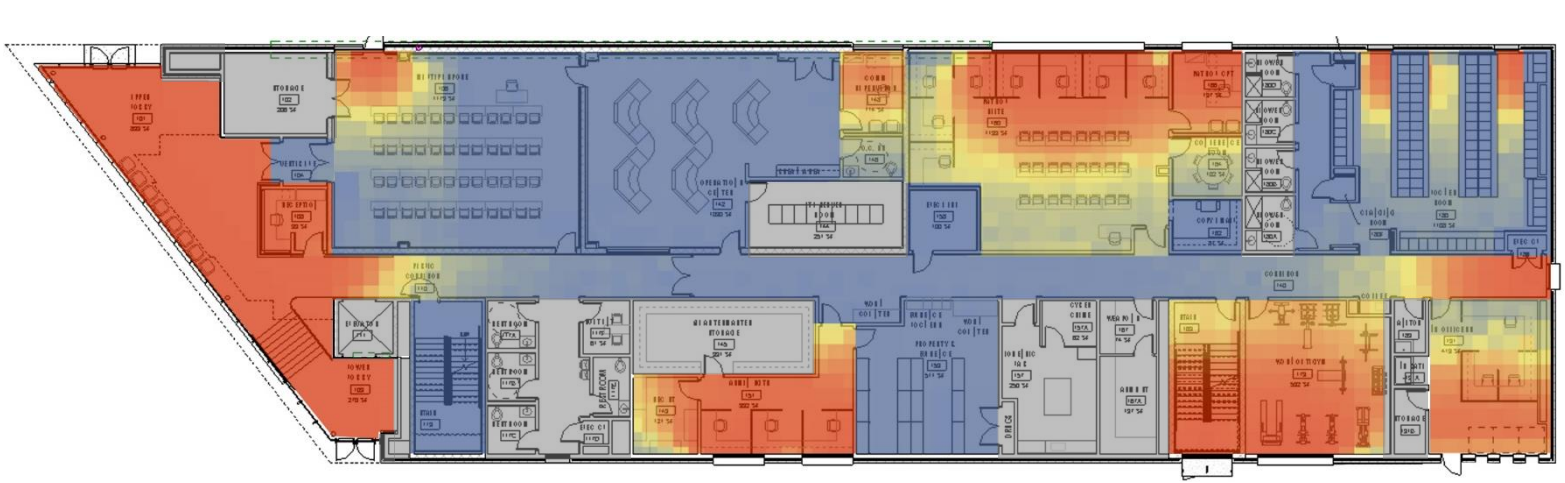


ENERGY USE


System Comparison
ASHRAE 90.1 2007
ASHRAE 90.1 2010
Energy Use Intensity (Kbtu/Sqft/Yr)
80
70
60
50
40
30
20
10
0
61
47
53
SELECTED OPTION
VAV
Chilled Beams
FCU


Energy Breakdown
Exterior Lighting 4%
Interior Lighting 19%
Heating 10%
Cooling 30%
Fans 11%
Plug 26%

DAYLIGHT MAP
FIRST FLOOR PLAN



sDA

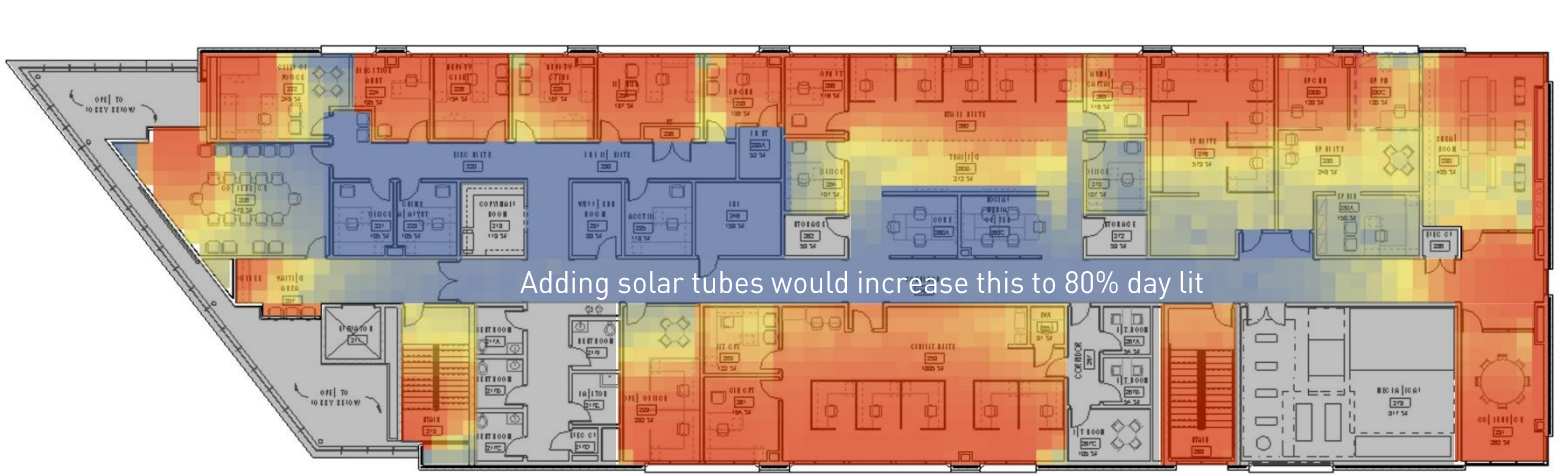
39.4 %

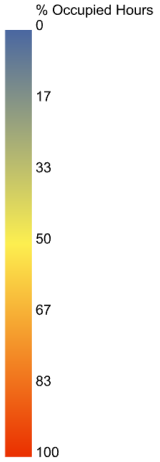
Spatial Daylight Autonomy de-scribes the percentage of floor area that receives at least 300 lux for at least 50% of the annual occupied hours. As per the WELL requirements, a 55% sDA is the minimum to achieve the optimization

Spaces Not Regularly Occupied

Not Included in calculation

DAYLIGHT MAP
SECOND FLOOR PLAN





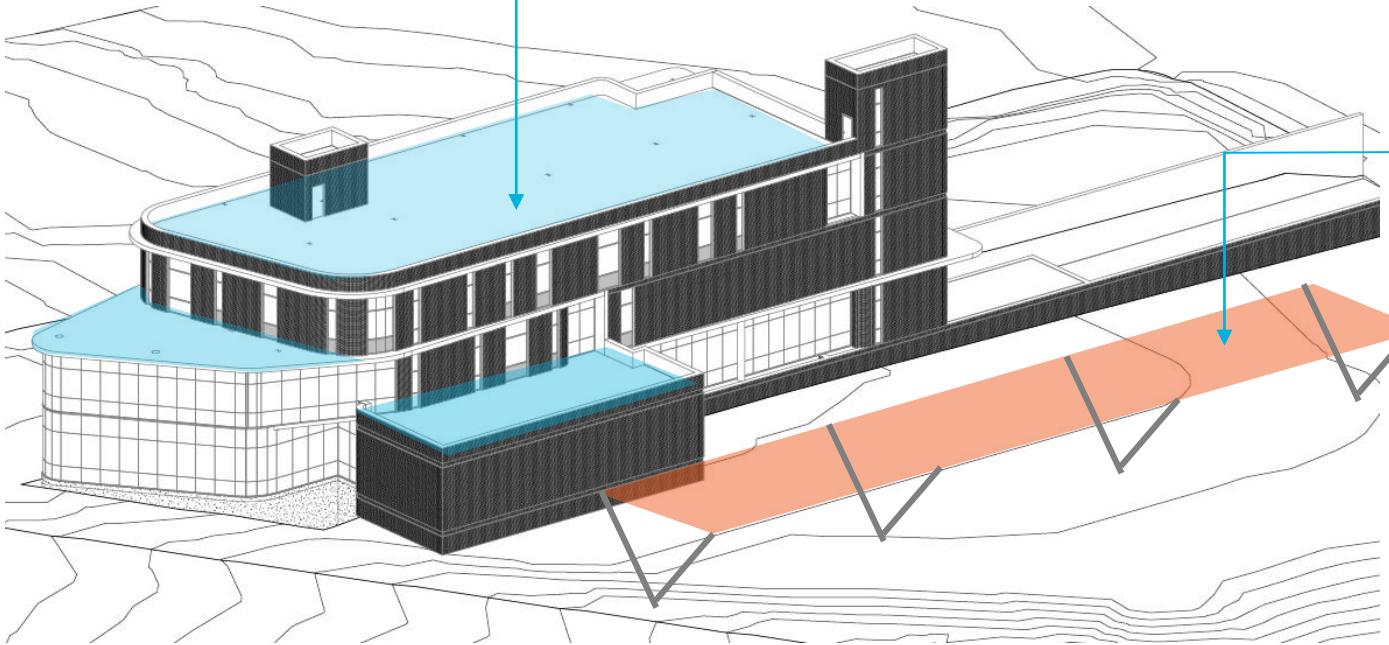
Spaces Not Regularly Occupied
Not Included in calculation

sDA

72.5 %

PHOTOVOLTAIC PANELS

CREATING A NET ZERO ENERGY DESIGN



EUI Offset

16

11

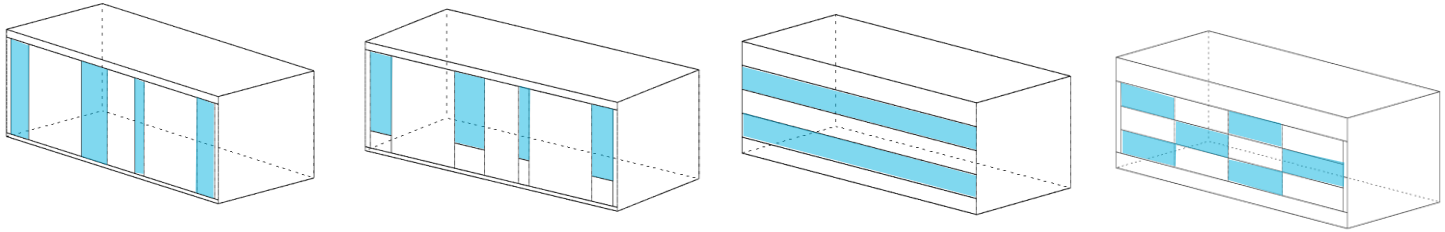
Building EUI : 27

EUI Offset: 27

11000 sqft

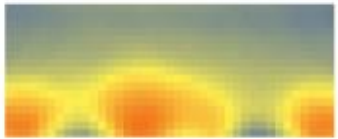
6500 sqft

FAÇADE STUDY
WORKSTATION AREA



Continuous Daylight Autonomy

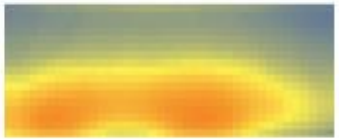
30%

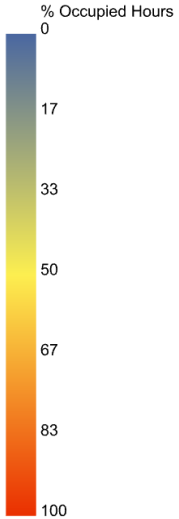


22%

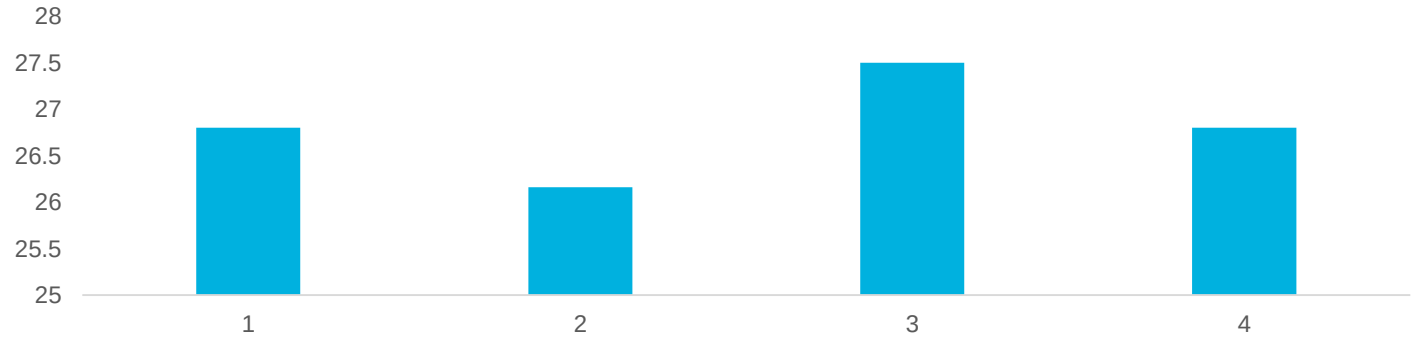
42%

30%

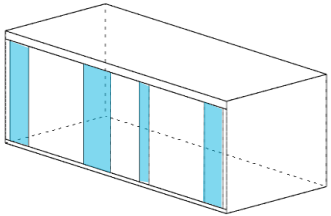




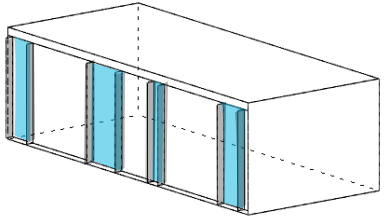
EUI (KBTU/SF)



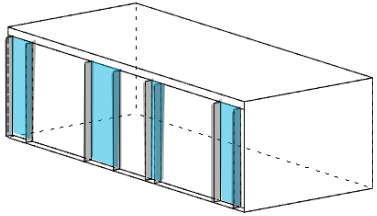
FAÇADE STUDY
SHADING STRATEGY



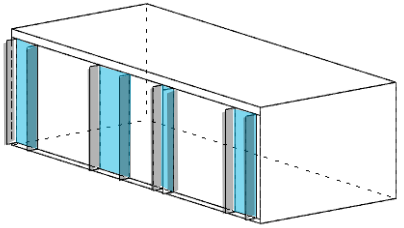
Baseline
No Shading



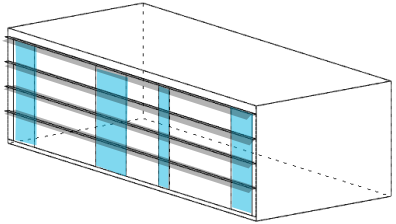
Alternative 1
6” Vertical Fins



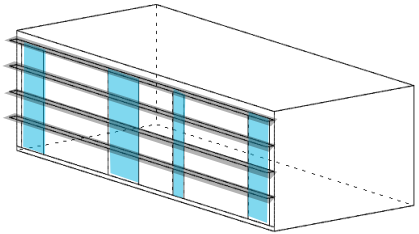
Alternative 2
12” Vertical Fins



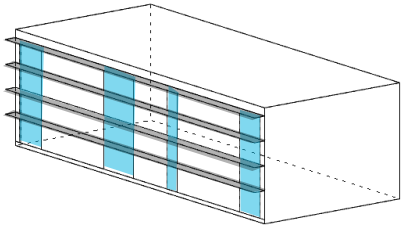
Alternative 3
18” Vertical Fins



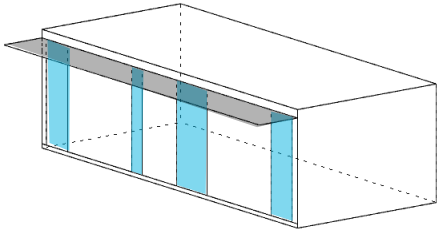
Alternative 4
6” Horizontal Fins



Alternative 5
12” Horizontal Fins

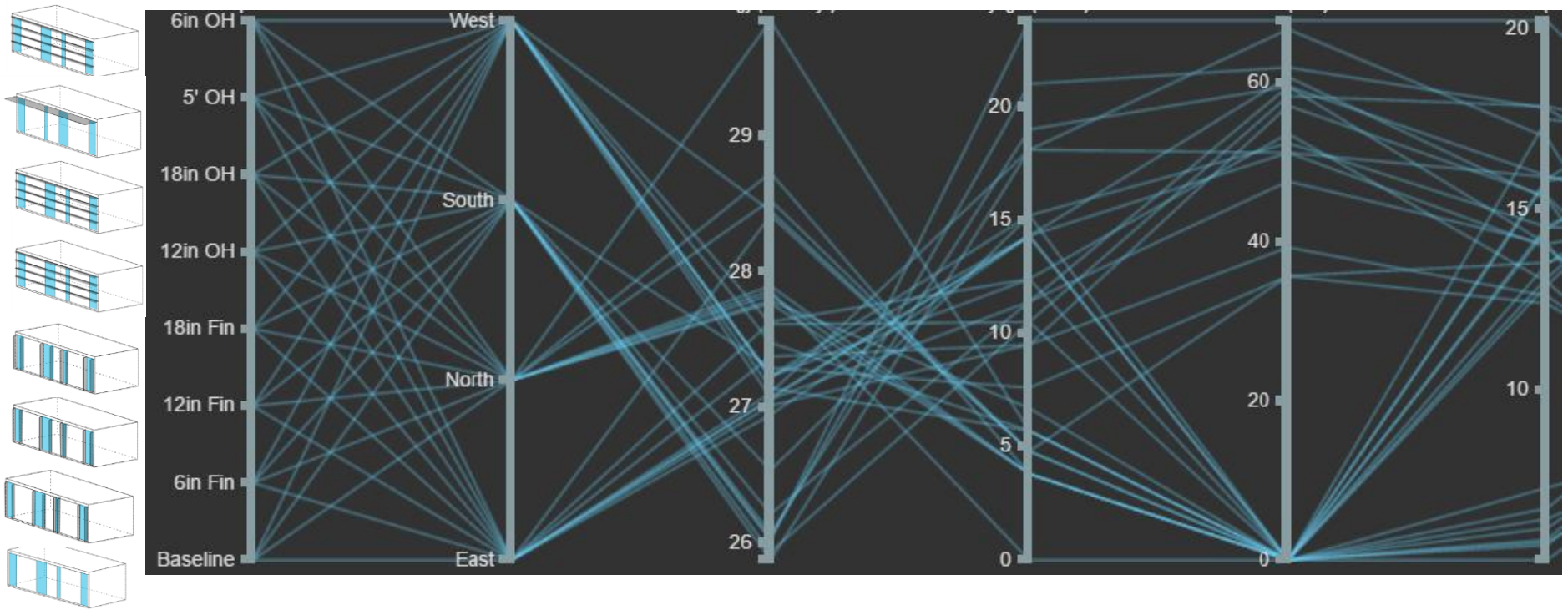


Alternative 6
18” Horizontal Fins



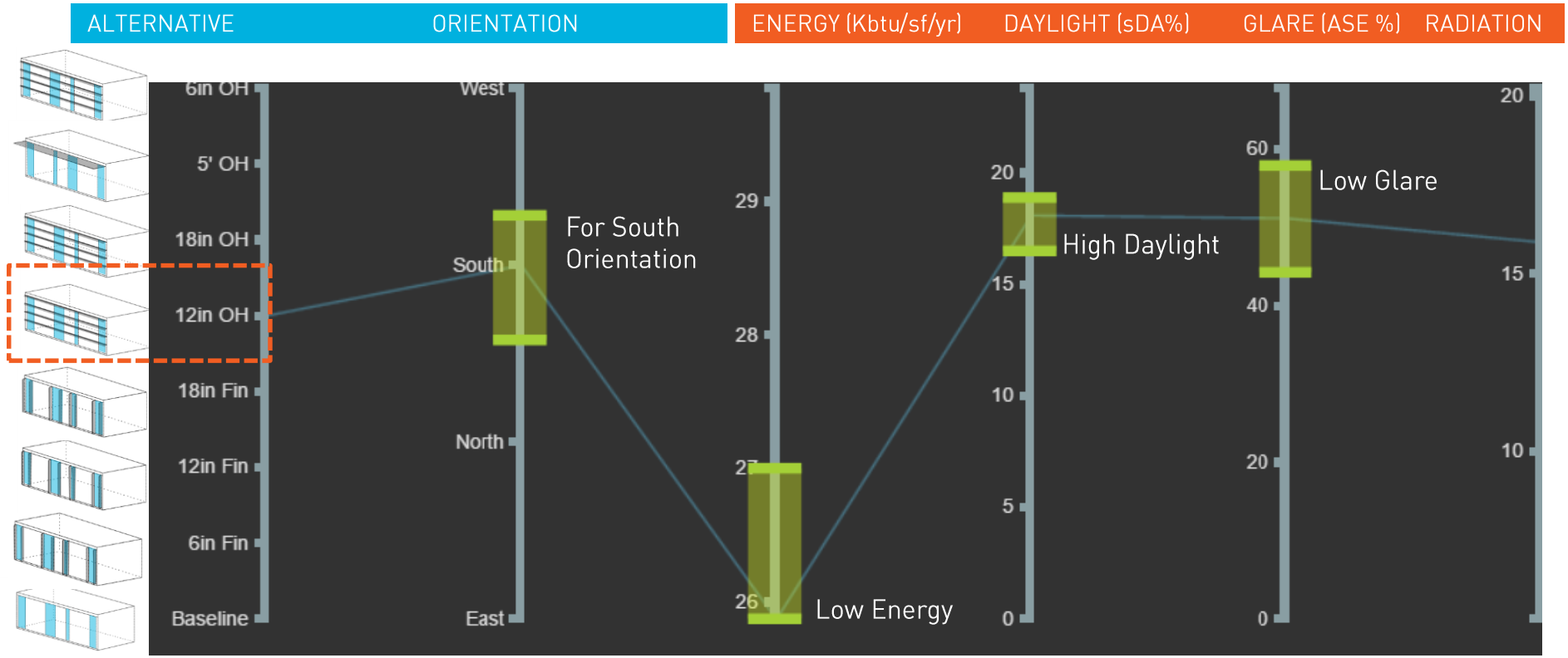
Alternative 7
5’ Overhang

UNDERSTANDING THE RESULTS
SHADING STRATEGY



UNDERSTANDING THE RESULTS
PROCESS TO SELECT OPTIMAL RESULT

CLICK HERE

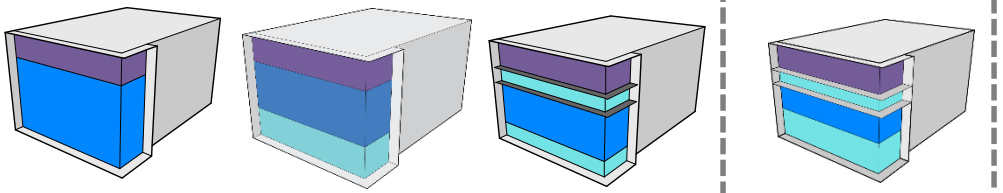


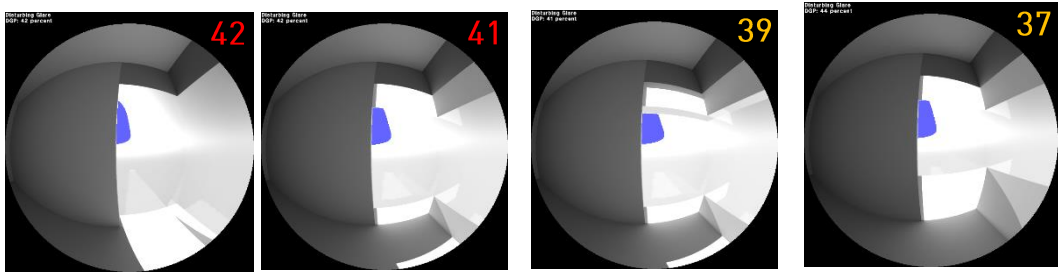
GLARE-FREE FACADE

SOUTH EAST CONFERENCE ROOM

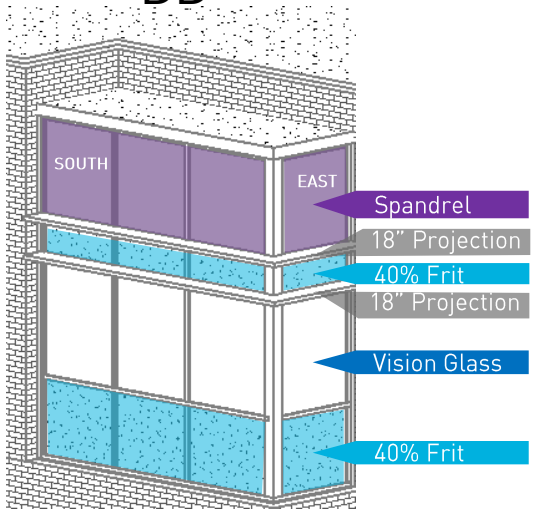
SD

Recommended Option





DD



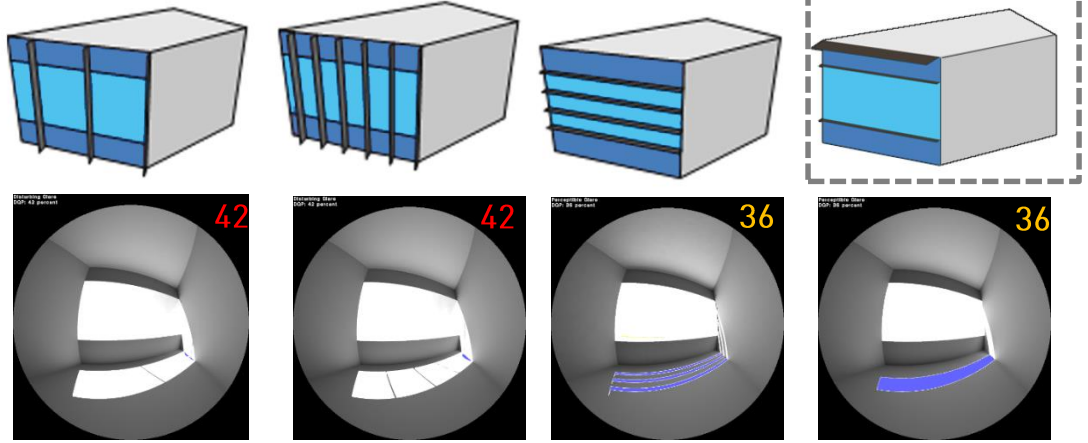
Intolerable Glare	Disturbing Glare	Perceptible Glare	Imperceptible Glare
>45	40-45	35-40	<35

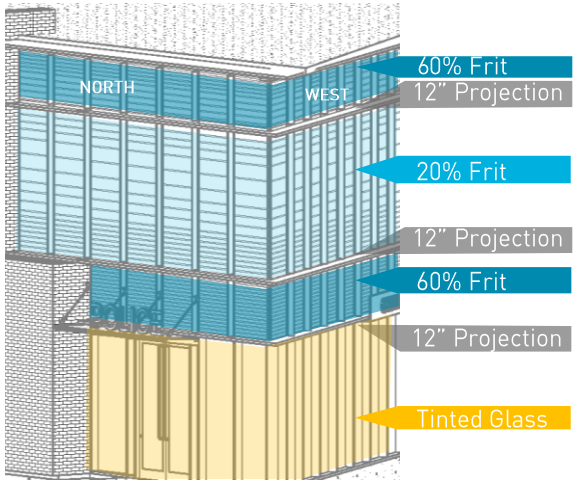
GLARE-FREE FACADE
WEST CONFERENCE ROOM

SD

Recommended Option

DD





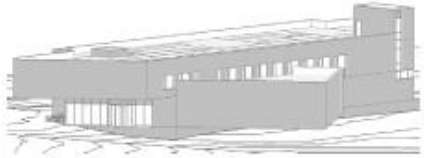
Intolerable Glare	Disturbing Glare	Perceptible Glare	Imperceptible Glare
>45	40-45	35-40	<35

DESIGN EVOLUTION
ENERGY AND DAYLIGHT

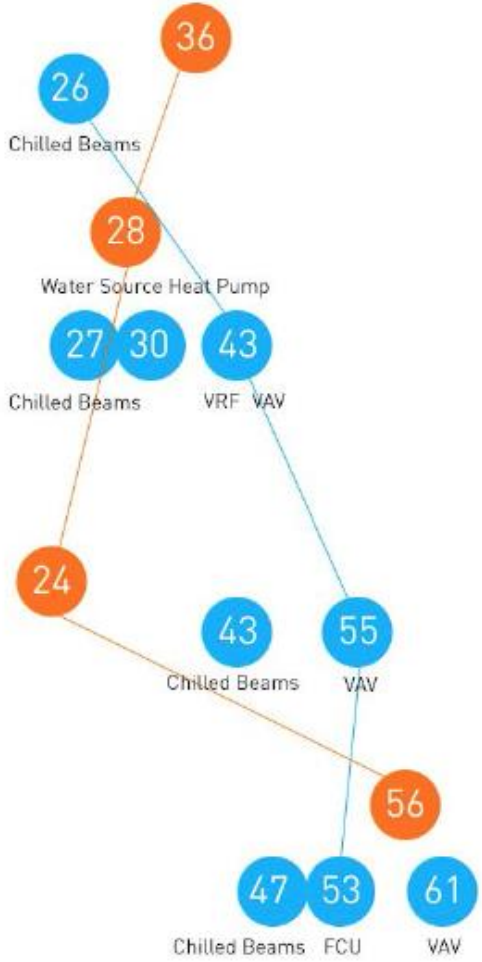
Pre Design

Concept Design

Schematic Design



Design Development

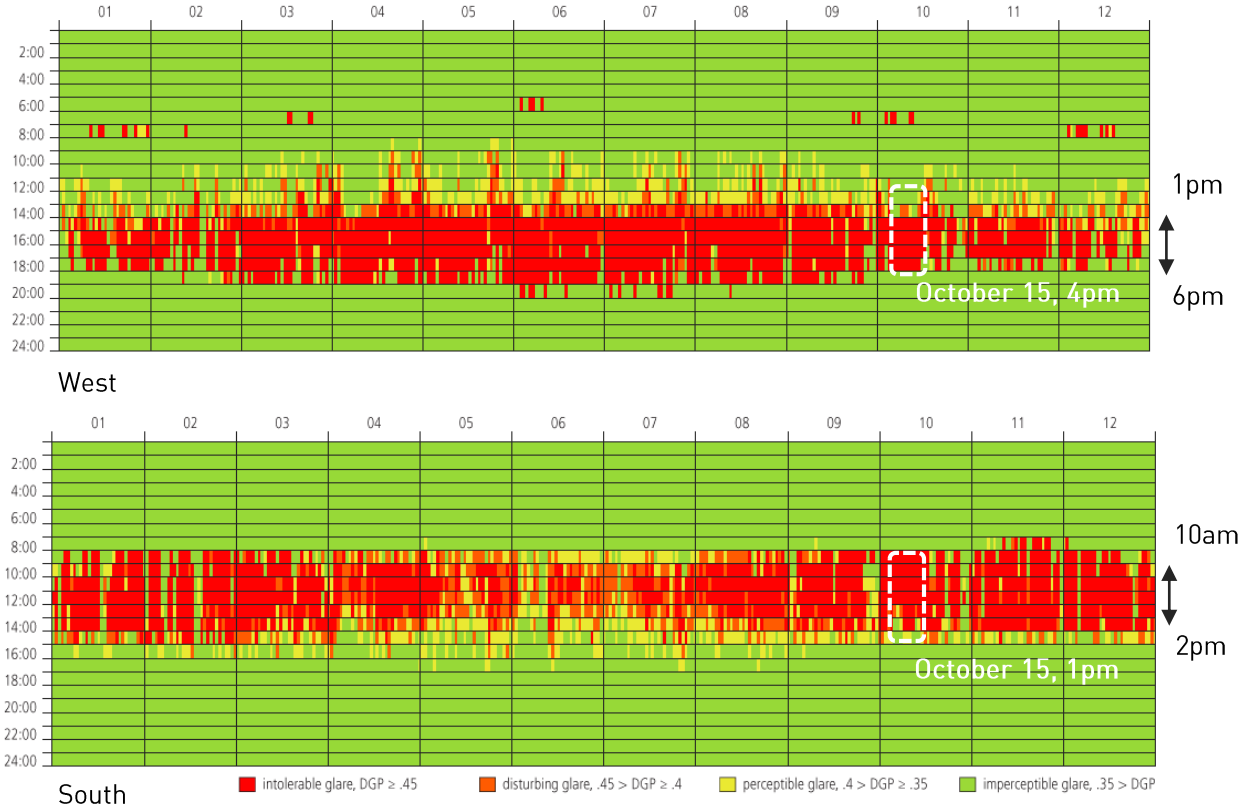


53 Kbtu/sf/yr Energy

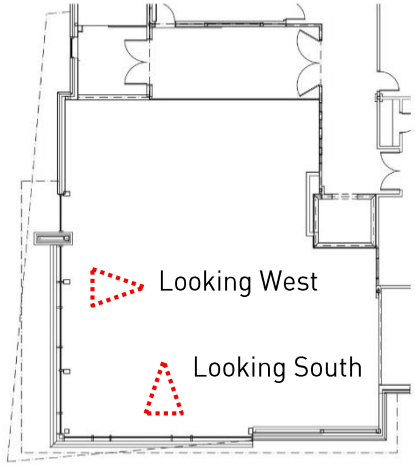
56 % Daylight

Project: Student Serv
Success Center
School: Atlanta Metr
State College
Architect: GSSTJ

GLARE
YEARLY GLARE STUDY



The diagrams on the left show yearly glare studies for West and South without any shading strategy on the façade. This helps us understand that if no strategy is used, there will be high amounts of glare in the space. Using this, we pick two points in time to test for various façade options

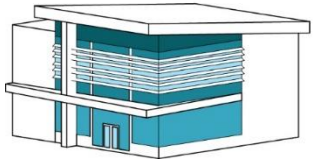


Point of View

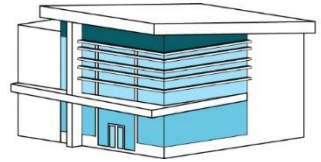
GLARE
1ST FLOOR LOOKING WEST

The Glare looking out to the West is Intolerable and needs to be mitigated using appropriate shading strategies. Of the 3 tested strategies, option 3 is most effective in reducing the daylight glare probability.

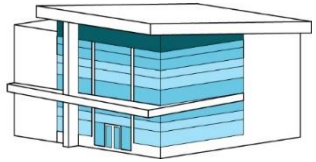
Imperceptible Glare	Perceptible Glare
<35	35-40
Disturbing Glare	**Intolerable Glare**
40-45	>45



Option 1

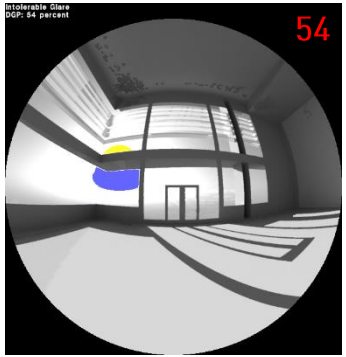


Option 2



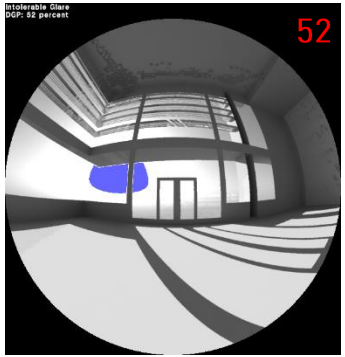
Option 3

October 21 4pm



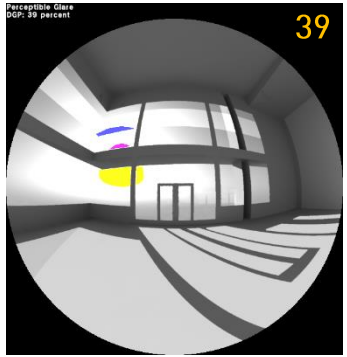
Horizontal shades,
Mecho shades,
Dark tint glass,
Dbl. pane glazing

October 21 4pm



Horizontal Shades,
Fritted glass
Dbl. pane glazing

October 21 4pm

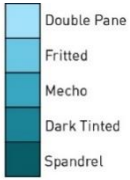


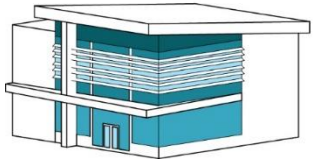
Spandrel glass
Fritted glass
Dbl. pane glazing

GLARE
1ST FLOOR LOOKING SOUTH

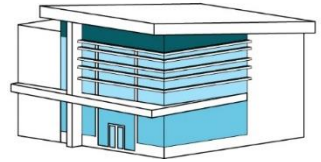
The Glare looking out to the South is Perceptible and needs to be mitigated using appropriate shading strategies. Of the 3 tested strategies, option 3 is most effective in reducing the daylight glare probability.

Imperceptible Glare	Perceptible Glare
<35	35-40
Disturbing Glare	**Intolerable Glare**
40-45	>45

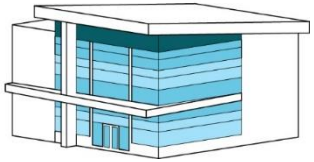




Option 1

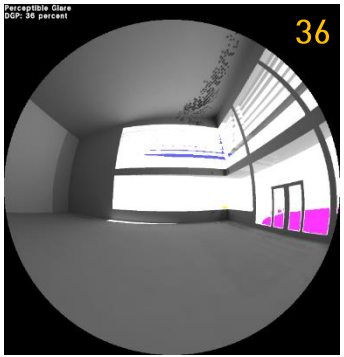


Option 2



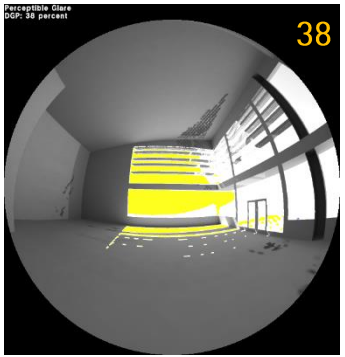
Option 3

October 21 4pm



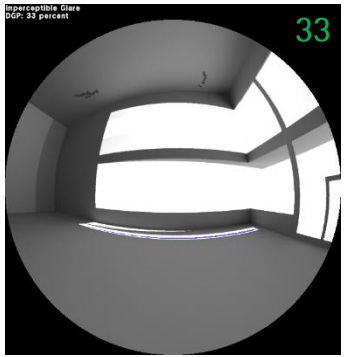
Horizontal shades,
Mecho shades,
Dark tint glass,
Dbl. pane glazing

October 21 4pm



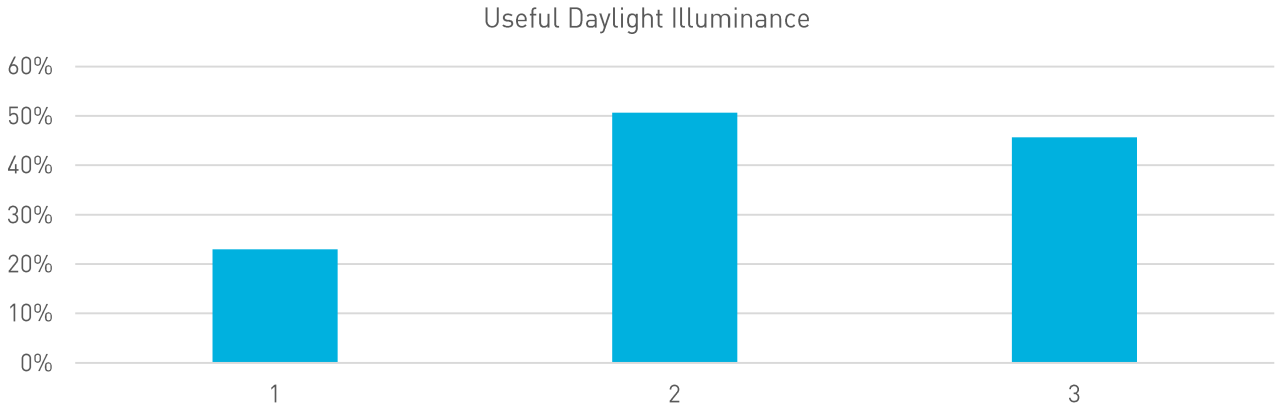
Horizontal Shades,
Fritted glass
Dbl. pane glazing

October 21 4pm

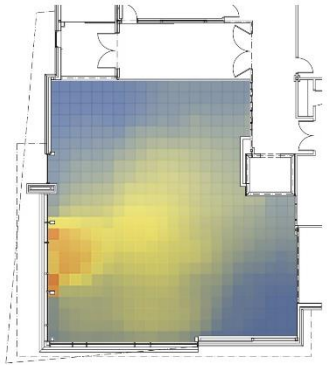


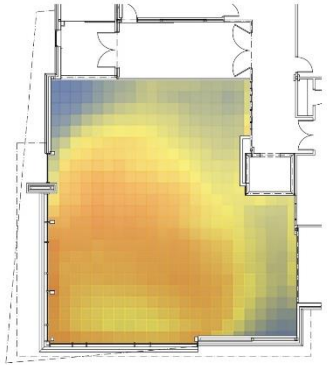
Spandrel glass
Fritted glass
Dbl. pane glazing

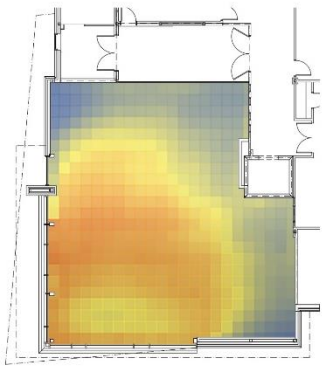
USEFUL DAYLIGHT ILLUMINANCE
THREE FAÇADE OPTIONS

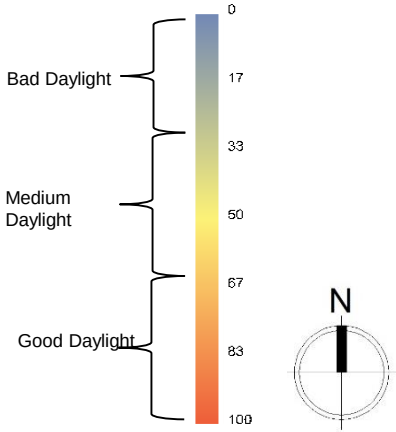


Orange is good, blue is bad. The diagrams on the left show daylight maps. Option 2 and 3 perform well from a daylight standpoint, allowing the daylight the penetrate deep into the floor plan to help reduce the use of electrical lights.

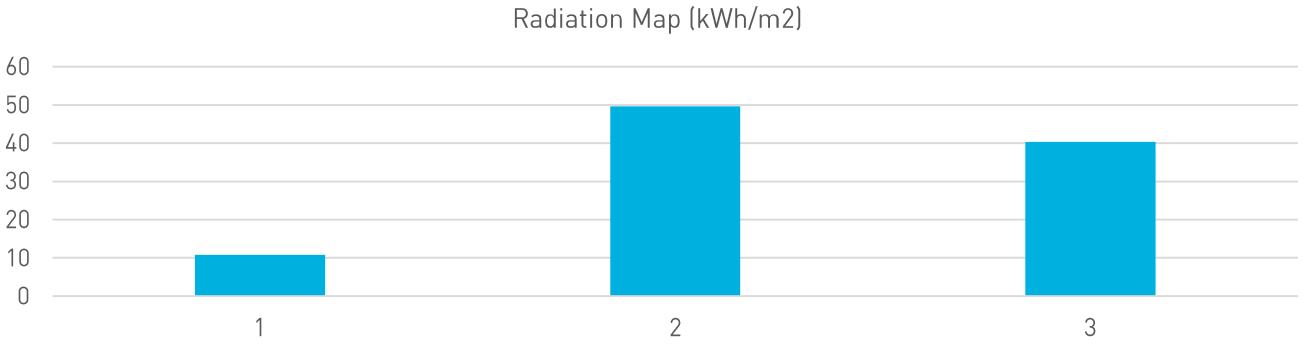




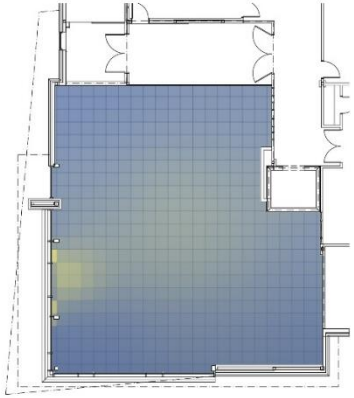




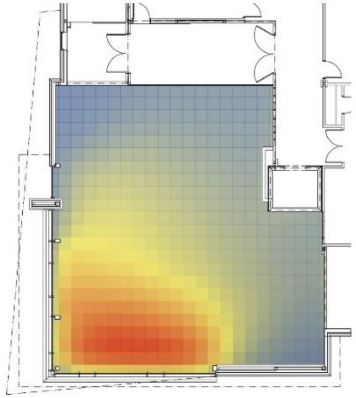
RADIATION
FINDING THE HOT SPOTS



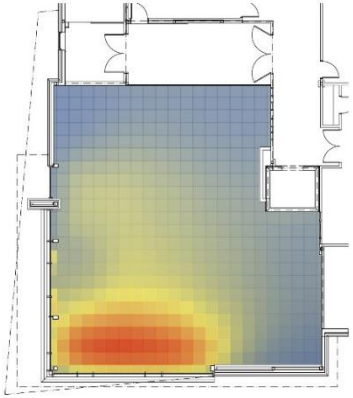
For Atlanta, lower radiation is better. The radiation maps on the left helps us understand the three different options. Option 1 with Mecho shades allows is very little radiation. Option 2 is the worst performing from a radiation standpoint, creating the highest amounts of hot spots.



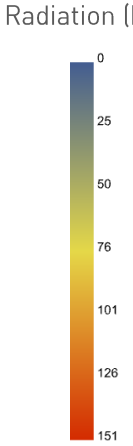
Option 1 - 10.75 kWh/m2

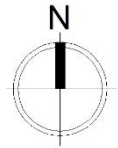


Option 2 – 49.67 kWh/m2



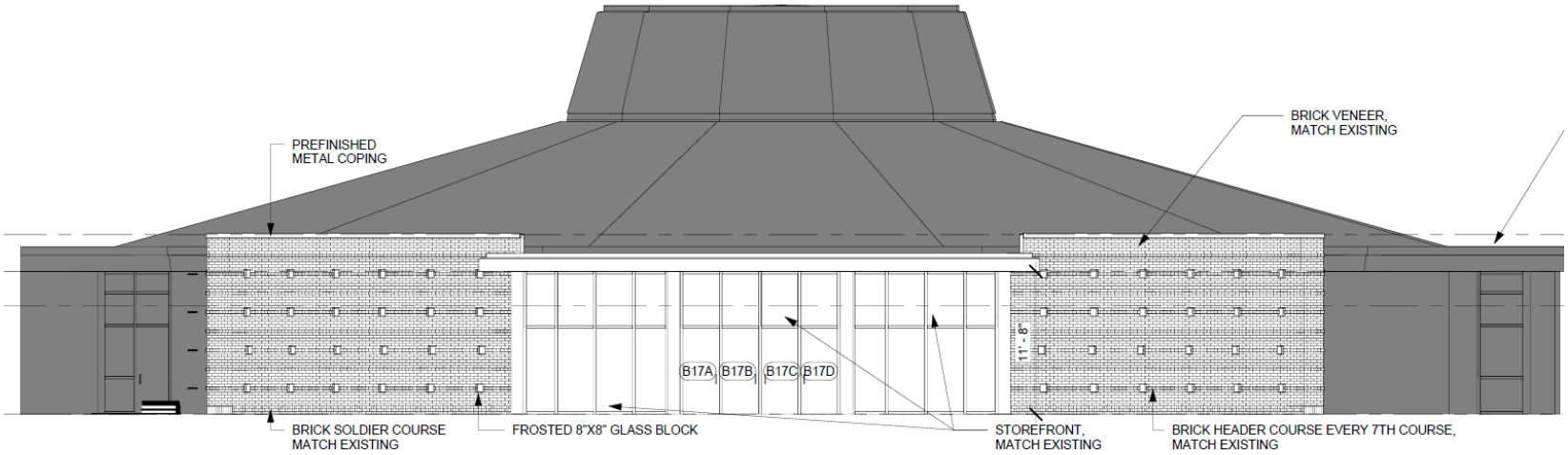
Option 3 – 40.37 kWh/m2





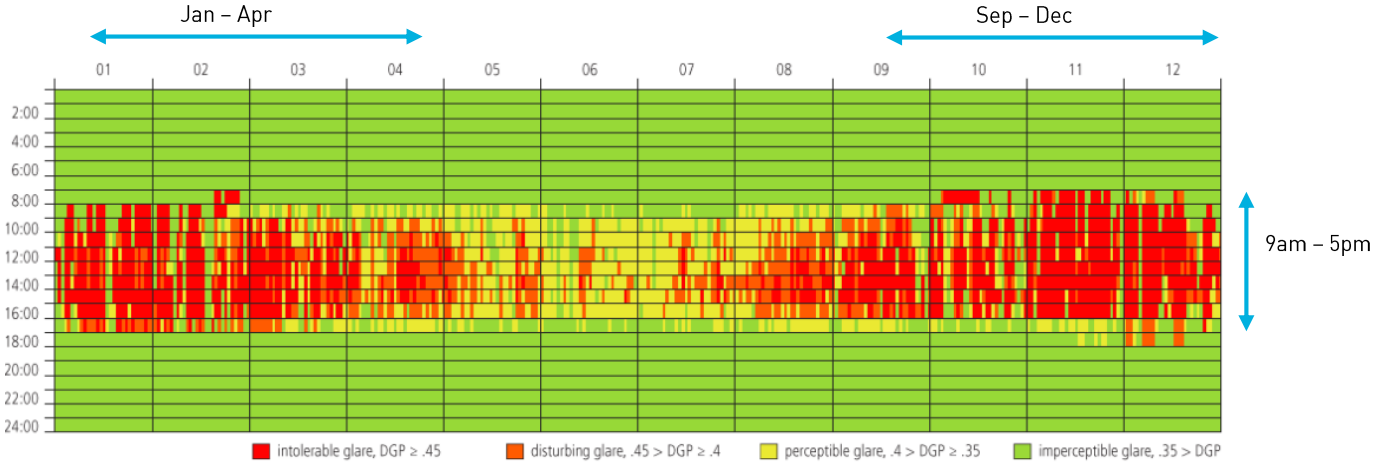
Project: Lecture Hall and Art Science Building Renovation
School: Clayton State University
Architect: Flynn Finderup Architects / JW Robinson & Associates

RENOVATION
LOBBY SPACE

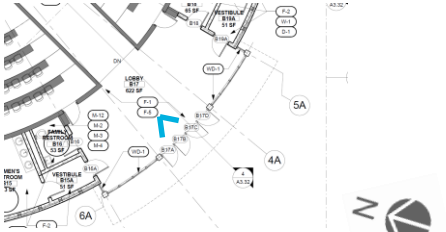


GLARE POTENTIAL – SOUTH WEST FACADE

TIME OF YEAR WITH INTOLERABLE GLARE



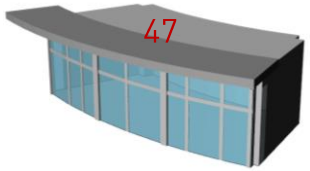
Imperceptible Glare	Perceptible Glare
<35	35-40
Disturbing Glare	**Intolerable Glare**
40-45	>45



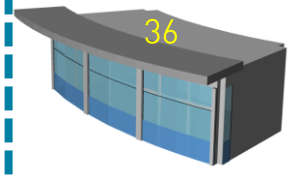
Glare View

GLARE POTENTIAL – TESTING ALL FAÇADE OPTIONS

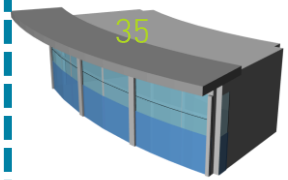
LECTURE HALL- USING PPG SOLARBAN 60 GLASS



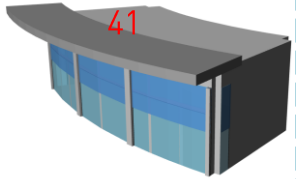
Baseline – No Shading



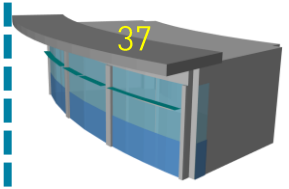
3’ Spandrel Glass at the Bottom



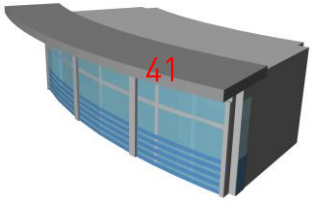
4’ Spandrel Glass at the Bottom



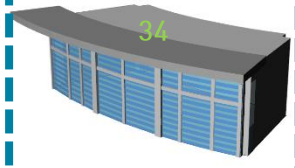
4’ Spandrel Glass at the Top



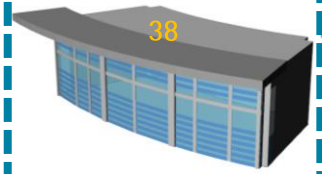
4’ Spandrel Glass at the Bottom with 12” Fin



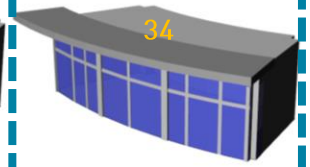
4’ 60% Frit Glass at the Bottom



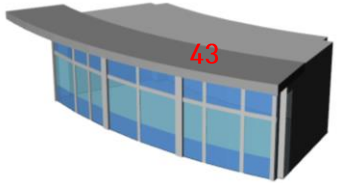
60% Frit Glass Throughout



4’ 60% Frit Glass at the Bottom and 2’ at top



60% Shaded Glass Spec

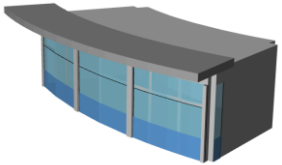


3’ Spandrel Glass at the Bottom and 3’ at the Top

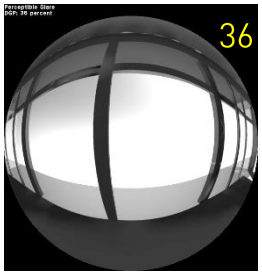
GLARE POTENTIAL – SHORT-LISTED OPTIONS

LECTURE HALL- USING PPG SOLARBAN 60 GLASS

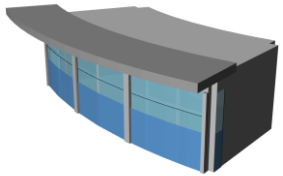
Preferred Options



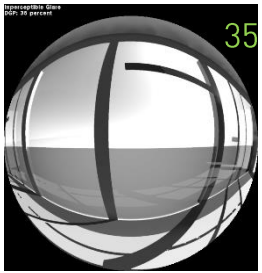
3' Spandrel Glass at the Bottom



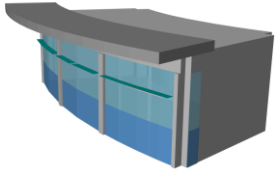
Perceptible Glare



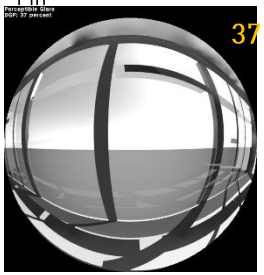
4' Spandrel Glass at the Bottom



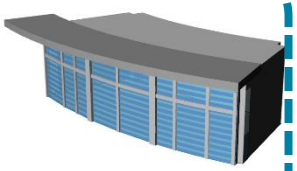
Imperceptible Glare



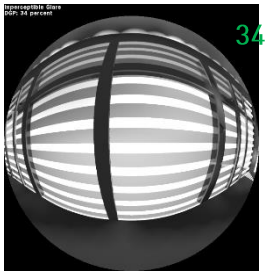
4' Spandrel Glass at the Bottom with 12" Fin



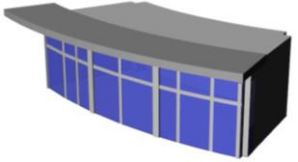
Perceptible Glare



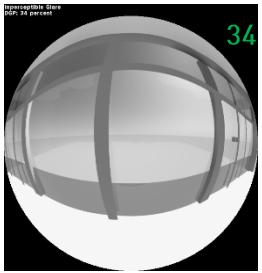
60% Frit Glass Throughout



Imperceptible Glare



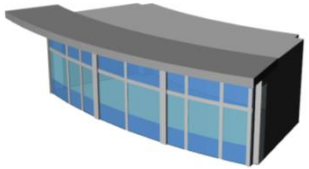
60% Shaded Glass Spec



Imperceptible Glare

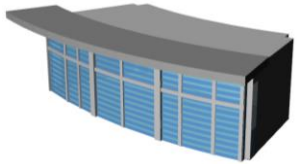
GLARE POTENTIAL – PREFERRED OPTIONS

LECTURE HALL- USING PPG SOLARBAN 60 GLASS



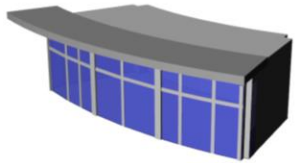
3' Spandrel Glass at the Bottom and 3' at the Top

Spandrel Glass Panel



60% Frit Glass Throughout

Glass with 60% Silk-screening ceramic frit
Viracon
Oldcastle
*There are other manufacturers that provide similar glass



60% Shaded Glass Spec

Glass with Visible Transmittance (VT) below 40%
Solarban® 90 Tint+ Clear
Solarban® 70XL (2) Solargray® + Clear
*There are products by other manufacturers that qualify similar spec.